

The International Fossil Plant Names Index (IFPNI): a new step in the development of palaeobotany

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Manuscript received: 26 April 2022

Accepted for publication: 29 April 2022

ABSTRACT

Doweld A.B. 2022. The International Fossil Plant Names Index (IFPNI): a new step in the development of palaeobotany. *Geophytology* 50(1&2): 1–10.

The present paper outlines the history and aims of The International Fossil Plant Names Index (IFPNI). Launched in May 2014, IFPNI is serving as a global registry of fossil plant names which revealed numerous and sometimes unexpected problems: new historical bibliographic studies of palaeobotanical literature produced changes in botanical nomenclature, authorship and places of some established fossil plant names.

Keywords: Palaeobotany, botanical nomenclature, taxonomic literature, taxonomic online index.

INTRODUCTION

The International Fossil Plant Names Index (IFPNI) was launched in May 2014 as an online database [<http://fossilplants.info>, now renamed <http://ifpni.org>] of the names of fossil plants, algae, fungi, allied prokaryotic forms (formerly treated as algae and *Cyanophyceae* in particular), algae-related protists (so-called ‘ambiregnal’ organisms) and fossil microproblematica (*incertae sedis* or doubtfully attributed to plants or algae) (Doweld 2015), which were all described since 1820 (a starting point for the nomenclature of fossil plants). It was a historical event in palaeobotany since there was no previously cumulative global registry of scientific names of fossil organisms covered by the International Code of Nomenclature for Algae, Fungi, and Plants (ICN) (formerly International Code of Botanical Nomenclature).

IFPNI as a service to the global scientific community was constructed as an open-access platform to provide an online and a community-generated registry of fossil plant nomenclature. The dynamic database aims to document all nomenclatural novelties (new scientific names of extinct organisms) and associated data, including registry of the scientific publications containing nomenclatural acts (palaeobotanical taxonomic literature indexed ca. 1700 geological and biological serials worldwide in 45 modern languages), authors in palaeobotany/palaeontology, additional data for palaeogeography, stratigraphy and repository for species and infraspecific fossil taxa.

As a result of work since 2014, at present the IFPNI has 80997 names of fossil plants from 10338 publications indexed in 1703 journals and 1020 books, authored by 5477 authors [IFPNI official online public statistics, 22 March 2022]. 159 users and editors/

contributors were registered in the IFPNI, which actively provided new data and updates. The IFPNI Staff is headed by the Editor-in-Chief, Alexander B. Doweld, and two Managing Editors, all residing in the Fundamental Botanical Library of the National Institute of Carpology (Gaertnerian Institution), Moscow, Russian Federation. Now the online registration allows authors and/or publishers to easily register their own new fossil species before publishing, and to use the permanent unique IFPNI LSID codes under each newly proposed new or recombined name in their publications before their printing (see e.g. Doweld in *Phytotaxa* 227: 299–300. 2015 & 236: 86–90. 2015). This new tool provides unique cross-reference to fossil plant species in further searches through publications in web.

IFPNI, as a platform, was initially developed on the basis of MongoDB data base and consequently moved to the MySQL enables users to meet the database challenges of next generation web, cloud, and communications services; it is hosted on virtual servers in Europe and easily and freely available to users worldwide with no restrictions. Altogether, 8910 active users from 49 countries produced 27,430,577 inquiries to the databases of the IFPNI [Source: Yandex.Metrika, 22 March 2022].

IFPNI — DEVELOPMENT DURING 2014–2022: ONLINE REGISTRATION, PROCESSING AND EVALUATION OF FOSSIL PLANT NAMES

Fossil Plant Names

Suprageneric Names: Suprageneric names of fossil and extant algae, cyanobacteria, fungi and plants were extracted from Doweld’s “*Prosyllabus Tracheophytorum*” (2001) and published parts of the “*New Syllabus of Plant Families*” (2005+). Suprageneric names of extant vascular plants were also verified against J. Reveal’s “*Indices Nominum Supragenericorum Plantarum Vascularium and International Plant Names Index*” (IPNI), algae against *Index Nominum Algarum* (INA), bryophytes and hepatics against *Bryophyte Names Authority List*. At

present IFPNI recorded 1947 suprageneric names [IFPNI official online public statistics, 22 March 2022]. IFPNI recorded both valid and invalid suprageneric names with comments on their invalid status in botanical nomenclature. Suprageneric names also include the artificial designations of palaeopalynology used for fossil spore-pollen generic groupings (Turma, Anteturma, Subturma, Groups, etc.).

Generic Names: IFPNI now incorporates all data from the previously compiled, but outdated Andrew’s *Index of Generic Names of Fossil Plants, 1820–1965* and its supplements: 1966–1973 (Blazer 1975); 1974–1978 (Watt 1978); 1979–2000 (Schultze-Motel 2003). Generic names were revised and processed as for their validity in accord with the modern revised versions of the *International Code of Nomenclature for Algae, Fungi, and Plants* (formerly *International Code of Botanical Nomenclature*) and the *International Code of Zoological Nomenclature* (when applied to algal organisms traditionally considered also as protists in zoology). Generic names of extant organisms were also used in the IFPNI in order to record their extinct species. At present IFPNI recorded 17042 generic names [IFPNI official online public statistics, 22 March 2022].

Infrageneric Names: Infrageneric names were used intermittently in the developing taxonomic classifications of fossils in the past, therefore, at present IFPNI recorded just 414 infrageneric names of plant fossils [IFPNI official online public statistics, 22 March 2022].

Species and Intraspecies Names: The fossil species names are the main component of the IFPNI. Once generic names, both fossil and extant, were uploaded and registered into IFPNI, the retro registration of fossil plant species was started. Now IFPNI recorded 58951 species and 2096 infraspecies names (forms, varieties, subspecies, etc.) [IFPNI official online public statistics, 22 March 2022]. We have found unexpectedly the high amount of homonyms among registered species names (ca 1.5%). IFPNI Staff regularly notifies IPNI, *AlgaeBase*, *MycoBank*, *Index*

Fungorum and INA about homonym cases to update their own records. In addition to registration of the original author's data, the spelling of species names is re-checked against modern rules of orthography outlined in ICN (Arts. 60-61), and the corrected spelling is recorded too along with improper author's terminations. IFPNI also registered invalidly published names (when author failed to designate holotype, provide illustration, or indicate repository for holotype, etc.); these names are annotated with invalid status by listing of specific infringement reasons of ICN rules.

IFPNI also incorporated the so-called artificial fossil spore taxa, which were initially formed by the use of the artificial group names followed by a specific epithet; such artificial classifications and their taxa were first proposed and developed in further by Soviet (Russian) palaeopalynologist Sofia Naumova at the XVII International Geological Congress in Moscow (Naumova 1937). Her numerous successors in the former Soviet Union and numerous countries in the world provided several thousands of such names for fossil spores (including higher plants, mosses, and algae cysts) and pollen species: all these names are recorded in the IFPNI as a tribute to early era of palaeopalynology and its initial artificial nomenclature survived up to 1970ths.

Type Specimens: IFPNI provides registration of lecto-, neo-, epi- and other types of fossil plant taxa. Since this type of registration of nomenclatural acts is sensitive as for correct application of the names in systematics, IFPNI scrupulously evaluated users' changes and additions to the database. IFPNI focuses on the registration of holotypes, paratypes, isotypes, epitypes, and newly designated lectotypes, the cooperation and consultations on the holotype barcoding and verification of their existence with principal palaeobotanical repositories in 37 countries, such as Birbal Sahni Institute of Palaeosciences (Lucknow, India), Chernyshev Central Scientific-Research Geological Exploration Museum (S.-Petersburg, Russia), Harvard University (USA), Komarov Botanical Institute (S.-Petersburg, Russia);

Museum für Naturkunde (Berlin, Germany), National Museum of Natural History, Smithsonian Institution (Washington, USA), Muséum National d'Histoire Naturelle (Paris, France), Natural History Museum (London, U.K.), Beologische Bundesanstalt (Vienna, Austria), National Museum (Prague, Czechia), Naturhistoriska riksmuseet (Stockholm, Sweden), Yale University (New Haven, USA) and numerous others.

IFPNI — UTILITY AND SERVICE DATABASES

Palaeobotanical Collections and Repositories:

The registration of fossil plant taxa from their literature sources is supplemented by the formation of the full documentation on their specimens served as type material. Since the IFPNI focuses on the registration of syntypes, holotypes, paratypes, isotypes, epitypes, and newly designated lectotypes, the separate database of repositories of Palaeobotanical Collections (analogous to the Index Herbariorum) is formed of modern institutions housed fossil plant collections in 37 countries and 189 cities. IFPNI also reflects the history of the type specimens from old ceased institutions to modern ones (f.e. Königliche Naturalien-Kabinett der Herzöge von Württemberg, Stuttgart, Kingdom of Württemberg, and present Staatliches Museum für Naturkunde Stuttgart, Germany, respectively), its losses due to wars, fires or floods.

Authors of fossil plant names, fossil plants collectors and palaeontologists with interests in fossil plants: Author names of palaeobotanists were registered and edited by adding years of life (when known); now more than 5477 names with full names and, more importantly, standardized abbreviations and transliterations (for Cyrillic and Eastern languages) are available. IFPNI has more than 37% (!) unique records of authors (palaeobotanists and palaeontologists) contributing to systematic botany, which still escaped from IPNI author database. The interchanges between IFPNI and IPNI is active, especially due to the generous assistance of Dr. Kanchi N. Gandhi (Harvard University Herbaria), who also served as an Editor for the Harvard Index of Botanists, an international

databases of authors of plant names, botanical and mycological collectors, and authors of publications of importance to systematic botany and mycology. Author names in the IFPNI were standardized against Brummitt & Powell's *Authors of Plant Names* (1992) with minor changes and alterations reflected priority of author's original spelling used in their taxonomic publications.

IFPNI is active in historical searches for the missing dates of life of palaeobotanists authors of publications of importance to palaeobotany; a cooperation and numerous inquiries is supported by numerous University Libraries and Archives, as well as Archives of scientific Academies, Institutions and Museums. Unfortunately, due to the modern restrictions of the preservation of personal data, which debunk any possibilities for historical and biographical studies, most contemporary authors are lacking their years of birth, and this enormous situation is still continuing. However, due to the generous assistance from some palaeobotanists [Jiří Kvaček, Prague (Czechia), Ramesh K. Saxena, Lucknow (India)] and biographers [Lotte Burkhardt, Berlin (Germany), Valentina Nazarenko, Lvov (Ukraine)], data on the life years of numerous palaeobotanists were uncovered and incorporated in further to the IFPNI.

Taxonomic Literature (Palaeobotany):

Registration of publications containing nomenclatural acts and new scientific names was based on the format used in Stafleu's "Taxonomic Literature II, including the full bibliographic description on the basis of the International Standard Bibliographical Documentation" (ISBD) and providing working links to available digitized libraries (BHL, JSTOR, JSTAGE, Elsevier, Springer, Taylor & Francis, CNKI, etc.). IFPNI is served as an aggregator of the direct links to available digitized taxonomic literature bearing protologues with illustrations. Currently IFPNI has registered literature in 45 languages, viz. Abkhazian, Afrikaans, Armenian, Azerbaijani, Byelorussian, Bulgarian, Chinese, Croatian, Czech, Danish, Dutch, English, Estonian, Finnish, French, Georgian, German, Greek, Hungarian,

Irish, Italian, Japanese, Kazakh, Korean, Latin, Latvian, Lithuanian, Moldavian, Norwegian, Persian, Polish, Portuguese, Romanian, Russian, Serbo-Croatian, Slovak, Slovenian, Spanish, Swedish, Tajik, Turkish, Turkmenian, Ukrainian, Uzbek, and Vietnamese. IFPNI Staff continued bibliographic searches for missing in TL-2 precise publication dates of old and new taxonomic literature as well as registration of newly published taxonomic publications beyond the coverage of TL-2 (1753-1940).

The transliteration of books and serials in Cyrillic and Eastern languages were done in accord with the "International Organization for Standardization" (ISO) standards. 1703 journal and serial titles were registered by providing full and standardized abbreviated form in accord with the "Botanico-Periodicum-Huntianum Supplement" (1991) with a few exceptions; BPH Staff in the Hunt Institute of Botanical Documentation (USA) is notified regularly for new serial titles, in which new fossil taxa were published. So, more than 794 serial titles, new for BPH, were registered and contributed to BPH Staff for addition and improving their records to achieve uniform standardization between IFPNI and BPH. For each journal title provided standardized full and abbreviated titles, superseded and preceded (if any) titles when the journal changed its name, years of publication, ISSN numbers, publishing body (organization).

Online Palaeobotanical Library: In addition to separate data bases of serials, books and publications, IFPNI formed a service palaeobotanical online library with a free access to the original protologues of fossil taxa, processed for IFPNI database of suprageneric, generic, species and infraspecies names of fossil organisms, covering the period 1753 to present time. At present time, the access is free for all users of IFPNI via links published in the database of publications. However, in further it is planned to start a subscription to this collection of mostly self-made copies (more than 10,000 publications) from old and ill-known papers and books originated in 59 countries in 35 languages.

IFPNI — UTILITY DICTIONARIES

Geography and Palaeogeography: The names of countries have been standardized using the “Times Atlas of the World” (12th ed. 2013) or “Webster’s New Geographical Dictionary” (3rd ed. 1997). Place names have been converted to their modern country equivalents, but the original name is retained in a comment field. Names of palaeocontinents, geological terranes, tectonic plates, palaeo oceans and seas, mountain systems, palaeogeographic provinces were extracted from the available geological literature. Palaeogeographic names are used in IFPNI as well as modern geographical names in the correct describing of the distribution of fossil plant taxa in the geological history.

Stratigraphy: Names of global stratigraphic units (systems, series and stages) of the International Chronostratigraphic Chart and the subordinate units (periods, epochs, and age) of the International Geologic Time Scale are only used when accepted by the International Commission on Stratigraphy (ICS). When different names of stratigraphic units were used in the protologues of fossils in the past, these are to be changed for the use in IFPNI in accord with modern International Geologic Time Scale (<http://www.stratigraphy.org/index.php/ics-chart-timescale>). Regional and outdated old stratigraphic units are mostly rejected or mentioned in a comment field when their precise age is still unknown or doubtful.

IFPNI — REFORMS OF (PALAEO)BOTANICAL NOMENCLATURE RELATIVE TO FOSSILS

Establishing the IFPNI as a global registry of fossil plant names revealed numerous and sometimes unexpected problems in the botanical nomenclature relative to fossils.

Historical bibliographic studies and changes in botanical nomenclature: The intensive and active bibliographic researches of the old natural historical, botanical and geological literature changed sometimes dramatically the established custom and traditions of

the citation of the places and authors of some fossil plant genera and fossil-species. So, all new fossil-genera of Brongniart, traditionally sought to be published in his “Sur la classification et la distribution des végétaux fossiles” (Paris, 1822), were in reality first published ahead in a summary 3-paged paper in the February issue of Bulletin des Sciences par la Société Philomatique de Paris under title “Sur la classification et la distribution des végétaux fossiles en géneiral, et sur ceux des terrains de seïdiment supeïrieur en particulier” (Brongniart 1822a). His classical paper was divided between publications in the journal Mémoires du Muséum d’Histoire Naturelle Paris [8(3): 203–240, pl. 1–4 (1 June 1822) and 8(4): 297–348, pl. 5–6 (21–29 September 1822)], while the often cited 91-paged pre-reprint, including June and ahead September parts of the paper from Mémoires, Sur la classification et la distribution des végétaux fossiles, Paris, was already published on 24 June 1822. The detailed bibliographic studies of the early works of Brongniart debunked the validity of publication of some fossil-species, e.g. *Phyllites populinus* Brongn. (*populina*), and its acceptance of the type species for the fossil-genus *Phyllites* Brongn. After these studies, *Phyllites* Brongn. (in Bull. Sci. Soc. Philom. Paris 1822 (Février): 26. Feb 1822) is valid from February 1822, but the fossil-species *Phyllites populinus* Brongn. (in Mém. Mus. Hist. Nat. 8(3): 210, 237, pl. 3: fig. 4. 1 June 1822), previously thought to be validly published through combined generico-specific description of the fossil-genus and fossil-species (ICN, Art. 38.5), remained invalid since no description was associated with a fossil species epithet and its sole illustration (l.c. pl. 3: fig. 4. 1822) does not serve as an illustration with an analysis in place of a written description or diagnosis, which were recently revised in the Code (vide ICN, Art. 38.7), and therefore, Brongniart’s popular fossil-species for fossil poplars (*Populus*), not validly published in 1822, became substituted in palaeobotany by *Populus latior* A. Braun (in Neues Jahrb. Mineral. Geognosie 1845(2): 169. 1845) (Doweld 2017a). The attempt to ‘revive’ Brongniart’s epithet as *Populus populina* Erv. Knobl. (in Neues Jahrb. Geol. Paläontol., Monatsh. 1964(10):

601. 1964) was ineffective and nomenclaturally superfluous. But the situation with fossil-genus *Phyllites* Brongn. is still unresolved, since the general nomenclatural botanical compilations like Index Nominum Genericorum (ING) treated it as a later (para)homonym of the extant fern genus *Phyllitis* J. Hill (Brit. Herb. 525. 28 January 1757), and if it is true, this case should be confirmed by a special decision of Nomenclatural Committees and rectified by the International Botanical Congress, and therefore all fossil-species should be attributed to the nomenclatural synonym of *Phyllites* Brongn., *Monophyllites* Kuntze (in Post & Kuntze, Lex.: 373. 1903) (Doweld, in prep.).

The same curious validation of the Palaeozoic widely widespread fossil-genus *Sphenopteris* (Brongn.) Sternb., was incidentally found in earlier part of the Sternberg's Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt as *Sphenopteris* (Brongn.) Sternb. (Vers. Fl. Vorwelt [1](3): 36. May 1823), not as previously established *Sphenopteris* (Brongn.) Sternb. (Versuch Fl. Vorwelt 1 (Tentamen): xv. September 1825 ('*Sphaenopteris*'). Cleal and Thomas (2018) incorrectly interpreted Sternberg's elevation of Brongniart's section to the generic level, *Filicites* section *Sphenopteris* Brongn. (in Mém. Mus. Hist. Nat. 8(3): 233. 1 June 1822).

In addition to these examples of the effective, but surprising historical bibliographic findings, one may add that numerous additional actions to suppress earlier disused or forgotten fossil-genera were necessary to stabilize the current palaeobotanical nomenclature and systematics. In this connection, more than 50 official proposals were made to the Nomenclatural Committee of Fossils to officially conserve or reject fossil-family, fossil-generic and fossil-species names and to include them in the official lists of conserved or rejected names in Appendices of the International Code of Nomenclature for algae, fungi, and plants, and the whole work is still in progress. So, widely used names in palaeobotany, such as *Coniopteris* Brongn. (Doweld 2013b), *Cycadeoidea* Buckl. ex Lindl. & Hutton (Doweld 2016), *Discoaster* Hok (Doweld 2014),

Equisetites Sternb. (Doweld 2013a), *Lepidopteris* Schimp. (Doweld 2012), *Palmoxylon* Schenk (Doweld 2017c), *Taeniopteris* Brongn. (Doweld 2013c), *Voltziopsis* Potonié (Doweld 2017b), *Lyginopteris* Brongn. (Doweld 2018), *Lonchopteris* Brongn. (Doweld 2019), *Podozamites* Braun (Doweld 2022), and so forth, were conserved and retained in botanical nomenclature in spite of their illegitimate or superfluous initial nomenclatural status. Some names (f.e. *Pityis* Witham; Doweld & Reveal 2002) was conserved with that spelling, although in spite of the rectified decision of the International Botanical Congress to adopt the proposal, some palaeobotanists continue even now to ignore the conserved and only correct spelling and use the old, rejected spelling *Pitus*.

The additional reform of the palaeobotanical nomenclature was also started by the proposal to oppress fossil-generic names with no illustrations (Doweld 2010a), resulted in the modification of the Article 43.2 (ICN) to include illustrations for a new valid fossil-generic names proposed on or after 1 January 1912. This clarification of the Code eliminated numerous fossil-generic names, proposed with no illustrations. So, prior to Melbourne Code (2012) the monotypic fossil-genus *Laconiella* Krasser (in Sitzungsber. Akad. Wiss. Wien, Math.-Naturwiss. Kl. Abt. 1, 129: 16. 1920) included only one species, *Laconiella sardinica*, which was not validly published as no illustration or figure or reference to a previously and effectively published illustration or figure was provided. But *Laconiella* as a generic name was a validly published generic name. As a result, *Laconiella* (1920) was a senior synonym of widely known and used *Caytonia* H.H. Thomas (in Philos. Trans., Ser. B, 213: 314. 1925). A special proposal was initially submitted to conserve *Caytonia* against *Laconiella* (Doweld 2010b), but it was a superfluous when the Code was modified by a new necessitated requirement to supplement new fossil-generic names by illustrations (Doweld 2010a), so the fossil-genus *Laconiella* Krasser was deleted from the Appendix II of the Code as not validly published under the modified Melbourne and subsequent editions of the Code.

Standardization of data on authors and serials for unification of citations between IFPNI, IPNI and HUH: Numerous authors of fossil plant, algae and fungal names were not still incorporated in the database of the authors of plant names, which is an integral part of the International Plant Name Index (IPNI). The Index of Botanists, curated by the Harvard University Herbaria (now K.N. Gandhi), also has omissions of numerous palaeobotanists and palaeontologists, contributing to fossil plant naming. Since 2014, about 1879 author names were contributed to IPNI and HUH, and the unification of their standard abbreviation forms were made.

IFPNI — PROPOSALS TO AMEND THE CODE TO UPDATE REGULATIONS OF THE NOMENCLATURE OF PLANT FOSSILS

These additional initiatives consist of a few specific, mostly editorial amendments of the ICN provisions in order to reflect the historical development of palaeobotanical nomenclature, which are published here for wide discussions among palaeobotanical community.

Since in the newest revisions of ICN, the former outlived notions like ‘organo-genus’, ‘forma-species’ and others were eliminated, it is necessary to formally fix their correspondence with modern notions of ICN, thus allowing its correct treatment in the functioning indexing centers. However, ICN should have also additional operational notions how to proceed with another category of artificial binary names, which were applied to fossil spore, pollen and other microfossil taxa (of algal and fungal nature). These numerous artificial binary names (hundreds known and registered in the International Fossil Plant Names Index (IFPNI), produced by combination of the name of fossil spore group or subgroup with epithet, look like usual fossil species, but in reality they were not associated with generic names, but instead with their substitutes. The proposals of the formal outlining of the distinction between fossil taxa and these artificial designations will help significantly to indexing centers to correctly treat nomenclatural difficulties found in the old palaeobotanical literature.

IFPNI recorded numerous fossil names generated in early years of palaeopalynology (1930–1960s), which were formed as binary designations, but unlike species (formed as a combination of generic name and species epithet) these designations were associated with the artificial names of non-generic groups or subgroups of fossil spore, pollen or other microfossils. These designations, substitutes to generic level in artificial system of classification, were initially developed in the artificial system of classifications of fossil spores and pollen. Most influenced 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 [was] 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 subgroup of fossil spores in the artificial classification of microfossils (group *Azonotriletes* Lubert of class *Irrimales* Naumova). *Leiotriletes* is not a generic name, although it was used in binary combinations like *Leiotriletes minutissimus* Naumova (in Izv. Akad. Nauk S.S.S.R., Ser. Geol. 1949(4): 52. 1949). As a genus, *Leiotriletes* was later validated 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 October 1953) and *Leiotriletes* Naumova ex R. Potonié & Kremp (in Geol. Jahrb. 69: 120. 31 March 1954).

Such an approach to form artificial fossil spore/pollen designations eliminated the potential nomenclatural conflict when if the fossil spore/pollen genus or species would be found and described earlier than the very fossil plant, the spore/pollen designations could not compete with the fossil generic names established on other organs of the plant. However, later in palaeopalynology another option was chosen to form so-called form-genera or organ-genera in plant classification [formally existed in former ICBN editions from Stockholm (1952) to Tokyo (1994), superseded

by ‘morphogenus’ from St. Louis (2000) to Melbourne (2012), and all at least eliminated from ICN after Melbourne]. Nevertheless, fossil spore taxa, formed as artificial binary combinations, were persisted and actively used in palaeopalinology up to 1990ths (!). In addition, as IFPNI 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, fossil spore species, *Anemia pseudaurifera* Bolchovitina (in Trudy Inst. Geol. Nauk Akad. Nauk S.S.S.R. 145: 38. 1953), validly published under generic name *Anemia* O. Swartz (Syn. Filicum: 6, 155. 1806), was later transferred (recombined) as *Chomotriletes pseudauriferus* (Bolchovitina) Chlonova (in Trudy Inst. Geol. Geofiz. Sibirsk. Otdel. Akad. Nauk S.S.S.R. 3: 11, 38. 1961), but *Chomotriletes* in this case was accepted as a name of a formal artificial subgroup of fossil spores, *Chomotriletes* Naumova (in Trudy XVII Sess. Mezhdunar. Geol. Kongr. 1937, 1: 357. 1940 [“1939”]). Therefore, *Chomotriletes pseudauriferus* (Bolchovitina) Chlonova is not a fossil species, 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. 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, now IFPNI have faced enormous nomenclatural conundrum of artificial and non-artificial (exact) designations, which should be made distinct in records. Needless to say that these artificial designations are all invalid in terms of botanical nomenclature, and might not be taken even for the purposes of homonymy. In this connection, a few new provisions are proposed below to resolve the historical situation:

The difference in spelling of epithets, formed under the rules of Zoological and Botanical Codes, is a permanent headache of the IFPNI and indexing centers of other microorganisms. Although the correction of spelling is permissible now in accord with Art. 60.12,

the initial form, generated in zoological nomenclature, remained nevertheless correct under the Zoological Code. This schism might not be bridged at present, since traditions of spelling in both nomenclatures are different. In IFPNI we recorded both spellings, and users could find names either by spelling *Hystrichosphaerina schindewolfi* and *Hystrichosphaerina schindewolfii*. But I suggest that it is rational to allow both types of spelling, correct under different Codes, as permissible alternative spellings that should not be treated as an error to be corrected. This allows to indexing centers, compiling such microorganisms governed by two Codes, to record both original and (if any) correctable spellings.

IFPNI — FUTURE

Establishing IFPNI as a registry of fossil plant names will largely provide an opportunity to introduce unprecedented stability into botanical nomenclature. Not only will taxonomic data be freely available, but also an alerting-service targeting taxa of interest to particular user groups will be provided. Completeness of the fossil plant species registry will be achieved by having registration of new names as a possible ICN requirement for availability (to be discussed and worked out at the Special Committee on Registration of Plant Names established by last Melbourne International Botanical Congress, see Barkworth et al. 2016a, 2016b), along with retrospective registration of existing names. With Code-compliance built into the registration process, we will avoid creation of homonyms, nomenclaturally superfluous names, invalid names or names with incorrect orthography. IFPNI will enable the tracking of names and hence facilitate the correction of many problems prior to publication and name availability. The IFPNI interface will provide automatic checking for Code-compliance, and thus prevent new homonymy, stabilize spellings, fix genders and stems, and provide stability in gender agreement.

A possible additional benefit of IFPNI would be the universal availability of new original descriptions and

partially original descriptions from retro literature. Comments field is provided for the possibility to upload newest and revised descriptions and diagnoses of registered fossil taxa. Making the inclusion of original descriptions mandatory would be very difficult to achieve, partly for reasons of current copyright laws. However, IFPNI will provide a voluntary field for original descriptions, with links to the original papers, along with additional inclusion of holotype and/or lecto/neotype illustrations. As a result, a comprehensive photo bank of principal specimens serving types of fossil species might be in further constructed.

The standardization of input data on palaeogeography and further implementation of geographical map tools will provide the possibility to get a list of taxa for palaeofloristic analysis for specified period of time and locality. Tools on the site also let users generate palaeomaps, data summary tables, lists of taxa, first appearances, time scale confidence intervals, stratigraphic confidence intervals, synonymy lists for taxa, and finally the IFPNI will provide comprehensive Fossil Record for registered taxa. The building of such a comprehensive Index is achieved to the next International Botanical Congress in Madrid in 2024, which will solve the problems of registration of new names as a possible ICN requirement for availability, and hence a data base of previously validly and invalidly published taxa (retro registration) should be done with a maximum. This goal might be achieved by a broad cooperation of palaeobotanists worldwide, which are invited to actively participate as data contributors of their own taxa (authors) and/or taxa under study (users) of IFPNI.

ACKNOWLEDGEMENTS

The author is grateful to Dr. Ramesh K. Saxena and anonymous reviewers for helpful suggestions. Special thanks go to Mrs. Valentina Bublik, Fundamental Botanical Library, National Institute of Carpology (Gaertnerian Institution), for bibliographic assistance and verifications. The research is a contribution to the Palaeoflora Europaea Project, Palaeoflora of Russia (Palaeoflora Rossica) Project

(NOM-22-001A) and The International Fossil Plant Names Index (IFPNI).

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