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New names of fossil *Nymphaeaceae* and allied forms

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ABSTRACT

Doweld A.B. 2022. New names of fossil *Nymphaeaceae* and allied forms. Geophytology 52(1&2): 1–28.

The classification and nomenclature of some fossil remains of the *Nymphaeaceae* are revised. The fossil-genus *Nikitinella* P.I. Dorof. is revised to include *Tavdenia* P.I. Dorof. and *Eoeuryale* Miki, nom. inval.: ***Nikitinella brasenioides* sp. nov.**, ***Nikitinella germanica* sp. nov.**, ***Nikitinella irtyshensis* sp. nov.**, ***Nikitinella moldavica* sp. nov.**, ***Nikitinella sibirica*** (P.I. Dorof.) **comb. nov.**, ***Nikitinella tambovica* sp. nov.**, ***Nikitinella tymensis* sp. nov.** The fossil-genus *Pseudoeuryale* P.I. Dorof. is re-classified to include *Palaeoeuryale* P.I. Dorof. and *Irtyshenia* P.I. Dorof.: ***Pseudoeuryale akashiensis*** (Miki) **comb. nov.**, ***Pseudoeuryale carpatica*** (Szafer) **comb. nov.**, ***Pseudoeuryale caucasica*** (P.I. Dorof.) **comb. nov.**, ***Pseudoeuryale lissa*** (C. Reid & E. Reid) **comb. nov.**, ***Pseudoeuryale lusatica*** (P.I. Dorof.) **comb. nov.**, ***Pseudoeuryale mikiana* sp. nov.**, ***Pseudoeuryale nipponica* sp. nov.**, ***Pseudoeuryale sukaczevii*** (P.I. Dorof.) **comb. nov.**, ***Pseudoeuryale tenuicostata*** (P.I. Dorof.) **comb. nov.** The fossil-species *Brasenia antiqua* Dawson nom. illeg. non *Brasenia antiqua* Newberry, is excluded from the genus *Brasenia* and placed in a new fossil-genus ***Brasenica* gen. nov.**, ***Brasenica dawsonii*** (Hollick) **comb. nov.** (type), ***Brasenica laramiensis*** (Hollick) **comb. nov** and ***Brasenica weymouthii*** (Hollick) **comb. nov.** The fossil-species *Brasenia pliocaenica* Kink. is re-classified as ***Ceratophyllum pliocaenicum*** (Kink.) **comb. nov.** The fossil-species *Nymphaeites choffatii* is re-classified as a fossil fern and segregated into a distinct monotypic fossil-genus ***Ceratopteridopsis* gen. nov.**, ***Ceratopteridopsis choffatii*** (Saporta) **comb. nov.** The fossil foliage, previously misapplied to the basionym of the genus, *Klitzschophyllites choffatii* (Saporta) B.A.R. Mohr, Bern.-de-Oliv., Barale & Ouaja, is replaced by a new name, ***Klitzschophyllites exchoffatii* sp. nov.** The fossil-genus *Serenopsis* Hollick is reinstated from the synonymy of *Nelumbo* and *Nelumbites* and revised; ***Serenopsis arctica*** **(**Heer) **comb. nov.** is proposed a senior synonym of the type species, *Serenopsis kempii* Hollick. *Nelumbo puertae* Gandolfo & Cúneo, based on fossil leaves, is re-classified as a new fossil-genus ***Notolumbo* gen. nov.**, ***Notolumbo puertae*** (Gandolfo & Cúneo) **comb. nov.** A new fossil-genus ***Notolumbites* gen. nov.**, based on fruit receptacles, is created: ***Notolumbites pabloanus* gen & sp. nov.** ***Nelumbites minimus*** Vachrameev from the Albian of Central Asia is segregated in a distinct monotypic fossil-genus ***Asiolumbo* gen. nov.**: ***Asiolumbo minima*** (Vachr.) **comb. nov.** A new monotypic fossil-genus ***Omsukchania* gen. nov.**, ***Omsukchania samylinae* gen. & sp. nov.**, is created for the distinctive fossil leaves from the Russian Far East, previously putatively designated as '*Nelumbites* aff. *minimus*' Vachr. The formerly Far Eastern fossil-species of *Nelumbo* were excluded in a distinct fossil-genus ***Paralumbo* gen. nov.**: ***Paralumbo amurensis*** (Krysht. ex Snig.) **comb. nov.**, ***Paralumbo orientalis*** (Matsuo) **comb. nov.**, ***Paralumbo jiayinensis*** (F. Liang, G. Sun & T. Yang) **comb. nov.** *Nelumbo bactriana* Ovcz. is revised as a new fossil-genus ***Ovczinnikovia* gen. nov.**; ***Ovczinnikovia bactriana*** (Ovcz.) **comb. nov.** Previously invalidly published fossil-genus *Nelumbago* McIver & Basinger nom. inval. is validated: ***Nelumbago montana*** (R.W. Brown ex A.D. Watt) **comb. nov.** A new fossil-genus ***Nelumbophyllites* gen. nov.** is created to replace the former artificial denomination *Nelumbites*, misapplied to *Nelumbo*-like leaves: ***Nelumbophyllites tenuifolius*** (Lesq.) **comb. nov.**, ***Nelumbophyllites crossii*** (Knowlt.) **comb. nov.** A new name is proposed for the previously invalidly published *Nuphar palfalvyi* (***Nuphar palfalvyana* sp. nov.**). ***Nelumbo protonucifera* nom. nov.** is proposed instead of *Amomum europaeum* Kownas. Fossil *Nymphaea pulchella* LaMotte, being an illegitimate later homonym of extant *Nymphaea*

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pulchella De Candolle, is re-named ***Nymphaea knowltonii* nom. nov.** *Nymphaea minuta* Nikitin (fossil) is replaced by a new name ***Nymphaea nikitinii* nom. nov.**, because of the earlier homonyms, *Nymphaea minuta* Saporta (fossil) and *Nymphaea minuta* Landon, Edwards & Nozaic (extant). New combinations are made: ***Palaeonymphaea prisca*** (Balueva & V.P. Nikitin) **comb. nov.**, ***Nuphar diatoma*** (MacGinitie) **comb. nov.**, ***Nupharipollenites aculeatus*** (Kuprian.) **comb. nov.**, ***Nupharipollenites minor*** (Krutzsch) **comb. nov.**, ***Nupharipollenites parvus*** (Lubom.) **comb. nov.** The following fossil-species are lectotypified: *Nelumbo lakesiana* Lesq., *Serenopsis kempii* Hollick, *Protorhipis choffatii* Saporta, *Peucedanum dubium* Ludwig; *Nelumbo dawsonii* Hollick is neotypified. A new integrated system of classification of extant and fossil *Nymphaeidae* is presented; ***Hydatellidae* subcl. nov.**, ***Pluricarpellatiales* ord. nov.**, ***Pluricarpellatiaceae* fam. nov.**, ***Monetianthaceae* fam. nov.**, ***Microvictoriaceae* fam. nov.** and ***Cecilanthaceae* fam. nov.** are validated.

Keywords: Botanical nomenclature, Eurasia, Miocene, palaeobotany, Siberia, North America, *Nymphaeidae*, *Hydatellidae*, *Magnoliopsida*.

INTRODUCTION

The Nymphaealean phylad (water-lilies and relatives), treated once by Takhtajan (1997) and Doweld (2001) as a distinct subclass of angiosperms, *Nymphaeidae* Takht. 1997, is one of the poorly understood phylads of flowering plants, containing in the near past unrelated taxa (*Nelumbonaceae*, now commonly *Nelumbonales*) and newly recovered problematic *Hydatellales* Doweld & Reveal (in Reveal & Doweld 1999), which was related recently upon the molecular studies (Saarela & al. 2007; Rudall & al. 2007; Sokoloff & al. 2008, 2019; APG IV 2016). In spite of the widespread statements about close affinity of *Hydatellales* with *Nymphaeales*, the first order is clearly distinct and standing aside the traditional circumscription of the water lilies in its linear leaves with a single vein, axillary inflorescences bearing minute flowers, unistaminate and unicarpellate, lacking perianth, fruits pseudomonomerous, splitting into three valves or achenial, bitegmic tenuinucellate ovules with a massive suprachalazal nucellar tissue ("perisperm"), exotestal-endotegmic seeds with a mostly undifferentiated embryo. The whole combination of cited characters excluding *Hydatellales* from the *Nymphaeidae*, and assign it a status of a long-branched phylad among earlier angiosperms deserving the same subclass rank as for *Nymphaeidae*.

The fossil record of the traditional *Nymphaeidae* (excl. *Hydatellales*) is very diverse (Table 1), with numerous Cretaceous fossil-taxa, which could not fit in the extant families recognized within the order by molecular markers (Borsch & al. 2008; APG 2016). One of the recent impressive discoveries was the flowers of the fossil-genus *Pluricarpellatia* Mohr & al. 2008. The flowers had apocarpous gynoecium of 6 to 12 free carpels, which are (?) spirally attached to the receptacle, stigmatic area not modified, with one or a few seeds, attached to the lateral carpel wall. However, except for some superficial similarity in leaf venation (presence of festooned brochidodromous secondary venation (in *Cabombaceae* venation weakly brochidodromous to cladodromous), the morphogenetic hiatus between fossils and extant forms is added by the differences in the unmodified stigmatic areas of the carpels, which precludes a close relationship. The distance between *Pluricarpellatia* and *Cabombaceae* debunks the possibility to include this fossil taxon in the modern family as well as the very *Nymphaeales*, and I segregate it in a distinct fossil-family and a fossil-order, *Pluricarpellatiaceae* Doweld, fam. nov. and *Pluricarpellatiales* Doweld, ord. nov. respectively. It is likely that this is one of the numerous blind lines of early angiosperm evolution in the Cretaceous, became extinct before the Tertiary radiation of extant forms, with no direct affinity to the latter.

The peculiar finding of another Cretaceous flower was *Monetianthus* Friis, K.R. Pedersen, Balthazar, G.W. Grimm & P.R. Crane (Friis & al. 2009). The flowers were actinomorphic, bisexual, perianth of 9–10 tepals, androecium of 20(–60?) stamens, gynoecium syncarpous, with a partly inferior ovary of 12–13 carpels arranged radially around a central column; ovules 6 per

Table 1. Subclass *Nymphaeidae*: an integrated system of classification of extant and fossil taxa (1753–2022). † = Fossil taxa.

NYMPHAEIDAE

Subclass: ***Nymphaeidae*** Takht. Divers. Class. Fl. Plate: 83. 1997.

≡ *Nymphaeanae* Thorne ex Reveal, Novon 2: 236. 1992, pro superord.

†***Jaguariba*** Coiffard, B.A.R. Mohr & Bern.-de-Oliv.

†***Brasipelta*** Krassilov

†Order 1. ***Pluricarpellatiales*** Doweld, ord. nov.

Carpels free (? more), (?) spirally attached to the receptacle, stigmatic area not modified, with one or a few seeds, seeds attached to the lateral carpel wall; (?) with laminar attachment. Leaves cordate, excentrically peltate to centrally peltate; festooned brochidodromous secondary venation.

†Fam. ***Pluricarpellatiaceae*** Doweld, fam. nov.

Flowers on long peduncles in inflorescences, carpels 6 to 12 free (? more), (?) spirally attached to the receptacle. Carpels oblong to ovate, stigmatic area not modified, mature carpels with one or a few seeds, seeds attached to the lateral carpel wall; (?) with laminar attachment. Ovules anatropous, seeds ellipsoidal to ovoid, smooth to slightly verrucate, rounded at basal end with cap, operculum and micropyle-hilum complex. Micropyle and hilum closely adjacent to each other. Leaves cordate, excentrically peltate to centrally peltate; festooned brochidodromous secondary venation.

†***Pluricarpellatia*** B.A.R. Mohr, Bern.-de-Oliv. & David W. Taylor

Order 2. ***Cabombales*** Martius, Consp. Regn. Veg.: 38. 1835 ("*Cabombeae*").

(=) *Hydropeltidales* Spenner, Handb. Angew. Bot. 1: 202. 1834 ("*Hydropeltideae*").

†***Brasenites*** H.-S. Wang & Dilcher

†***Eilatinea*** Krassilov

†***Scutifolium*** David W. Taylor, G.J. Brenner & S.H. Basha

Fam. ***Cabombaceae*** A. Richard in Bory, Dict. Class. Hist. Nat. 2: 608. 1822 («*Cabombeae*»), nom. cons.

= *Hydropeltidaceae* Dumortier, Comment. Bot.: 64. 1822 («*Hydropeltideae*»).

Tribe ***Cabombeae*** G. Gardner in Hooker's Icon. Plate Ser. 2, 7: ad tab. 641. 1844.

≡ *Cabomboideae* Burnett, Outl. Bot.: 842, 1093, 1122. 1835 ("*Cabombidae*"), pro subfam.

Cabomba Aubl.

Tribe ***Hydropeltideae*** DC. Syst. Nat. 2: 32, 36. 1821.

≡ *Hydropeltidoideae* Eaton, Bot. Dict. ed. 4: 37. 1836 ("*Hydropeltideae*"), *pro subfam.*

†***Dusembaya*** P.I. Dorof.

†***Braseniella*** P.I. Dorof.

Brasenia Schreb.

= †*Cratopleura* C.A. Weber

= †*Holopleura* Caspary

Order 3. ***Nymphaeales*** Berchtold & J. Presl, Přiroz. Rostl.: 270. 1819 ['1820'] ("*Nymphoideae*").

≡ *Nymphaeineae* Engler, Syllabus, ed. 2: 115. 1898, pro subord.

(=) *Euryalales* H. L. Li, Amer. Midl. Nat. 54: 39. 1955.

(=) *Barclayales* Doweld, Prosyllabus: xxiii. 2001.

?†***Panefolium*** A. Boyd

?†***Nuphaea*** Gee & David W. Taylor

Fam. ***Nupharaceae*** A. Kerner, Pflanzenleb. 2: 699. 1891.

†***Notonuphar*** Friis, A. Iglesias, Reguero & Mörs

Tribe ***Nuphareae*** Endlicher, Gen. Plate: 900. 1839 («*Nupharinae*»).

≡ *Nupharoideae* M. Ito, Bot. Mag. (Tokyo) 100: 33. 1987 ("*Nuphariodeae*"), *pro subfam.*

†***Paleonuphar*** Hollick

†***Nupharipollenites*** E. Nagy

= †*Nupharipollis* Krutzsch, *syn. nov.*

†***Paranuphar*** Doweld

Nuphar Sm.

= *Nymphozanthus* L.C. Richard, nom. rejic. [≡]

= *Ropalon* Raf.

†Fam. ***Monetianthaceae*** Doweld, *fam. nov.*

Flowers actinomorphic, bisexual, perianth of 9-10 tepals, androecium of 20(-60?) stamens, gynoecium syncarpous, with a partly inferior ovary of 12-13 carpels arranged radially around a central column. Placentation laminar. Ovules ca 6 per carpel. Ovules anatropous and ascending, bitegmic. Pollen (attached) monocolpate, coarsely reticulate.

†***Monetianthus*** Friis, K.R. Pedersen, Balthazar, G.W. Grimm & P.R. Crane
?†***Carpestella*** Balthazar, K.R. Pedersen, P.R. Crane & Friis
Fam. ***Nymphaeaceae*** Salisbury, Ann. Bot. (König & Sims) 2: 70. 1805 («*Nymphaeeae*»), nom. cons.
= *Euryalaceae* J. Agardh, Theor. Syst. Plate: 51. 1858 («*Euryaleae*»).
= *Barclayaceae* H.L. Li, Amer. Midl. Nat. 54: 40. 1955.
†***Anoectomeria*** Saporta
†***Nymphaeapollenites*** Thiele-Pfeiffer
†***Nymphaeites*** Sternb. ex Casp.
†***Symphaenale*** Mas. Takah., Friis & P.R. Crane
Tribe ***Barclayeae*** Endlicher, Gen. Plate: 900. 1839.
≡ *Barclayoideae* Weberbauer, Bot. Jahrb. Syst. 18: 248. 1894, pro subfam.
†***Protobarclaya*** E. Reid & M. Chandler
†***Barclayopsis*** Erw. Knobloch & Mai
Barclaya Wall.
Hydrostemma Wall.
Tribe ***Euryaleae*** Endlicher, Gen. Pt.: 899. 1839.
≡ *Euryalinae* Planchon, Ann. Sci. Nat. Bot. Sér. 3, 19: 19. 1853 ("*Euryaleae*"), pro subtrib.
≡ *Euryaloideae* R. Thorne, Aliso 8: 194. 1974 ("*Euryalioideae*"), pro subfam.
(=) *Victorieae* Horaninow, Char. Ess. Fam.: 61. 1847, pro trib.
†***Allenbya*** Cevallos-Ferriz & Stockey
†***Nikitinella*** P.I. Dorof.
= †*Eoeuryale* Miki, nom. inval.
= †*Tavdenia* P.I. Dorof.
†***Pseudoeuryale*** P.I. Dorof.
= †*Palaeoeuryale* P.I. Dorof.
= †*Irtyshenia* P.I. Dorof.
†***Sabrenia*** M.E. Collinson
†***Susiea*** Wi. Taylor, DeVore & Pigg
Euryale Salisb.
= *Anneslea* H.C. Andrews, nom. rejic.
Victoria Lindley
Tribe ***Nymphaeeae*** DC. Syst. Nat. 2: 43, 48. 1821.
≡ *Nymphaeoideae* Arnott, Encycl. Brit. ed. 7, 5: 96. 1832 ("*Nymphaeeae*"), pro subfam.
= *Ondineeae* Tamura, Acta Phytotax. Geobot. 33: 344. 1982.
≡ *Ondineoideae* Chrtek & Slavíková, Acta Univ. Carol. Biol. 36: 231. 1992, pro subfam.
†***Castaliites*** Hollick
†***Nymphaeocaulon*** Trivedi & Ambwani
†***Palaeonymphaea*** M. Chandler
= †*Pania* V.P. Nikitin, *syn. nov.*
†***Paranymphaea*** E.W. Berry
Nymphaea L.
= *Castalia* R. A. Salisbury
= *Clairvillea* Hegetschweiler
= *Ondinea* Hartog
= †*Palaeolobium* Unger [haud typo]
†***Pseudonymphaea*** V.P. Nikitin

EXCLUDED TAXA

†***Aquatifolia*** H.-S. Wang & Dilcher (*Nelumbonales* or *Ceratophyllidae*?)
†***Braseniopsis*** Saporta (*Ceratophyllidae*?)
†***Nupharanthus*** Krassilov (eudicots)
†***Nymphaeacidites*** S.C.D. Sah (Incertae sedis)
†***Nymphaeoipollis*** Venkatach. & R.K. Kar (= †***Proxapertites*** van der Hammen; Araceae)
†***Nymphar*** K. Ozaki (? *Gentianales*)
†***Nymphaeopsis*** Kräusel (Incertae sedis)
Incertae sedis *Magnoliidae*:

†Fam. ***Microvictoriaceae*** Doweld, *fam. nov.* (? *Illiciales*)

Flower actinomorphic, (?) bisexual, perianth of 9-10 tepals, androecium of 20 stamens, gynoecium syncarpous, with a partly inferior ovary of 12 carpels arranged radially around a central column. Placentation laminar. Ovules about 6 per carpel. Ovules anatropous, ascending, bitegmic. Pollen (attached) monocolpate, coarsely reticulate.

†***Microvictoria*** Gandolfo, Nixon, Crepet

†Fam. ***Cecilanthaceae*** Doweld, *fam. nov.*(? *Magnoliales*)

Flowers actinomorphic, bisexual, with (?) 30–40 strap-shaped whorled tepals. Stamens ca. 50, whorled, broad, scale-like, spatulate, ending in short connective apex; anther ca. 2/3 to 3/4 length of stamen; filament and anther not differentiated, thecae adaxial, 4 pollen sacs (?) embedded. Pollen (?). Staminodes lacking. Carpels ca. 100, whorled, uniovulate, lacking distinct style. Receptacle hemispherical.

†***Cecilanthus*** Herendeen, J.A. Doyle, P.K. Endress & Mas. Takah.

Subclass ***Hydatellidae*** Doweld, subcl. nov.

Axillary inflorescences bearing minute flowers, unistaminate and 1-carpellate, lacking perianth, fruits pseudomonomerous, splitting into three valves or achenial, with three veins and stigmatic papillae, ovules bitegmic, tenuinucellate, with a massive suprachalazal nucellar tissue ("perisperm"), seeds exotestal-endotegmic with a mostly undifferentiated embryo. Leaves linear, with a single vein.

Order ***Hydatellales*** Reveal & Doweld, Novon 9: 551. 1999.

Fam. ***Hydatellaceae*** U. Hamann, New Zealand J. Bot. 14: 195. 1976.

Trithuria J.D. Hooker

= *Hydatella* Diels

carpel, placentation laminar. The suite of floral characters places the fossil in a distinct lineage, differed from *Nymphaeaceae* by a peculiar star-shaped arrangement of carpels (in contrast to the whorled arrangement in *Nymphaeaceae*); the arrangement of stamens and peritanth is not clear due to the poor preservation, it was most likely not spiral. The associated isolated pollen grains (on carpels) are monocolpate, semitectate with an open coarse reticulum and a columellate infratectal layer; but extant *Nymphaeales* have a different type: inaperturate, monocolpate, or zonocolpate but always with a continuous tectum. The inferior gynoecium is similar to that in *Nymphaeaceae*; placentation is laminar, with ovules placed on the septa between locules, but in *Nymphaeales* placentation may sometimes appear linear on the septa, although ovules mostly placed irregularly over the whole surface of the septa. Another Lower Cretaceous (Albian) fossil-genus based on flowers, *Carpestella* Balthazar, K.R. Pedersen, P.R. Crane & Friis 2008, is similar to *Monetianthus* in having a syncarpous gynoecium with partly inferior ovary, carpels with a similar number (13 vs 12), arranged around a central protrusion, and with septal slits. However, *Carpestella* had more floral parts (15 tepals vs. 9–10 and 60 stamens vs. 20 in *Monetianthus*), surrounding the carpels than has *Monetianthus*; *Carpestella* both perianth and androecium are arranged in a distinct spiral pattern. In spite of some differences between two fossil-genera, both taxa constituted a very distinct lineage of early angiosperms, superficially similar to extant families of *Nymphaeales*, and therefore, it is rationale to place these fossil-genera in a distinct fossil-family *Monetianthaceae* Doweld, fam. nov.

The putative relative, Lower Cretaceous (Turonian) fossil-genus *Microvictoria* Gandolfo, Nixon & Crepet 2004, based on the poorly preserved fossil flower, seems more distantly related than *Monetianthus* in having a deep floral cup and a larger number of floral organs, perianth parts and (?) bracts completely cover the outside of the flower, sepal- or bract like tepals extend from the pedicel to the rim of the floral cup, bearing petal-like tepals. *Microvictoria* was described as having an inferior ovary, but Endress (2008) suggested that an inferior ovary is unlikely, and therefore he concluded, with which I concur, that *Microvictoria* is most likely not related to *Nymphaeales*. The combination of floral characters points out that *Microvictoria* is most likely related to order *Illiciales* s.l., but still is distantly related to extant genera of the order, which might be summarized in the proposing of a new fossil-family *Microvictoriaceae* Doweld fam. nov., extinct in the Cretaceous times with no direct descendants in the Tertiary.

The same is true for the previously suggested nymphaealean fossil-genus *Cecilanthus* Herendeen,

J.A. Doyle, P.K. Endress & Mas. Takah. 2016. The flower was collected in the Upper Cretaceous (Cenomanian) sediments of Maryland, USA, with a receptacle and a whorled phyllotaxis, (?) 30–40 strap-shaped whorled tepals, numerous (ca. 50) scale-like, spatulate stamens, its filament and anther not differentiated, carpels numerous (ca. 100), uniovulate, lacking distinct style. This combination of characters, especially whorled phyllotaxis, places outside this fossil-genus from extant *Nymphaeales*, it seems that a distinctive fossil-genus could be more reasonably affiliated with extant *Magnoliales*, but it is too distant to include the fossil-genus in existing extant families. So, a new fossil-family *Cecilanthaceae* Doweld fam. nov. is formed to accept these peculiar fossils with a complex of floral characters, similar to one in *Magnoliales* s.l., but never in such a combination.

The fossil flower *Nupharanthus* Krassilov (in Krassilov & Bacchia 2000), described from the Cenomanian sediments of the Middle East (Lebanon), has nothing in common to do with extant *Nupharaceae*, except for etymologically derived generic name from extant genus *Nuphar*. The pentamerous advanced flower (5 sepals, petals with oblique anastomoses, and 10–merous androecium) places the fossil outside *Nymphaeales* with no exact placements (? Eudicots). The fossil dispersed Tertiary pollen, once referred to extant *Nuphar* as distinct fossil-species *Nuphar aculeata* Kuprianova 1959 and *Nuphar parva* Lubomirova 1967, is transferred to the amended fossil pollen genus *Nupharipollenites* E. Nagy 1969, a senior synonym of the fossil pollen genus *Nupharipollenites* Krutzsch 1970 (see discussion in details below). In addition, the fossil seeds, previously referred to extant genus *Nuphar* as a distinct fossil-section, *Nuphar* sect. *Nupharella* Dorofeev 1975, is revised and excluded in a separate fossil-genus *Paranuphar* Doweld gen. nov. (see below).

The exclusion of *Nelumbo* from the *Nymphaeidae* to the order of its own, *Nelumbonales* Martius 1835, or even subclass *Nelumbonidae* Takht. 1997 [which was later rejected and synonymized with subclass *Hamamelididae* Takht.], dramatically changed the classification and nomenclature of the fossil forms, previously attributed to water lilies and *Nelumbo*-like fossils. Numerous previously designated *Nelumbo*-like fossils, sometimes combined with nymphaealean genera, are re-classified and excluded from *Nymphaeidae*, as well as from *Nelumbonales*.

New replacement names for homonymic fossil-species of *Nymphaea* are proposed in accord with the requirements of the International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) (Turland et al. 2018). New fossil plant names and nomenclatural adjustments (including lecto and neotypifications) were registered, through a pilot registration version proposed before the XIX International Botanical Congress in Shenzhen in 2017, in the International Fossil Plant Names Index (IFPNI 2014–onwards) (Doweld 2015, 2016, 2022) with unique persistent registration barcodes (LSIDs, Life Science Identifiers). The registration of new plant taxa (Barkworth et al. 2016 a, b) was accepted at the XIX International Botanical Congress in Shenzhen 2017 (Turland et al. 2017).

RE-CLASSIFICATION OF *EOEURYALE* MIKI, NOM. INVAL.: *TAVDENIA*, *NIKITINELLA* AND *EOEURYALE* (SECT. *TOMSKIELLA*)

The fossil-genus *Eoeuryale* Miki, nom. inval. (1960) was invalidly described based on the seeds from the Neogene of Central Japan; author did not designate necessitated holotype for the type species of the monotypic fossil-genus, and therefore, both names, generic and species, were all invalidly published. This was uncritically overlooked by Dorofeev and Negru (1970), Dorofeev (1975, 1988) and Mai (1988), who continued to use the invalid fossil-generic name and described, again invalidly, additional fossil-species. However, the situation with the nomenclature of this fossil-genus, having 6 known fossil-species, was in addition complicated by the description of two additional similar fossil-genera based on the seeds from West Siberia, *Tavdenia* Dorofeev 1975 and *Nikitinella* Dorofeev 1975. The examination of the seed diversity among *Eoeuryale* Miki sensu Dorofeev (1975),

Tavdenia Dorofeev and *Nikitinella* Dorofeev, questioned the distinctness of the previously proposed fossil-genera. The seed type is nearly the same in all 3 genera in seed morphology and spermoderm structure, and therefore, the borders between genera, as it was also noticed by Dorofeev (1975), are not clear and solid. The distinctness might be noticed in seed-coat sculpturing and exotestal cells outline only, and these characters could not be taken up for the characters of the generic level. In sum, all 3 genera should be merged into a single one, and since *Eoeuryale* was not validly published up to our days, the priority of this generic name is lost. *Eoeuryale* sect. *Tomskiella* Dorofeev (1975: 65) is also invalid, since the generic name *Eoeuryale* was invalid at the time of its publication too. As a result, I choose *Nikitinella* as a prioritable name and, as a consequence, the validly published fossil-species of the previously published *Tavdenia* is recombined here, as well as 6 known fossil-species of invalid *Eoeuryale* Miki sensu Dorofeev are validated here under validly published fossil-generic name *Nikitinella*:

Genus: ***Nikitinella*** P.I. Dorof. in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 63. 1975 [‘1974’].

= *Tavdenia* P.I. Dorof. in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 62. 1975 [‘1974’].

= *Eoeuryale* Miki, J. Inst. Polytechn. Osaka City Univ., Ser. D, Biol. 11: 67. 1960, nom. inval.

Type species: *Nikitinella tavdensis* P.I. Dorof.

Nikitinella brasenioides Doweld, **sp. nov.**

≡ *Eoeuryale brasenioides* Miki, J. Inst. Polytechn. Osaka City Univ., Ser. D, Biol., 11: 67. 1960, nom. inval. (no type).

Description: Seeds large, 5–7 mm × 4–5 mm, ovoid to ellipsoidal, arillate; seed sculpturing of lobed cells with curved walls; spermoderm 2-layered, exotesta of very narrow cells with irregularly thickened side walls.

Holotype: Akazu, Seto City, Aichi Prefecture, Japan (F7246, Osaka Museum of Natural History, Osaka, Japan) – figured by Miki (1960: plate 2, figure E, F).

Geological age: Pliocene.

Fossil status: Seeds.

IFPNI registration LSID: 58D4E6D1-20DD-CCCC-F8DE-DFC29A193116.

Nikitinella germanica Doweld, **sp. nov.**

≡ *Eoeuryale germanica* Mai, Tert. Res. 9: 90. 1988, nom. inval.

Description: Seeds large, 2.5–8 mm × 1.5–6.5 mm, ovoid to ellipsoidal, arillate (remains visible); seed sculpturing of small, digitate, somewhat prolongated in one direction cells; exotestal cells strongly thickened in the outer third only, with long, conical lumen.

Holotype: Bituminous clays near Römerkeller, Kostebrau near Senftenberg/Lower Lusatia, Saxony, Germany (Mai Coll. 6171, Senckenberg Naturhistorische Sammlungen Dresden, Abteilung Museum für Mineralogie und Geologie, Dresden, Germany) – figured by Mai (1988: plate 2, figure 1, 1a).

Geological age: Upper Miocene (Langhian = Rauno Beds of the Niederlausitz Browncoal Formation).

Fossil status: Seeds.

IFPNI registration LSID: 30B71DD4-17DD-161B-C57F-023657B68325.

Nikitinella irtyshensis Doweld, **sp. nov.**

≡ *Eoeuryale irtyshensis* Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 66. 1975 [‘1974’], nom. inval.

≡ *Eoeuryale irtyshensis* Dorofeev in [Dorofeev & Negru], Dokl. Akad. Nauk SSSR 190(3): 696. 1970, nom. inval. (no type).

Description: Seeds large, 4.4–7.1 mm × 3.1–6.5 mm, ovoid to ellipsoidal, nearly arillate (mostly lacking); seed sculpturing smooth, exotestal cells large, irregularly polygonal and lobed, cell walls large, thick, with thickened lateral walls.

Holotype: Lezhanka village, right bank of Irtysh river, Omsk region, Russian Federation (33/1-K521, Komarov Botanical Institute, Russian Academy of

Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1975: plate 102, figure 17).

Geological age: Miocene.

Fossil status: Seeds.

IFPNI registration LSID: A329262F-F08B-ED8E-9CC3-6066C06F6F98.

Nikitinella moldavica Doweld, **sp. nov.**

≡ *Eoeuryale moldavica* Negru [in Dorofeev] in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 66. 1975 [‘1974’], nom. inval.

≡ *Eoeuryale moldavica* Negru in [Dorofeev & Negru], Dokl. Akad. Nauk SSSR 190(3): 687. 1970, nom. inval. (no type).

Description: Seeds large, 4.4–5.9 mm × 2.3–5.2 mm, rounded, exarillate; seed sculpturing smooth or even lacking, exotestal cells large, polygonal, cell walls large, thick, with thickened lateral walls.

Holotype: Bursuk village, Moldova [formerly USSR] (1/32, Grãdina Botanicã (Institut), Academiei de ªtiinþe a Moldovei, Chiºinãu, Moldova) – figured by Dorofeev (1975: plate 102, figure 13).

Geological age: Upper Miocene (Serravallian = Sarmatian).

Fossil status: Seeds.

IFPNI registration LSID: 7CDEDD2C-B77B-E53F-EE77-8A395837BB7E.

Nikitinella sibirica (Dorofeev) Doweld, **comb. nov.**

≡ *Nuphar sibirica* Dorofeev, Trudy Sibirsk. Nauchno-Issled. Inst. Geol., Geofiz. & Miner. Syr. 22(1): 398, figure 98. 1962 (“*sibiricum*”).

≡ *Nuphar sibirica* Dorofeev, Tret. Fl. Zap. Sibiri: 173. 10 Jun 1963, isonym.

≡ *Tavdenia sibirica* (Dorofeev) Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 62. 1975 [‘1974’] [as ‘*Tavdenia sibirica* Dorofeev sp. nov.’ in error].

Lectotype (designated by Dorofeev 1975: 62): Belojarka village, right bank of Tavda River, Sverdlovsk region, Russian Federation (32/1-3-K511, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1975: plate 102, figure 1).

Geological age: Oligocene.

Fossil status: Seeds.

IFPNI registration LSID: 5FE32594-F92E-AF90-20B3-380F7635A58B.

Remarks: Dorofeev (1962) originally described the new fossil-species *Nuphar sibirica* Dorofeev with necessitated type designation, but with no specification of the type specimen on the published illustrations. At that times such a practice was not prescribed by the Code, and therefore the fossil name was validly published. Later he incorrectly thought (Dorofeev 1975) that 1962 name was invalidly published, and proposed a new fossil-species under a different generic designation, “*Tavdenia sibirica* Dorofeev, sp. nov.”, which should be correctly considered as a new combination (not sp. nov.), based on the former validly published fossil name: *Tavdenia sibirica* (Dorofeev) Dorofeev.

Nikitinella tambovica Doweld, **sp. nov.**

≡ *Eoeuryale tambovica* Dorofeev, Miotsen. Fl. Tambovsk. Obl. 108. 1988, nom. inval.

Description: Seeds large, 2.5–5.8 mm × 1.7–4.6 mm, ovoid to ellipsoidal, arillate; seed sculpturing smooth, exotestal cells minute, irregularly polygonal and lobed, cell walls large, with thickened lateral walls.

Holotype: Rodionovskie Vyselki, Tambov region, Russian Federation (415, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1988: plate 21, figure 6).

Geological age: Miocene.

Fossil status: Seeds.

IFPNI registration LSID: DBA06C95-56D1-7AA1-BEF3-7863744F78C5.

Nikitinella tymensis Doweld, **sp. nov.**

≡ *Eoeuryale tymensis* Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 64. 1975 [‘1974’], nom. inval.

Description: Seeds 3.3–3.4 mm × 2.5–3.1 mm, ovoid to ellipsoidal, arillate; seed sculpturing smooth, exotestal cells minute, isodiametric, 3–6-gonal, cell walls thick, slightly curved.

Holotype: Dunaevsky Jar, Kompasskij Bor, Tym River, Tomsk region, Russian Federation (45/2-K518, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1975: plate 102, figure 5).

Geological age: Oligocene.

Fossil status: Seeds.

IFPNI registration LSID: 746396A4-71F1-1D3D-9271-B3DA6884066F.

RE-CLASSIFICATION OF *IRTYSHENIA, PSEUDOEURYALE* AND *PALAEOEURYALE*

Studying West Siberian nymphaealean fossil seeds, Dorofeev (1972) created three distinct fossil-genera, *Irtyshenia* Dorofeev 1972*, Pseudoeuryale* Dorofeev 1972*,* and *Palaeoeuryale* Dorofeev 1972. The base for these fossil-genera was a specialized archaic seed type with curved seed edge, lacking in the seed type of *Nikitinella* s.l. The seeds of extant *Euryale* mainly lacks this seed edge, although rudimentary remains of the seed edge might be noticed in *E. ferox* Salisb. (Dorofeev 1975). Later Dorofeev (1975) ascertained that the borders between these fossil-genera are 'not very strong', and both seed morphology, ultrasculpture and spermoderm anatomy constitute a single fossil seed type with variations in spermoderm layers and seed sculpturing, depending on the seed maturity. In this connection, three nearly similar fossil-genera *Irtyshenia* Dorofeev 1972*, Pseudoeuryale* Dorofeev 1972*,* and *Palaeoeuryale* Dorofeev 1972 are united into a single one, *Pseudoeuryale* Dorofeev emend. Doweld, s.l.:

Genus: ***Pseudoeuryale*** P.I. Dorof., Bot. Zhurn. (Moscow & Leningrad) 57: 1050. 1972 emend. Doweld, **emend. nov.**

= *Palaeoeuryale* P.I. Dorof., Bot. Zhurn. (Moscow & Leningrad) 57: 1052. 1972, syn. nov.

= *Irtyshenia* P.I. Dorof., Bot. Zhurn. (Moscow & Leningrad) 57: 1049. 1972, syn. nov.

Type species: *Pseudoeuryale dravertii* P.I. Dorof.

Pseudoeuryale akashiensis (Miki) Doweld, **comb. nov.**

≡ *Euryale akashiensis* Miki, Jap. J. Bot. 8(4): 315. 1937.

Lectotype (designated here): Nakayagi-Yagi, Akashi City, Hyogo Prefecture, Japan (F19692, Osaka Museum of Natural History, Osaka, Japan).

Geological age: Pliocene.

Fossil status: Seeds.

IFPNI registration LSID: 21ECFF27-CBB4-05A5-E372-50116B47AC88.

Pseudoeuryale carpatica (Szafer) Doweld, **comb. nov.**

≡ *Euryale carpatica* Szafer, Rozpr. Wydz. Mat.-Przyr. Polsk. Akad. Umiejętn., Dział B, Nauki Biol., Ser. 3, 32 [72] (2): 101 [263]. 1947.

Holotype: Krościenko nad Dunajcem, Powiat nowotarski, Województwo małopolskie, Poland (IB UJ 14/67, Instytut Botaniki im. W. Szafera, Polish Academy of Sciences, Krakow, Poland) – figured by Szafer (1947: plate 9, figures 9–12).

Geological age: Pliocene.

Fossil status: Seeds.

IFPNI registration LSID: 9FA72D91-F1EF-672C-7EB9-F9B356030A23.

Pseudoeuryale caucasica (Dorofeev) Doweld, **comb. nov.**

≡ *Palaeoeuryale caucasica* Dorofeev, Bot. Zhurn. (Moscow & Leningrad) 57: 1053. 1972.

Holotype: Left bank of Mzymta River, near Adler, Sochi, Krasnodar Territory, Russian Federation (1/2, coll. K-532 [532-1], Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1972: plate 1: 9; 1975: plate 107, figure 7).

Geological age: Pliocene.

Fossil status: Seeds.

IFPNI registration LSID: C51CF320-52BD-60B7-45F2-C31B737E7878.

Pseudoeuryale europaea (C.A. Weber) Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 68. 1975 ["1974"].

≡ *Euryale europaea* C.A. Weber, Ber. Deutsch. Bot. Ges. 25: 157. 1907.

≡ *Pseudoeuryale europaea* (C.A. Weber) Dorofeev, Bot. Zhurn. (Moscow & Leningrad) 57: 1053. 1972, comb. inval. (no basionym).

Neotype (designated here): Chekalin, Kaluga region, Russian Federation (1/3, coll. K-600, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1975: plate 108, figure 7 as '*Palaeoeuryale* sp.').

Geological age: Middle Pleistocene.

Fossil status: Seeds.

Pseudoeuryale lissa (C. Reid & E. Reid) Doweld, **comb. nov.**

≡ *Euryale lissa* C. Reid & E. Reid, Meded. Rijksopsp. Delftstof. 6: 88. 1915.

Holotype: Brunssum, Limburg province, The Netherlands ([not specified], Naturalis Biodiversity Center, Leiden, The Netherlands) – figured by C. Reid & E. Reid (1915: plate 7: 11).

Geological age: Pliocene.

Fossil status: Seeds.

IFPNI registration LSID: C1974FDA-7BD8-DF87-E6B5-AB2AE2B4D7F5.

Pseudoeuryale lusatica (Dorofeev) Doweld, **comb. nov.**

≡ *Irtyshenia lusatica* Mai, Tert. Res. 9: 91. 1988.

Holotype: Welzow near Spremberg/Lower Lusatia, Saxony, Germany (MMGD 4116, Coll. Mai, Senckenberg Naturhistorische Sammlungen Dresden, Abteilung Museum für Mineralogie und Geologie, Dresden, Germany) – figured by Mai (1988: plate 1: 11, 11a).

Geological age: Upper Miocene (Langhian).

Fossil status: Seeds.

IFPNI registration LSID: 8326A252-0BF5-AFAA-587C-8B0BE1CAE03E.

Pseudoeuryale mikiana Doweld, **sp. nov.**

= *Euryale lissa* Reid in Miki, J. Inst. Polytechn. Osaka City Univ., Ser. D, Biol., 11: 70, Figure 2 D, Figure 3 Bd, Plate 3 E-H. 1960 (typo excl.).

Description: Seeds elliptic, 6–7 mm long, 5–6 mm wide, usually arillate, hilum of raphe outside cap, testa with many layers 0.1–0.5 mm thick. Exotestal cells short, quadrangular in section, margin crenulate.

Holotype: Kowa Chita, Aichi Prefecture, Japan (F7399, F7311 (seed-coat), F7322 (seed-coat cross-section),Osaka Museum of Natural History, Osaka, Japan) – illustrated by Miki (1937: Plate 3 E-H).

Geological age: Pliocene.

Fossil status: Seeds.

IFPNI registration LSID: D1E10EB5-032C-08AC-8D88-6536CB53FBCD.

Pseudoeuryale nipponica Doweld, **sp. nov.**

= *Euryale europaea* C.A. Weber in Miki, J. Inst. Polytechn. Osaka City Univ., Ser. D, Biol., 11: 69, Figure 2 A, Plate 4 F-H. 1960 (typo excl.).

Description: Seeds ovate or round; 5–10 mm long, 5–7 mm wide, large hilum of raphe is separated from the cap. Testa multilayered, 0.6–0.8 mm thick, exotestal cells as high as wide, margin of membrane straight with large space, surface 6-gonal, convex, papilla lacking.

Holotype: Simokurada, Kanagawa Prefecture, Japan (F7499, Osaka Museum of Natural History, Osaka, Japan) – illustrated by Miki (1938: figure 7 H).

Geological age: Pliocene.

Fossil status: Seeds.

IFPNI registration LSID: 6410732C-B448-B8C5-21CF-FD7A58C1B794.

Pseudoeuryale sukaczevii (Dorofeev) Doweld, **comb. nov.**

≡ *Euryale sukaczevii* Dorofeev, Paleontol. Zhurn. 1959 (2): 128. 1959.

≡ *Palaeoeuryale sukaczevii* (Dorofeev) Dorofeev, Bot. Zhurn. (Moscow & Leningrad) 57: 1053. 1972.

Holotype: Lezhanka village, right bank of Irtysh river, Omsk region, Russian Federation (K521-19/2, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1959: plate 9: 28–31, text-figure 2 a–v; 1975: plate 107, figure 2).

Geological age: Miocene.

Fossil status: Seeds.

IFPNI registration LSID: D29D1C2A-A104-3684-9595-7A55A121F71E.

Pseudoeuryale tenuicostata (Dorofeev) Doweld, **comb. nov.**

≡ *Euryale tenuicostata* Dorofeev, Paleontol. Zhurn. 1959 (2): 130. 1959.

≡ *Irtyshenia tenuicostata* (Dorofeev) Dorofeev, Bot. Zhurn. (Moscow & Leningrad) 57: 1049. 1972.

Holotype: Lezhanka village, right bank of Irtysh river, Omsk region, Russian Federation (K521-20/5, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1959: plate 9: 32, 33, text-figure 3; 1975: plate 104, figure 5).

Geological age: Miocene.

Fossil status: Seeds.

IFPNI registration LSID: 8326A252-0BF5-AFAA-587C-8B0BE1CAE03E.

RE-CLASSIFICATION OF *NUPHAR* SECT. *NUPHARELLA*

The modern studies of the seed morphology and ultrastructure of extant species of the genus *Nuphar* (Yamada & al. 2001; Chen & al. 2004) revealed the prominent difference between the representatives of the extant *Nuphar* and fossil seeds putatively included in a distinct section of *Nuphar*, *Nupharella* Dorofeev (1975). They concluded that in all the modern *Nuphar* seeds examined, none has the features of sect. *Nupharella*. Elevating the fossil sect. *Nupharella* to the genus level has been considered (Chen & al. 2004), but never done. The current revision of *Nuphar* considers only modern species, and portrays two sections: sect. *Nuphar* and sect. *Astylus* (Padgett 1999; Padgett & al. 1999); sect. *Nupharella* is excluded into the genus of its own, *Paranuphar* Doweld gen. nov.

Genus: ***Paranuphar*** Doweld, **gen. nov.**

= *Nuphar* section *Nupharella* Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 74. 1975 ["1974"].

IFPNI registration LSID: FFB938EB-BE0D-7088-7D2B-94B1D85A378E.

Diagnosis: Seeds ovoid to ellipsoidal, foveolae deep, cap ovoid, often with a protrusion towards ventral side; hilum elongate, partially outside the cap, at the margin of apex, or elongate and raised, placed partly on the cap and partly below; spermoderm exotestal, exotesta consists of narrow and high cells, the secondary walls thickened in the upper parts, cell lumens droplet-shaped, resemble the outline of exotesta in *Brasenia* seeds.

Type species: *Paranuphar tavdensis* (Dorofeev) Doweld, comb. nov.

Paranuphar canaliculata (Dorofeev) Doweld, **comb. nov.**

≡ *Nuphar canaliculata* C. Reid & E. Reid, Meded. Rijksopsp. Delftstof. 6: 86. 1915.

Lectotype (designated by Dorofeev 1975: 79): Reuver (De Ruiver), The Netherlands (not specified, Institut royal des Sciences naturelles de Belgique, Bruxelles, Belgium) – figured by Reid & Reid (1915: plate 7: figure 1).

Geological age: Pliocene.

Fossil status: Seeds.

IFPNI registration LSID: 3A13B036-1212-A06B-BC89-28A25B14BC4E.

Paranuphar macrosperma (Dorofeev) Doweld, **comb. nov.**

≡ *Nuphar macrosperma* Dorofeev, Tret. Fl. Zap. Sibiri: 174, plate 27: 5, 6. 1963.

≡ *Nuphar macrosperma* Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 77.1975 [“1974”], nom. inval. (isonym).

Lectotype (designated by Dorofeev 1975: 77): Ebargul’skoe village, right bank of Irtysh River, Omsk region, Russian Federation (20/1-K527, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1963: plate 27: figure 6; 1975: plate 110, figure 10).

Geological age: Miocene.

Fossil status: Seeds.

IFPNI registration LSID: 70BA2C08-F49C-B364-10E0-09BFE0786858.

Paranuphar mozyrensis (Dorofeev) Doweld, **comb. nov.**

≡ *Nuphar mozyrensis* Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 77.1975 [“1974”].

Holotype: Borehole 75, 27 m depth, Mozyr’, Gomel’ region, Belarus(10/1-K491, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1975: plate 109, figure 7).

Geological age: Miocene.

Fossil status: Seeds.

IFPNI registration LSID: E494DA9F-13DC-ED81-B129-F63003CF7EB6.

Paranuphar tastachensis (Dorofeev) Doweld, **comb. nov.**

≡ *Nuphar tastachensis* Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 78. 1975 [“1974”].

Holotype: Tastakh Lake, between Indigirka and Khrom rivers, Yakutia (Saha) Republic, Russian Federation (1/2-K553, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1975: plate 109, figure 10).

Geological age: Eocene.

Fossil status: Seeds.

IFPNI registration LSID: EE885A86-A9CA-1DC7-4698-B86CAAFF7C0E.

Paranuphar tavdensis (Dorofeev) Doweld, **comb. nov.**

≡ *Nuphar tavdensis* Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 75. 1975 [“1974”].

Holotype: Belojarka village, right bank of Tavda River, Sverdlovsk region, Russian Federation (33/3-K511, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1975: plate 109, figure 3).

Geological age: Oligocene.

Fossil status: Seeds.

IFPNI registration LSID: 68C08020-75AA-755D-F20C-25B816D0356C.

Paranuphar tomskiana (Dorofeev) Doweld, **comb. nov.**

≡ *Nuphar tomskiana* Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 75. 1975 [“1974”].

Holotype: Rezhenka village, left bank of Bol’shaja Kirgizka River, Tomsk region, Russian Federation (24/1-K516, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1975: plate 109, figure 4).

Geological age: Oligocene.

Fossil status: Seeds.

IFPNI registration LSID: CBF839EE-D68A-591F-2057-706AC3A11453.

Paranuphar tymensis (Dorofeev) Doweld, **comb. nov.**

≡ *Nuphar tymensis* Dorofeev in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 77. 1975 [“1974”].

Holotype: Dunaevsky Jar, Kompasskij Bor, Tym River, Tomsk region, Russian Federation (44/1-K518, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Dorofeev (1975: plate 109, figure 8).

Geological age: Oligocene.

Fossil status: Seeds.

IFPNI registration LSID: 44415737-A19F-0105-E788-C1252D402B19.

Paranuphar wutuensis (L. Chen, Manchester & Z.-D. Chen) Doweld, **comb. nov.**

≡ *Nuphar wutuensis* L. Chen, Manchester & Z.-D. Chen, Amer. J. Bot. 91: 1266. 2004.

Holotype: Wutu village, Shandong Province, China (PEPB54164, Institute of Botany, Chinese Academy of Sciences, Beijing, China) – figured by Chen & al. (2004: plate 1 C, 3 A-C, E-F).

Geological age: Miocene.

Fossil status: Seeds.

IFPNI registration LSID: 8CFDBD9F-8F6D-D170-6E6A-5DEF90272585.

SYNONYMY OF *PALAEONYMPHAEA* AND *PANIA*

Recently Balueva & Nikitin (in Nikitin 2007) described a new fossil-genus *Pania* Balueva & V.P. Nikitin, based on the Upper Eocene (Priabonian) seeds from Western Siberia. However, the same, nearly identical seed type was described by Chandler (1962) from the Eocene sediments of England (Europe) as *Palaeonymphaea* Chandler. As a consequence, *Pania* is subsumed in the synonymy of *Palaeonymphaea*.

Palaeonymphaea prisca (Balueva & V.P. Nikitin) Doweld, **comb. nov.**

≡ *Pania prisca* Balueva & V.P. Nikitin, Paleokarp. Stratigr. Paleog. Neog. Aziatsk. Rossii: 57. 2007 [“2006”].

Holotype: Kljuchi railway station, Altaj Territory, Russian Federation (13-3/1, Coll. Ñò.52-28.223, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation [formerly Novosibirskgeologija, Novosibirsk, Russian Federation]) – figured by Nikitin (2007: plate 3, figure 6).

Geological age: Upper Eocene (Priabonian).

Fossil status: Seeds.

IFPNI registration LSID: EF0D8E1E-F20B-F108-F770-B0CECF45684C.

SYNONYMY OF *NUPHARIPOLLENITES* AND *NUPHARIPOLLIS*

Nagy (1969) first described a distinct fossil pollen genus *Nupharipollenites* E. Nagy for fossil dispersed pollen of the *Nuphar*-type. However, analogous fossil pollen genus *Nupharipollis* Krutzsch was established later by Krutzsch (1970), which upon priority should be synonymized with earlier *Nupharipollenites*, and all its fossil-species should be recombined.

Genus: ***Nupharipollenites*** E. Nagy, Magyar Állami Földt. Intéz. Évk. 52(2): 400. 1969.

= *Nupharipollis* Krutzsch, Atlas Mitt. Jungtert. Disper. Spor. Pollen Mitteleur. 7: 34. 1970, syn. nov.

Type species: *Nupharipollenites kedvesii* E. Nagy.

Nupharipollenites aculeatus (Kuprianova) Doweld, **comb. nov.**

≡ *Nuphar aculeata* Kuprianova, Probl. Bot. 4: 138. 1959.

Holotype: Ashutas Mountain, Eastern Cis-Zajsan, Kazakhstan (Specimen 3, 2113/554, leg. Ì. F. Neuburg 1927, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation) – figured by Kuprianova (1959: plate 2: 10, 11).

Geological age: Oligocene.

Fossil status: Dispersed pollen.

IFPNI registration LSID: E3A45620-6910-EC4A-B574-F7E47FB3782D.

Nupharipollenites echinatus (Krutzsch) Mohr, Palaeontographica, Abt. B, Paläophytol. 191: 65. 1984.

≡ *Nupharipollis echinatus* Krutzsch, Atlas Mitt. Jungtert. Disper. Spor. Pollen Mitteleur.7: 148. 1970.

Holotype: Rippersroda borehole 1–28/1 (4,6/101,3), Germany (Explate 4519 Ng. = VII/40/1-2, Bundesanstalt für Geowissenschaften und Rohstoffe, Mikropaläontologische Sammlung, Berlin, Germany) – figured by Krutzsch (1970: plate 40, figure 1–2).

Geological age: Upper Pliocene.

Fossil status: Dispersed pollen.

Nupharipollenites minor (Krutzsch) Doweld, **comb. nov.**

≡ *Nupharipollis minor* Krutzsch, Atlas Mitt. Jungtert. Disper. Spor. Pollen Mitteleur. 7: 150. 1970.

Holotype: Hohenvoos borehole 2/59-10107/2 (17,5/118,3), Germany (Explate 6586 Ng. = VII/41/1-2, Bundesanstalt für Geowissenschaften und Rohstoffe, Mikropaläontologische Sammlung, Berlin, Germany) – figured by Krutzsch (1970: plate 41, figure 1–2).

Geological age: Upper Miocene.

Fossil status: Dispersed pollen.

IFPNI registration LSID: C8E58EB7-FF72-80AA-E13B-0A404C033718.

Nupharipollenites parvus (Lubomirova) Doweld, **comb. nov.**

≡ *Nuphar parva* Lubomirova, Paleontol. Zhurn. 1967(3): 93. 1967.

Holotype: Un-Shakr-Yugan river, Kazym River basin, Khanty-Mansi Autonomous District, Russian Federation (prep. 203/1 (78,7 × 9,3), All-Russian Petroleum Research Exploration Institute (VNIGRI), St.-Petersburg, Russian Federation) – figured by Lubomirova (1967: plate 11, figures 14–16).

Geological age: Oligocene (Novomikhailovskaja suite).

Fossil status: Dispersed pollen.

IFPNI registration LSID: 9AF2E429-9A4A-154C-51F3-13D9D5E1B512.

HOMONYMS AND INVALID NAMES

Nuphar palfalvyana Doweld, **sp. nov.**

≡ *Nuphar palfalvyi* Bůžek & László, Folia Hist.-Nat. Mus. Matraensis 17: 54. 1992, nom. inval.(Turland et al. 2018, Art. 40).

Holotype: Visonta, northern Hungary (BK-5485, Magyar Földtani és Geofizikai Intézet, Budapest, Hungary) – figured by Bůžek & László (1992: plate 4, figures 1–5).

Geological age: Upper Miocene (Tortonian [Pannonian]).

Fossil status: Seeds.

Eponymy: In honour of István Pálfalvy, Hungarian palaeobotanist and geologist, discoverer of the fossils.

IFPNI registration LSID: DF39C62F-2C55-3968-1531-BCAAA5C7E805.

Remarks: The fossil-species *Nuphar palfalvyi* Bůžek & László was established on the fossil seeds from the Upper Miocene (Tortonian) = Pannonian sediments of northern Hungary (near Visonta). However, it is invalid name since the holotype was not designated (Turland et al. 2018, Art. 40), but 15 specimens were cited and inventorized under two collection numbers Nos BK-5485, BK-5539. The fossil-species is validated here.

Nuphar diatoma (MacGinitie) Doweld, **comb. nov.**

≡ *Nymphaea diatoma* MacGinitie, Publ. Carnegie Inst. Washington 416: 55. 1933.

≡ *Nymphaeites diatoma* (MacGinitie) C.A. Arnold, Contr. Mus. Paleontol. Univ. Michigan 5: 85. 1937.

Holotype: Trout Creek, Harney Co., Oregon, USA (# 590, Museum of Paleontology, University of California, Berkeley, USA) – figured by MacGinitie (1933: Plate 8, figure 1).

Geological age: Miocene.

Fossil status: Leaves [holotype only].

IFPNI registration LSID: 497C5B4F-2748-F46A-B92C-AEA9D4086609.

Remarks: MacGinitie (1933) published fossil-species, based on two specimens, rhizome (paratype) and leaf (holotype), with no organic connection. Accepting the holotype, which is a species of the genus *Nuphar*, the fossil-species is amended by restriction to the holotype only (excluded rhizomata) and therefore transferred to *Nuphar*.

Nymphaea knowltonii Doweld, **nom. nov.**

≡ *Nymphaea pulchella* LaMotte, Mem. Geol. Soc. Amer. 51: 230. 1952, nom. illeg. non *Nymphaea pulchella* De Candolle (1821: 51).

≡ *Castalia pulchella* Knowlton (1930: 94), nom.

illeg. non *Castalia pulchella* (De Candolle) Britton (1906: 138) (Turland et al. 2018, Art. 53.1).

Holotype: Dawson arkose, left bank of Jimmy Camp Creek 0.7 mile above Richfield Springs ranch house, about 9 miles east, of Colorado Springs, Colorado, USA (USNM P 37725 (National Museum of Natural History, Smithsonian Institution, Washington, USA) – figured by Knowlton (1930: Plate 57, Figure 3 & restoration: Plate 42, Figure 1).

Geologic age: Palaeocene (Denver Formation).

Fossil status: Leaves.

Eponymy: In honour of Frank Hall Knowlton (1860–1926), American palaeobotanist and geologist, discoverer of the fossils.

IFPNI registration LSID: F0930147-6758-CC9A-47AE-72673D0FA094.

Remarks: The peculiar nymphaeacean fossil foliage was initially described as a distinct fossil-species *Castalia pulchella* Knowlton (1930: 94) from the Palaeocene (Denver Formation) sediments of Colorado Springs, Colorado, USA. However, it is a later illegitimate homonym (Turland et al. 2018, Art. 53.1) of the previously validly published extant species *Castalia pulchella* (De Candolle) Britton (1906: 138). Since the extant genus *Castalia* Salisbury (1805: 71) is a nomenclatural synonym of earlier established *Nymphaea* Linnaeus 1753, Lamotte recombined the fossil-species in *Nymphaea*, *N. pulchella* LaMotte (1952: 230), being unaware of homonymic status of the fossil-species; therefore, it should be treated as a new replacement name, not a combination, since the resulted name was based on the homonym. However, in its turn, LaMotte's name is an again later illegitimate homonym (Turland et al. 2018, Art. 53.1) of the previously validly published extant species *Nymphaea pulchella* (De Candolle) Britton (1906: 138). Thus, the fossil-species *Nymphaea pulchella* LaMotte a" *Castalia pulchella* Knowlton is renamed here *Nymphaea knowltonii* Doweld, nom. nov.

Nymphaea nikitinii Doweld, **nom. nov.**

≡ *Nymphaea minuta* V.P. Nikitin, Paleokarp. Stratigr. Paleog. Neog. Aziatsk. Rossii ed. 2006: 56. 2007, nom. illeg. [Nikitin 1964: 129 – nom. nud.], non *Nymphaea minuta* Saporta (1891: 13; 1890: 191 – nom. nud.) nec *Nymphaea minuta* Landon, Edwards & Nozaic (2006: 887), nom. illeg. (Turland et al. 2018, Art. 53.1).

Holotype: Voronov Yar I, Ob river, Tomsk region, Russian Federation (3–1/3, Coll. Ob.56-B.Ya.I-2, Komarov Botanical Institute, Russian Academy of Sciences, St.-Petersburg, Russian Federation [formerly Novosibirskgeologija, Novosibirsk, Russian Federation]) – figured by Nikitin(2007: plate 2, figure 34).

Geologic age: Lower Miocene (Burdigalian).

Fossil status: Seeds.

Eponymy: In honour of Vadim Petrovich Nikitin (1932–2012), Russian (Soviet) palaeocarpologist and geologist, discoverer of the fossils.

IFPNI registration LSID: 6D06C024-4DAF-A6E9-482F-8E3793C0A8A1.

Remarks: The fossil-species *Nymphaea minuta* V.P. Nikitin (2007: 56; 1964: 129, nom. nud.) was established on the fossil seeds from Burdigalian (Lower Miocene) sediments of Western Siberia (Voronov Yar I, Ob' river, Tomsk region, Russian Federation). However, it is a later illegitimate homonym (Turland et al. 2018, Art. 53.1) of the previously validly published fossil-species *Nymphaea minuta* Saporta (1891: 13) and extant species *Nymphaea minuta* Landon, Edwards & Nozaic (2006: 887), recently renamed *Nymphaea dimorpha* I.M. Turner (2014: 308). The fossil-species *Nymphaea minuta* V.P. Nikitin is renamed here *Nymphaea nikitinii* Doweld, nom. nov.

EXCLUDED TAXA

'Amomum' europaeum

Nelumbo protonucifera Doweld, **nom. nov.**

≡ *Amomum europaeum* Kownas, Acta Soc. Bot. Poloniae 28(3): 463. 1959 [*Nelumbo europaea* Tarasevicz [in Kuprianova & Tarasevicz] Bot. Zhurn. (Moscow & Leningrad) 68(2): 142. 1983, preoccupied].

Holotype: Dobrzyń nad Wisłą, Kuyavian-Pomeranian Voivodeship, Poland (MZ VII/9/29bis A and MZ VII/9/29bis B (part/counterpart), Muzeum Ziemi, Polish Academy of Sciences, Warsaw, Poland) – figured by Kownas (1959: Plate 1: 1; 2: 1).

Geological age: Upper Miocene (Langhian [Badenian]).

Fossil status: Fruit receptacles.

IFPNI registration LSID: A47213F1-CCD5-CB64-FCD2-47B5E2285CC5.

Remarks: The fossil-species *Amomum europaeum* Kownas was established on the fossil infuctescences from the Upper Miocene (Langhian) = Badenian sediments of Poland (Dobrzyñ nad Wis[31]), Kownas thought that they resemble recent *Amomum* or *Etlingera* infructescences in shape and size. However, Kowalski (2016) re-examined all visible structures and concluded that these *A. europaeum* remains represent the horizontally flattened receptacle ('gynobase') of *Nelumbo*. Furthermore, he placed these peculiar receptacular fossil remains in the synonymy of the widespread European Tertiary fossil-species *Nelumbo protospeciosa* Saporta, which was originally based on fossil leaves (lectotype designated by Snigirevskaja 1975), along with associated rhizomata and fruit receptacles. However, no organic connection was established or proved for all these fossil remains, and therefore there are no grounds to unite leaf, rhizomata and fruit remains in a single fossil-species. As a consequence, the fruit remains are segregated in a distinct fossil-species, *N. protonucifera*, the new name is proposed due to the existence of preoccupied by *N. europaea* Tarasevicz (in Kuprianova & Tarasevicz 1983), based on the fossil pollen remains.

'Brasenia' antiqua

Genus: ***Brasenica*** Doweld, **gen. nov.**

IFPNI registration LSID: A64EB909-CB5E-DF40-153D-D1187B6CC242.

Diagnosis: Leaves relatively small, orbicularor somewhat elliptical, with a wavy margin, centrally peltate, the central disk is less prominent; petiole centrally inserted; primary veins numerous (12 to 18), appear equally strong, diverging somewhat irregularly from the centre, dichotomizing 1–several times, connected by cross-nervation, slightly angled or bent outward, especially near the margin.

Type species: *Brasenica dawsonii* (Hollick) Doweld, comb. nov.

Brasenica dawsonii (Hollick) Doweld, **comb. nov.**

≡ *Nelumbo dawsonii* Hollick, Bot. Gaz. (Crawfordsville) 21: 309. 1894.

≡ *Nymphaeites dawsonii* (Hollick) Dorf (1942: 142).

≡ *Brasenia antiqua* Dawson (1885: 15), nom. illeg. non *Brasenia antiqua* Newberry (1883: 514).

Neotype (designated here): West side of Wood Mountain Creek, Saskatchewan, Canada (GSC 7412, Geological Survey of Canada, Ottawa, Canada) – figured by Berry (1935: 36, Plate 7, figure 1).

Geological age: Maastrichtian (Upper Cretaceous: Whitemud Formation).

Fossil status: Leaves.

Eponymy: From *Brasenia*, extant genus and suffix *–ica* (plural suffix), plural form of *-icus* (singular suffix), of or pertaining to, connected with.

IFPNI registration LSID: 66D63F12-6D68-B665-771F-E27110A25777.

Additional fossil-species:

Brasenica laramiensis (Hollick) Doweld, **comb. nov.**

≡ *Nelumbo laramiensis* Hollick, Bot. Gaz. (Crawfordsville) 21: 307. 1894.

Holotype: Florence, Colorado, USA (YPM PB 011613, Yale Peabody Museum of Natural History, New Haven, USA) – figured by Hollick (1894: unnumb. figure ad p. 308).

Geological age: Maastrichtian (Upper Cretaceous: Laramie Group).

Fossil status: Leaves.

IFPNI registration LSID: 8DFC39EC-26EE-5BD7-EDCF-4F4F8A362494.

= *Nelumbo intermedia* Knowlton, Bull. U.S. Geol. Surv.163: 53. 1900, syn. nov.

Type: Point of Rocks, Wyoming, USA (not located, National Museum of Natural History, Smithsonian Institution, Washington, USA) – figured by Knowlton (1900: Plate XIII, figures 3–5).

Geological age: Campanian (Upper Cretaceous: Montana Formation).

Fossil status: Leaves.

= *Nelumbo primaeva* E.W. Berry, J. New York Bot. Gard. 3(9): 75. 1903, syn. nov.

≡ *Nelumbites primaevus* (E.W. Berry) E.W. Berry (1916: 841) ("*primaeva*").

Holotype: Cliffwood, Monmouth County, New Jersey, USA (USNM PAL 321590, National Museum of Natural History, Smithsonian Institution, Washington, USA) – figured by Berry (1903: Plate 43, figure 1).

Geological age: Campanian (Upper Cretaceous: Matawan Formation).

Fossil status: Leaves.

Brasenica weymouthii (Hollick) Doweld, **comb. nov.**

≡ *Nelumbo weymouthii* E.W. Berry, Proc. U.S. Natl. Mus. 82 (2953, Art. 12): 7. 1933 ("*weymouthi*").

Holotype: In the low bluff on the south side of the junction of Everly Creek and Fontanelle Creek and about 125 feet east of a north-south fence northwest of Kemmerer, Wyoming, USA (39145, National Museum of Natural History, Smithsonian Institution, Washington, USA) – figured by Berry (1933: plate 1, figure 1).

Geological age: Albian (Aspen Shale).

Fossil status: Leaves.

IFPNI registration LSID: 56E02086-CDBD-4A3F-3ECF-EFCB37F65173.

Remarks: The leaves of fossil-species are variable in venation: *Nelumbo dawsonii* from the Belly River series at Medicine Hat, Alberta, has 18 veins; *N. laramiensis* from the Laramie group at Florence, Colorado, USA has 12 veins, *N. intermedia* from the Montana group at Point of Rocks, Wyoming, USA has 12–13 veins, *Nelumbo primaeva* from Matawan Formation of New Jersey, USA has 8 veins. As such a variation in number of veins is of the same order as that in living species, Berry (1935) and Dorf (1942) thought there is a solid justification in regarding these small leaves as a single Upper Cretaceous species *N. dawsonii*. In contrast, Snigirevskaja (1964) considered that *N. dawsonii* and *N. laramiensis* (with synonyms *N. intermedia* and *N. primaeva*) are not conspecific. *N. weymouthi* from the Aptian of Wyoming, USA with leaves having centrally peltate attachment of 12 radiating veins that may form loops, but more often connected by percurrent third order veins, is treated as a distinct fossil-species.

'Brasenia' pliocaenica

Ceratophyllum pliocaenicum (Kinkelin) Doweld, **comb. nov.**

≡ *Brasenia pliocaenica* Kinkelin [in Engelhardt & Kinkelin], Abh. Senckenberg. Naturf. Ges. 29(3): 251, plate 32, figures 15 a–b. 1908.

Type (not located): Weilbach, Frankfurt am Main, Germany (Senckenberg Naturhistorische Sammlungen Frankfurt, Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt am Main, Germany) – illustrated by Kinkelin, l.c. plate 32, figures 15 a–b. 1908.

Geological age: Pliocene.

= *Ceratophyllum dubium* Kirchheimer (1956: 130), syn. nov.

≡ *Peucedanum dubium* R. Ludwig (1857: 103), nom. illeg. non *Peucedanum dubium* Ledebour (1829: 310).

Lectotype (designated here): Weckesheim, Wetteraukreis, Hessen, Germany (MB.Pb.2005/0352, Museum für Naturkunde, Berlin, Germany) – illustrated by Ludwig, l.c. plate 20: figure 3. 1857.

Geological age: Upper Miocene (Messinian).

Fossil status: Fruits.

IFPNI registration LSID: 8AD98113-C79E-4E6D-7B5C-9B156AD549EF.

Remarks: Kirchheimer (1956: 130) was unaware of the homonymy of the fossil and extant species *Peucedanum dubium* R. Ludwig (1857: 103) non *Peucedanum dubium* Ledebour (1829: 310) and inadvertently published a *nomen novum* on the base of the illegitimate homonymic species name. Thus, he proposed a resulted nomenclaturally superfluous species name, *Ceratophyllum dubium* Kirchh. nom. superfl., included in the synonymy, *Brasenia pliocaenica* Kink. (in Engelhardt & Kinkelin 1908: 251), the species epithet which ought to be taken up for these fossils upon priority.

'Nymphaeites' choffatii

Genus: ***Ceratopteridopsis*** Doweld, **gen. nov.**

IFPNI registration LSID: AD8B0FB6-DA16-4E34-F301-0D10DC5327BF.

Diagnosis: Leaves obovate, with an irregular serrate margin. Venation reticulate, lacking freely-ending veinlets. Leaf lamina with minute rounded scars (remains of sporangia) scattered over the veins; bulging structures (vegetative buds, not glands)on the leaf margin between the teeth.

Type species: *Ceratopteridopsis choffatii* (Saporta) Doweld, comb. nov.

Ceratopteridopsis choffatii (Saporta) Doweld, **comb. nov.**

≡ *Protorhipis choffatii* Saporta, Compt. Rend. Hebd. Séances Acad. Sci. Paris 113: 252. 1891

≡ *Nymphaeites choffatii* (Saporta) Teixeira, Brotéria, Ci. Nat. 16(43)(1–2): 9 [5]. 1947

≡ *Klitzschophyllites choffatii* (Saporta) B.A.R. Mohr, Bern.-de-Oliv., Barale & Ouaja, Cretac. Res. 27: 467. 2006.

Lectotype (designated here): Cercal, Portugal (22910, Museu Geológico, Laboratório Nacional de Energia e Geologia, Lisboa, Portugal) – illustrated by Saporta (1892: plate 27, figure 1).

Geological age: Aptian (Lower Cretaceous).

Fossil status: Leaves.

Eponymy: From *Ceratopteris* (extant genus) and *-oides*, similar.

IFPNI registration LSID: 007EA953-F05A-D26D-0AE4-437B7FE8AB35.

Klitzschophyllites exchoffatii Doweld, **sp. nov.**

= *Klitzschophyllites choffatii* (Saporta) B.A.R. Mohr, Bern.-de-Oliv., Barale & Ouaja, Cretac. Res. 27: 467. 2006, excl. typo.

Description: Leaves small, obovate, base and apex obtuse. Basal part of leaf margin entire; more than two-thirds of apical part serrate to apically dentate. Primary veins (15 to 25) entering leaf lamina and each branching into up to 5 (if any) secondary veins. Teeth (10 to 15) simple, becoming triangular equilateral and having sinuses angular to rounded toward leaf apex. Secondary veins (up to 4, if any) entering parallel through each tooth.

Holotype: Cercal, Portugal(MPZ 2007-2362, Museo Paleontológico, Universidadde Zaragoza) – illustrated by Gomez & al. (2009: figure 2A).

Geological age: Aptian (Lower Cretaceous).

Fossil status: Leaves.

Eponymy: From misapplied *Klitzschophyllites choffatii* and ex-, from.

IFPNI registration LSID: 298F55F0-BBE5-8A32-E69E-743B6E8BB693.

Remarks: Teixeira (1947) revised Aptian fossil foliage, previously described as a fern, *Protorrhipis choffatii* Saporta (1891), and included them in the fossil-genus of vegetative remains (rhizomata) *Nymphaeites* Sternb. ex Caspary (1857). Later Mohr & al. (2006) transferred the fossil-species to the extinct genus *Klitzschophyllites* Lejal-Nicol 1987 (the genus was not validly published by Lejal-Nicol 1981); in addition, authors suggested an affinity with monocots. Gomez & al. (2009) suggested that these fossils are related to the dicotyledonous order *Ranunculales*. However, in none of these studies was the original type materials from Cercal (Portugal) investigated; later interpretations were based on Teixeira's (1947) different materials from a different locality, Arnal (Portugal), who regarded fossils from Cercal and Arnal as conspecific. However, the fossil leaves from Cercal

clearly differ in shape and texture from the leaves from Arnal; they have unusual reticulate venation pattern that lacks freely-ending veinlets characteristic for angiosperms. Friis et al. (2009) reported that the leaf-blade had minute rounded scars that were interpreted as remains of sporangia scattered over the veins, bulging structures on the leaf margin between the teeth were re-interpreted as vegetative buds rather than previously understood as glands. In consequence, this re-interpretation allows debunking any previously suggested affinity with monocots, *Ranunculales* or *Nymphaeites*, and relating the fossils with aquatic ferns of *Ceratopteris*-type. Therefore, I segregated this enigmatic fossil-species in the distinct fern fossil-genus *Ceratopteridopsis* gen. nov. The fossil foliage, misapplied and previously described as "*Klitzschophyllites choffatii*" (Saporta) B.A.R. Mohr, Bern.-de-Oliv., Barale & Ouaja (type excluded), is segregated in a new fossil-species, *Klitzschophyllites exchoffatii* Doweld, sp. nov.

'Nelumbites arcticus'

Genus: ***Serenopsis*** Hollick, Bull. Torrey Bot. Club 20: 169. 1893, emend. Doweld, **emend. nov.**

Type species: *Serenopsis kempii* Hollick.

Serenopsis arctica (Heer) Doweld, **comb. nov.**

≡ *Nelumbo arctica* Heer, Fl. Foss. Arct. 6 (Abth. 2): 92. 1882.

≡ *Nelumbites arcticus* (Heer) I.V. Lebedev, Trudy Sibirsk. Nauchno-Issled. Inst. Geol., Geofiz. & Miner. Syr. 22(1): 255. 1962, nom. inval. (no basionym).

≡ *Nelumbites arcticus* (Heer) Budantsev, Istor. Arkt. Fl. Rann. Kajnof. 54. 1983, nom. inval. (no basionym).

Holotype: Igdlokunguak, Greenland (not located, Natural History Museum of Denmark, Geological Museum, Copenhagen, Denmark) – illustrated by Heer (1882: plate 40, figure 6).

Geological age: Santonian (Upper Cretaceous).

Fossil status: Leaves.

IFPNI registration LSID: 571BD1D3-3796-DF28-40F4-11C3E74BC5F2.

= *Serenopsis kempii* Hollick, Bull. Torrey Bot. Club 20(4): 169. 1893, **syn. nov.**

≡ *Nelumbo kempii* (Hollick) Hollick, J. New York Bot. Gard. 3(31): 412. 1904.

≡ *Nelumbites kempii* (Hollick) I.V. Lebedev, Trudy Sibirsk. Nauchno-Issled. Inst. Geol., Geofiz. & Miner. Syr. 22(1): 255. 1962, nom. inval. (no basionym).

Lectotype (designated here): Glen Cove, Long Island, Nassau County, New York, USA (PB.011509.A, Yale Peabody Museum of Natural History, New Haven, USA) – figured by Hollick (1900: plate cxlix).

Geological age: Campanian (Upper Cretaceous: Magothy Formation).

Fossil status: Leaves.

Remarks: Hollick (1893) established the new monotypic fossil-genus *Serenopsis* based on the distinctive fossil foliage from the Upper Cretaceous (Campanian) sediments of Long Island, New York, USA and interpreted it as a palm foliage. Later he revised his interpretations and placed the fossils in extant genus *Nelumbo* (Hollick 1904). The placement of the fossils in extant *Nelumbo* was questioned (Snigirevskaja 1964); Lebedev (1962) incorrectly referred the monotypic genus *Serenopsis* and its sole fossil-species to the fossil-genus *Nelumbites* E.W. Berry (1911), infringed the rule of priority, since the latter fossil-genus was established later than *Serenopsis* in 1893. Since *Nelumbites* has no relationships with *Nelumbo*-like fossils, and should be referred to *Menispermales* s.l., the fossil-genus *Serenopsis* is reinstated for the distinctive Upper Cretaceous foliage. Knowlton (1930) and Snigirevskaja (1964) considered previously validly published fossil-species *Nelumbo arctica* Heer (1882) as a senior synonym of *Serenopsis kempii*, and the formal recombination is validated here.

'Nelumbo' puertae

Genus: ***Notolumbo*** Doweld, **gen. nov.**

IFPNI registration LSID: 3EA16935-D9D0-120C-F23A-DAF194B32015.

Diagnosis: Leaves simple, centrally peltate, orbiculate with entire margin; actinodromous, ca 12 primary veins diverging regularly from the center of the lamina, bifurcating at least once, and forming festooned brochidodromous archs; secondary veins poorly developed, intercalated with the primary veins; veins of third and fourth order opposite percurrent; areoles 4–5-sided; marginal ultimate venation looped, freely ending ultimate veins unbranched to 1–branched.

Type species: *Notolumbo puertae* (Gandolfo & Cúneo) Doweld, comb. nov.

Notolumbo puertae (Gandolfo & Cúneo) Doweld, **comb. nov.**

≡ *Nelumbo puertae* Gandolfo & Cúneo, Rev. Palaeobot. Palynol. 133: 172, Plate IA. 2005.

Holotype: Cañadón del Irupé, Mirasol Chico Creek, Los Altares (4369-IV), Chubut Province, Patagonia, Argentina (MPEF-Pb-Mz 864-A and B, Museo Paleontologico Egidio Feruglio, Trelew, Argentina).

Geological age: Campanian (Cretaceous).

Fossil status: Leaves.

Eponymy: From Ancient Greek íüôïò (nótos) "south" and *Nelumbo*, (extant genus).

IFPNI registration LSID: 78339037-5120-3582-F016-6EBDB5215F25.

Remarks: Gandolfo and Cuneo (2005) described the distinctive fossil foliage as *Nelumbo puertae* Gandolfo & Cuneo from the Campanian-Maastrichtian LaColina Formation of Patagonia, Argentina. This fossil-species differsfrom the extant genus *Nelumbo* in lacking a central disk and in havingreticulate tertiary and higher order venation and quadrangulararеolation. Since *N. puertae* cannot be placed in the the extant genus *Nelumbo* upon the differences in leaf structure, it should be excluded from *Nelumbo* in the fossil-genus of its own.

Genus: ***Notolumbites*** Doweld, **gen. nov.**

IFPNI registration LSID: 67C82754-EDDC-50E5-8032-BBA3345CF8D5.

Diagnosis: Fruit receptacles conical, 2.5 cm long and 1.1–1.5 cm indiam., the distal flat portion of the receptacle bearing 5–14 fruits [preserved like protuberances], which are surroundedby the thick wall of the receptacle. The wall of the receptacle produces a rim surrounding the fruits, each fruit is entrenched into a single cavity and therefore separated from each other. The fruits rounded to oblong, having a small aperture at the top.

Type species: *Notolumbites pabloanus* Doweld, sp. nov.

Notolumbites pabloanus Doweld, **sp. nov.**

Holotype: Cañadón del Irupé, Mirasol Chico Creek, Los Altares (4369-IV), Chubut Province, Patagonia, Argentina (MPEF-Pb-Mz 914, Museo Paleontologico Egidio Feruglio, Trelew, Argentina) – illustrated in Gandolfo and Cuneo (2005: plate 2, figure A).

Paratypes: MPEF-Pb-Mz 903, 920 (Museo Paleontologico Egidio Feruglio, Trelew, Argentina) – illustrated in Gandolfo and Cuneo (2005: plate 2, figures B, C respectively).

Geological age: Campanian (Cretaceous).

Fossil status: Fruit receptacles.

Eponymy (genus): From Ancient Greek íüôïò (nótos) "south" and *Nelumbo*, (extant genus).

IFPNI registration LSID: 558EE5E9-4A27-8047-4DE3-EEF9870171BB.

Eponymy (species): In honour of Pablo Puerta, Argentinean palaeontologist and explorer.

Remarks: Gandolfo and Cuneo (2005) found and illustrated floral receptacles in association with the fossil leaves of *Notolumbo puertae*. While these fossil remains are clearly similar to the floral receptacles of extant *Nelumbo*, they differ drastically in having a cylindrical, rather than obconic shape, and pits on the floral receptacle that occur on both the distal surface and the sides, rather than just on the distal surface, as in extant *Nelumbo*. It is clear that these fossil receptacles belong to an enigmatic extinct taxon, which is characterized by the unique combination of characters,

viz. the cylindrical shape of the fruit receptacle and the occurrence of fruits on both the distal and lateral surfaces of the fruit receptacle. This combination of characters places the fossils outside the extant lineage of *Nelumbo*. Since the fossil leaf and fruit materials were found only in association, and therefore there is no strong proof that they were produced by the same extant plants, the leaf and fruit fossils are placed in distinct fossil-genera.

'Nelumbites minimus'

Genus: ***Asiolumbo*** Doweld, **gen. nov.**

IFPNI registration LSID: CE4DAD67-06D7-CAE1-7700-7F7A0335F282.

Diagnosis: Leaves peltate, oval to rounded, with a crenate margin, apex sinuate, petiolate, petiole inserted in the basal half of the lamina. Venation radial, camptodrome; veins 6–7, thin, curved, twice to three times dichotomizing; main veinlet well differentiated, running to the apex, veins running downwards ill-defined, no bifurcations.

Type species: *Asiolumbo minima* (Vachrameev) Doweld, comb. nov.

Asiolumbo minima (Vachrameev) Doweld, **comb. nov.**

≡ *Nelumbites minimus* Vachrameev, Reg. Stratigr. SSSR 1: 183, plate 12, figure 5.1953 ("1952").

Holotype: Kyzyl-Shen, S Chushkakul', western Kazakhstan [formerly USSR] (3302/397, Geological Institute, Russian Academy of Sciences, Moscow, Russian Federation).

Geological age: Albian (Lower Cretaceous).

Fossil status: Leaves.

Eponymy: From *Asia*, name of the continent and *Nelumbo*, extant genus.

IFPNI registration LSID: 09F3FC69-B5B1-4813-DA26-C64A1D407C90.

Remarks: Vachrameev (1953) described the distinctive fossil foliage named as a distinct fossil-species *Nelumbites minimus* Vachrameev from the Albian of Kazakhstan, Central Asia (formerly the USSR). This fossil-species differs from the extant genus *Nelumbo* in lacking a central disk and in having reticulate tertiary and higher order venation and quadrangular areolation. Since *N. minimus* cannot be placed in the the fossil-genus *Nelumbites* upon the differences in leaf structure and venation with its type species, *N. virginiensis* (Fontaine) E.W. Berry, it should be excluded from *Nelumbites* in the fossil-genus of its own.The relationships with *Nelumbonaceae* are superficial, these Asian fossils represent perhaps the previously unrecognized endemic Asian fossil-genus.

Genus: ***Omsukchania*** Doweld, **gen. nov.**

IFPNI registration LSID: C43B785D-C2D1-5C0F-17DD-44591F8861CF.

Diagnosis: Stems thin, leafy; leaves peltate, minute, oval to oval to almost orbicular, with smooth or slightly undulate margins, the petiole attached to the lower surface of the leaf, not far from the lower margin, thin (less than 0.5 mm wide), up to 12 mm long. Venation palmate, camptodromous, veins indistinct, thin, generally 7 to 9 primaries, radiating from the top of petiole to the margin; the median primary straight, non-dichotomizing and gives off 2 or 3 pairs of secondaries; 2 or 3 primaries not dichotomizing, running downwards; the remaining veins divide dichotomously one to three times close to margin.

Type species: *Omsukchania samylinae* Doweld, sp. nov.

Omsukchania samylinae Doweld, **sp. nov.**

'*Nelumbites* aff. *minimus*' Vachrameev; Samylina (1968: 208; 1976: 82).

Holotype: Between Lesnoj Creek and Geologicheskij Creek, Sugoj River Basin, Omsukchan, Magadan region, Russian Federation (# 511/10, Komarov Botanical Institute, Russian Academy of Sciences, S.-Petersburg, Russian Federation) – illustrated in Samylina (1968: plate 1, figures 14, 15; text-figure 1D).

Geological age: Lower Cretaceous (Albian: Toptanskaja suite).

Fossil status: Leafy stems.

Eponymy: In honour of Valentina Alexeevna Samylina (1930–2002), eminent Soviet (Russian)

palaeobotanist, discoverer of the enigmatic fossils.

IFPNI registration LSID: 4BDDACB5-4E88-A29B-7E7B-13677FAEF45A.

Remarks: Samylina (1968, 1976) described very peculiar leafy stems from the Russian Far East (Omsukchan, Magadan Region, Russian Federation). She found that in size, outline and venation the leaves described much resemble those of *Nelumbites minimus* Vachr. from the Middle Albian deposits of Western Kazakhstan (Vachrameev 1953). However, the resemblance is only superficial since the main distinguishing character of the Far Eastern leaves is a greater number of primary veins and, accordingly, a lesser angle between them. This main venation character precludes the affinity with *Nelumbites minimus* Vachr. and makes them more like *Nelumbites tenuinervis* (Font.) E.W. Berry from the Albian (Patapsco Formation) of the Atlantic coast, U.S.A., which is treated as incertae sedis in *Nelumbites* or even a candidate for a distinct generic basket (Upchurch & al. 1994). Samylina (1968, 1976) also recorded poorly preserved 'reproductive' remains (not organically connected with leaves), thought to be a receptacle ('impression of an inversely conical, accrescent receptacle with fruits inside, like those of *Nelumbo*'), but its preservation is too poor for definite judgments on even what kind of plant organ is in reality, so her supposition that this is an 'impression of the female structure' is untenable.

Genus: ***Paralumbo*** Doweld, **gen. nov.**

IFPNI registration LSID: 5FA3EA49-F3F0-63BE-EAD3-DBA44BB69D03.

Diagnosis: Leaves suborbicular, 12 cm in diameter, margin slightly undulate; petiole stout. Primary veins 22–26 in number, radiating from the center of leaf, and forking uniformly and dichotomously two or three times with angles of 30–50°; first fork usually at about 1–3 cm from the center of leaf lamina; midvein distinct. Areolation fine, forming numerous regular hexagonal and pentagonal meshes and rarely rhombic forms.

Type species: *Paralumbo amurensis* (Kryshtofovich ex Snigirevskaja) Doweld, comb. nov.

Paralumbo amurensis (Kryshtofovich ex Snigirevskaja) Doweld, **comb. nov.**

≡ *Nelumbo amurensis* Kryshtofovich ex Snigirevskaja in Takhtajan, Iskop. Tsvetk. Rast. SSSR 1: 88. plate 31: figures 1–3.1975 ["1974"]; Kryshtofovich & Baikovskaja (in Baikovskaja 1951: 363, nom. nud.) & Kryshtofovich (in Kryshtofovich & Baikovskaja 1966: 252, plate 7, figure 6, nom. inval. [sine typo].

Holotype: Tsagayan mountain, Bureya River, Amur region, Far East, Russian Federation (87/6363 ["217/6363"], Central Scientific-Research Geological Exploration Museum after S. N. Chernyshev (CNIGR Museum), All-Russian Geological Institute (VSEGEI), St.-Petersburg, Russian Federation).

Geological age: Danian.

Fossil status: Leaves.

Eponymy: From Ancient Greek παρά (pará, "beside; next to, near, from") and [previously erroneously attributed] *Nelumbo*, extant genus.

IFPNI registration LSID: 0BCE5170-7F64-F828-1CE4-6B4A24DA0BFC.

Additional fossil-species:

Paralumbo orientalis (Matsuo) Doweld, **comb. nov.**

≡ *Nelumbo orientalis* Matsuo, Trans. & Proc. Palaeontol. Soc. Jap., New Series 14: 157, plate 20. 1954.

Holotype: Sarao, Kami-Ikeda-mura, Imadate-gun, Fukui Prefecture, Japan (10018 a, b [part/counterpart], Kanazawa University, Faculty of Science, Department of Geology, Kanazawa, Japan).

Geological age: Upper Cretaceous (Maastrichtian = Sarao Formation).

Fossil status: Leaves.

IFPNI registration LSID: 212861D1-D7AC-6A80-9F56-2D25FE14F7BE.

Paralumbo jiayinensis (F. Liang, G. Sun & T. Yang) Doweld, **comb. nov.**

≡ *Nelumbo jiayinensis* F. Liang, G. Sun & T. Yang [in F. Liang, G. Sun, T. Yang & S.-C. Bai], Cretac. Res. 84: 135, figure 3. 2017.

Holotype: East hill of Yong'ancun village, Jiayin, Heilongjiang, China (YX-B-300, Paleontological Museum of Liaoning, [PMOL], Shenyang, China).

Geological age: Upper Cretaceous (Santonian = Yong'ancun Formation).

Fossil status: Leaves.

IFPNI registration LSID: 37EC6C3E-08B6-6987-F264-E5F1331B12F1.

Remarks: When Kryshtofovich (in Baikovskaja 1951; Kryshtofovich & Baikovskaja 1966) described *Nelumbo amurensis* from the then thought Upper Cretaceous (Danian) sediments of the Russian Far East (Amur region), he was unaware of the analogues, similar fossil-species *Nelumbo orientalis* Matsuo (1954), described from the older Upper Cretaceous (Maastrichtian) sediments of now Japanese Archipelago. Both fossil-species are similar in venation, except for midvein differentiation in the Russian fossil-species, and constitute a quite distinct group from extant *Nelumbo*. Snigirevskaja (1964, 1975) was also of opinion that these fossil-species were arbitrarily assigned to the genus *Nelumbo*. The recently described Chinese fossil-species *Nelumbo jiayinensis* from the older Cretaceous sediments (Santonian) of NW China (Heilongjiang) is distinct by the lamina size and the larger angles of the radial veins than in *Paralumbo orientalis*.

Genus: ***Ovczinnikovia*** Doweld, **gen. nov.**

IFPNI registration LSID: 33531F86-FC4E-33D2-F80C-92D4ACBFFDA5.

Diagnosis: Leaves peltate, oval, margin slightly undulate; petiole thick, excentric. Primary veins36in number, up to 15 cm long, radiating from the center of leaf, forking dichotomously three times; first fork usually at about 5.5–8(1) cm from the center of leaf lamina. Central veins a few, distinct, running upwards from the rachis.

Type species: *Ovczinnikovia bactriana* (Ovcz.) Doweld, comb. nov.

Ovczinnikovia bactriana (Ovcz.) Doweld, **comb. nov.**

≡ *Nelumbo bactriana* Ovcz. [in Ovczinnikov & Zakharov], Ahboroti Akad. Fan. RSS Toçikiston, Šû'bai fan. hoç. ķisloķ biol. 1960 2(3): 43. 1961.

Holotype: Balçuvon (Baldzhuan), right bank of Kyzyl-Su River, south-western Tajikistan [formerly USSR] (s/n, Institute of Botany, Academy of Sciences of Tajikistan, Dushanbe, Tajikistan).

Geological age: (?)Middle Miocene (Khingousian suite).

Fossil status: Leaves.

Eponymy: In honour of Pavel Nikolaevich Ovczinnikov (1903–1979), eminent Soviet (Russian) botanist and florist, discoverer of the enigmatic fossils.

IFPNI registration LSID: F1B58766-8D4D-54EC-A37B-EF1A25CF5CDA.

Remarks: Ovczinnikov (in Ovczinnikov & Zakharov 1961) referred the peculiar leaf type to *Nelumbo* from the Tajik depression, an intermountain depression surrounded by Ghissar Range, Ghissar-Alaj, Pamir and Hindukush of Tien Shan. He realized that the fossil leaf type is distinct from all extant and known fossil forms of *Nelumbo* by excentric petiolate leaf with numerous veins (36) and distinct several central veins running upwards to the apex of the leaf. These characters preclude the possibility to refer this fossil to *Nelumbo* at all (Snigirevskaja 1964, 1975); the putative alternative relationship of the leaf may be with *Arecaceae*.

Genus: ***Nelumbago*** McIver & Basinger ex Doweld, **gen. nov.**

≡ *Nelumbago* McIver & Basinger, Palaeontogr. Canad. 10: 33. 1993.

IFPNI registration LSID: ACF63549-3A62-5E79-4A11-048C2111D590.

Diagnosis: Leaves orbiculate to suborbiculate, centrally peltate; margin entire. Venation actinodromous;

primary veins more than 10, radiating from centre, commonly dichotomizing near middle of leaf, arching and joining adjacent primary, forming series of loops distally; tertiary veins moderate, orthogonal reticulate.

Type species: *Nelumbago montana* (R.W. Brown ex A.D. Watt) McIver & Basingerex Doweld, comb. nov.

Nelumbago montana (R.W. Brown ex A.D. Watt) Doweld, **comb. nov.**

≡ *Nelumbo montana* R.W. Brown ex A.D. Watt, Taxon 20: 640. 1971 ("*Nelumbium montanum*").

≡ *Nelumbo montana* R.W. Brown, Profess. Pap. U.S. Geol. Surv. 375: 69. 1962 ("*Nelumbium montanum*"), nom. inval. (no type).

≡ *Nelumbago montana* (R.W. Brown) McIver & Basinger, Palaeontogr. Canad. 10: 33. 1993, comb. inval.

Holotype: In North Dakota, 3 miles north of Watauga, S. Dakota, USA (U.S.N.M. 167498, National Museum of Natural History, Smithsonian Institution, Washington, USA) – illustrated by Brown (1962: plate 35: figure 4).

Geological age: Paleocene (Fort Union Formation).

Fossil status: Leaves.

IFPNI registration LSID: F473004E-2B53-B105-B3A0-CC04F9540649.

Remarks: McIver and Basinger (1993) created a new fossil-generic name for the Palaeocene fossil leaves the peculiar leaf type related formerly to *Nelumbo* from Rocky Mountains of USA. Unfortunately, they overlooked that the type species of their new fossil genus, *Nelumbo montana* R.W. Brown (1962: 69), was invalidly published due to the lack of necessitated type designation in 1962. Authors overlooked that Watt (1971: 640) validated Brown's fossil-species. Therefore, their new *Nelumbago* McIver & Basinger, nom. inval., and *N. montana* (R.W. Br.) McIver & Basinger (1993: 33), comb. inval., were both invalidly published. A validation of *Nelumbago* is presented here.

Genus: ***Nelumbophyllites*** Doweld, **gen. nov.**

IFPNI registration LSID: DF3AC577-3F08-34FA-4567-AF1C9ECD7491.

Diagnosis: Leaves small, peltate, oval, margin slightly undulate; petiole thick, excentric. Primary veins (7-8)13-15in number, radiating from the center of leaf, forking dichotomously several times.

Type species: *Nelumbophyllites tenuifolius* (Lesq.) Doweld, comb. nov.

Nelumbophyllites tenuifolius (Lesq.) Doweld, **comb. nov.**

≡ *Nelumbo tenuifolia* Lesquereux, Rep. (Annual) U.S. Geol. Geogr. Surv. Territ. 1873, 7: 402. 1874.

Lectotype (designated by Knowlton 1930: 92): Sand Creek, Colorado, USA(USNM P 392, National Museum of Natural History, Smithsonian Institution, Washington, USA) – illustrated by Lesquereux (1878: plate 46, figure 3).

Geological age: Paleocene (Denver Formation).

Fossil status: Leaves.

IFPNI registration LSID: 4C543C67-CDFF-0CAF-93D9-3787E4A0E5E6.

= *Nelumbo lakesiana* Lesquereux, Rep. (Annual) U.S. Geol. Geogr. Surv. Territ. 1873, 7: 403. 1874.

Lectotype (designated here): Golden, Colorado, USA (USNM P 370, National Museum of Natural History, Smithsonian Institution, Washington, USA) – illustrated by Lesquereux (1878: plate 46, figure 1).

Geological age: Paleocene (Denver Formation).

Fossil status: Leaves.

Nelumbophyllites crossii (Knowlt.) Doweld, **comb. nov.**

≡ *Nelumbo crossii* Knowlton, Profess. Pap. U.S. Geol. Surv. 155: 93. 1930.

Holotype: Dawson arkose, lower part, 3,000 feet. east of the Douglas coal mine, Sedalia, Colorado, USA (USNM P 37793, National Museum of Natural History, Smithsonian Institution, Washington, USA) – illustrated by Knowlton (1930: plate 41, figure 3).

Geological age: Maastrichtian (Arapahoe Formation).

Fossil status: Leaves.

IFPNI registration LSID: 7A714111-4DB6-3A3F-8A3C-C1D7E84629FF.

Remarks: The fossil-generic name *Nelumbites* E.W. Berry, was absolutely unfortunate, since it does not necessarily imply any ancestral relationship to extant *Nelumbo*. Moreover, Berry (1916) explicitly concluded that this fossil foliage genus has no relationships at all with even *Nelumbonaceae*, having affinity with *Menispermales* s.l. In this connection, there is a need to have a distinct leaf fossil-genus for *Nelumbo*-like foliage, which could not be definitely included in extant genus *Nelumbo*. McIver & Basinger (1993) emphasized that along with Palaeocene fossil-genus *Nelumbago* there is a distinct phylad of Palaeocene Nelumbo of *N. tenuifolia*, *N. lakesiana* and *N. crossii*. I segregated these fossil-species into a separate fossil-genus *Nelumbophyllites* gen. nov., which replaced the former artificial denomination *Nelumbites*, misapplied to *Nelumbo*-like leaves.

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