A review of the nomenclature of *Gyrogona* and *Gyrogonites* (Fossil Algae: Charophyceae)

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**INTRODUCTION**

The distinctive charophycean reproductive organs from the Tertiary (Lower Oligocene [Rupelian]) deposits of France were first formally described by Lamarck (1801: 401) as fossil remains of an incompletely known mollusk named *Gyrogonites medicaginulus* because of its resemblance to the fruit of *Medicago sativa* (lucerne). The gyrogonites were shown to be fossilized charophycean reproductive structures by Leman in 1812, now understood as calcified female gametangia preserved after the escape or the decomposition of protoplasmic material. Differences in the starting date of zoological nomenclature (1 January 1758) and that of plant fossils (1 January 1820) are resolved by Art. 45.1 of the botanical code, by which *Gyrogonites* is acceptable as a validly published pre-1820 fossil charophycean name even though it was originally treated as a fossil animal. *Gyrogona* Lam. (1805) is a superfluous renaming of *Gyrogonites* (still considered at that time as a zoological name for a mollusk) and therefore should be rejected under the botanical and zoological codes. The inclusion of the type of *Gyrogonites* in the later established fossil higher-plant genus *Bechera* Sternb. (1825), a repository genus for vegetative verticillate axes and reproductive organs, renders the latter genus name as nomenclaturally superfluous and illegitimate. Six fossil species of *Gyrogonites* are validated for the first time, 19 species and related 2 subspecies of *Gyrogona* are formally recombined into *Gyrogonites*. Two names, *G. lemani* and *G. oehlertii*, are neotypified, and a lectotype is designated for *G. wrightii*. Precise dates of publication of the taxonomic works on gyrogonites of Bowdich, Brongniart, Fleming, Lamarck and Parkinson, supplementing records of *Taxonomic literature II*, are given for the first time.

**THE STATUS OF GYROGONITES**

A solution to the uncertainty lies in an appreciation of the differences between the botanical (*ICN*, McNeill & al., 2012) and zoological (*ICZN*, Ride & al., 1999) codes of nomenclature. *Gyrogonites* was initially described as a fossil animal (mollusk) in 1801. Because zoological nomenclature of all taxa of animals, fossil and extant, begins with the 10th edition of Linnaeus’s *Systema Naturae*, arbitrarily dated 1 January 1758 (Art. 3, *ICZN*), the generic name *Gyrogonites* is an available name in zoological nomenclature. According to the botanical code, the nomenclature of all fossils except diatoms begins with the first volume of Sternberg’s *Flora der Vorwelt* (1820–1838), dated arbitrarily 31 December 1820 (Art. 13.1f, *ICN*). Had *Gyrogonites* been described as a fossil plant rather than a fossil animal its publication by Lamarck in 1801 would not have been valid and instead valid publication would have dated to Bowdich (1822: 16) and not Lamarck (1822: 613) as many have incorrectly concluded (e.g., Horn af Rantzien 1956; Singh, 1980; Feist & al., 2005). Resolution of these differences is provided by Art. 45.1 of the *ICN*, which states “If a taxon originally assigned to a group not covered by this Code is treated as belonging to the algae or fungi, any of its names need satisfy only the requirements of the relevant other Code that the author was using for status
equivalent to valid publication under this Code [...]” At present, Art. 45.1 does not exempt the starting points (Art. 13.1), and perhaps, we may indeed want to see a modification of Art. 45.1 to see such cases like *Gyrogonites/Gyrogona* to be illustrative in examples as none of the seven examples under Art. 45.1 covers such a situation. In the International Fossil Plant Names Index (IFPNI, 2014–), a recently launched global registry of fossil plant names, *Gyrogonites* is the only case where a fossil generic name, now applied to a fossil algal taxon, was validly published and treated as a fossil animal prior to 1820, *ICN*’s starting point for fossil nomenclature (Art. 13.1f). After 31 December 1820, the *ICN* starting point for plant fossils, *Gyrogonites* was still considered by Bowdich (1822) as a fossil animal (not plant or algae). Should we take this place of valid publication of the zoological taxon for the purposes of botanical nomenclature, this would be a direct infringement of Art. 45.1, which proscribed the needs to “satisfy only the requirements of the relevant other Code”, since Bowdich’s taxon is actually a later isonym of Lamarck’s 1801 name and hence as such has no standing in zoological nomenclature in which this taxon has been generated. At present Art. 45.1 does not allow one to accept later isonyms under the zoological code as validly published names for the purposes of botanical nomenclature. I can see no serious disadvantages for current botanical nomenclature to accept the original places of valid publication of former animal fossils under the zoological code prior to the *ICN* 1820 starting point for some exceptional algal (not plant) fossils. In sum, *Gyrogonites* and the included species *G. medicaginula* were validly published by Lamarck (1801: 401) and are the earliest validly published names for this fossil taxon. Note that according to Art. 62.4 of the *ICN*, a generic name ending in -*ites* is to be treated as masculine regardless of the gender assigned to it by its author (Lamarck treated *Gyrogonites* as feminine), so that the species epithet should be “medicaginulus” rather than “medicaginula”.

### The Status of Gyrogona

Lamarck introduced *Gyrogonites* in 1801 as a fossil taxon that he presumed was also extant (i.e., non-fossil). Nonetheless he did not provide any evidence of the existence of an extant organism. Thus, *Gyrogonites* was introduced as a name for a fossil (i.e., not extant) organism. Later, he (1805, 1822) introduced the name *Gyrogona*, accompanied by a Latin diagnosis, and included within the new genus the previously validly published “*Gyrogonites medicaginula*”. These attempts by Lamarck to emend *Gyrogonites* to *Gyrogona* reflect his continued belief that the organism was extant (the ending -*ites* is typically reserved for fossil taxa in zoological nomenclature). Lamarck’s inclusion of only “*Gyrogonites medicaginula*” within *Gyrogona* when he introduced the latter name indicates that *Gyrogona* must be treated as an emendation of *Gyrogonites*, but not as an alternative generic name from which one might choose a preferred name. Horn af Rantzien (1956: 248) believed, “If a choice between these names must be made, the latter [*Gyrogonites*] should, logically, be preferred because of the indissoluble attachment of the generic name to its generic type, nomenclaturally the basic element.” Lamarck (1822: 614) disagreed with opponents who re-interpreted these fossils as plant remains (“Quelques personnes prétendent même que ce corps fossile n’est qu’une graine d’une plante aquatique, ce que je ne puis croire”); he continued to think that any extant mollusk might be found for which he proposed the name *Gyrogona*. Since Lamarck lost his eyesight around 1820, no further examination of these fossils by him was possible. This putative “extant” form was never found, and *Gyrogona* as such is merely a hypothetical name with no standing in zoological nomenclature at all (*ICZN*, Art. 1.3.1). As such *Gyrogona* cannot be treated as available (= validly published) under the *International Code of Zoological Nomenclature*. In some cases in zoological nomenclature, when the fossil name with suffix -*ites* was applied to fossils to distinguish them from extant members of that taxon, the termination -*ites* in generic names might be changed (deleted) from the whole or the stem of an available name of a genus (*ICZN*, Art. 20, example: fossil *Pectinites* Schlotheim, 1813: 92, 103, 112, vs. extant *Pecten* Müller, 1776: 248). But in 1801 there was no validly published (= available in zoology) generic name for extant form since the extant form was not known (found). In this connection, reverse transformation of *Gyrogonites* into *Gyrogona* was not possible (available) under the zoological code. Names that are not unavailable under the *ICZN* might not be treated as valid under the *ICN* (Art. 45), since such names did not “satisfy only the requirements of the relevant other Code”. Under the *ICN*, *Gyrogona* would be an illegitimate superfluous renaming of *Gyrogonites* (Art. 52.1), as under *ICZN*, this must be enforced as the provisions of Art. 45.1 limited to using the *ICZN* rules for valid publication and do not extend to the legitimate illegitimate status.

### Modern Confusion of Gyrogonites and Gyrogona

A modern treatise on fossil charophytes by Feist & al. (2005: 125) incorrectly interpreted the nomenclature of these fossils. They listed “*Gyrogona Lam. (1822)*” as the place of valid publication of the genus, presumably based on the assumption that the name was not validly published in 1801 or 1805 as those publications predated the starting point for fossil plant names. *Gyrogona Lam*. (1805) was strangely treated as a nomen nudum in spite of the fact that Lamarck provided a full description and even illustrations in that publication; perhaps, authors were taking the name as a nomen invalidum because it was published prior to the *ICN*’s 1820 starting point for plant fossils? The authors did not cite Lamarck (1801), as did previously specialists on fossil charophytes (Grambast, 1956; Horn af Rantzien, 1956; Singh, 1980).

In addition, the neotype proposed for *Gyrogona medicaginula* by Feist & al. (2005: 125) was ineffective because the
institutional deposition of the specimen illustrated was not provided (ICN, Art. 9.22), and authors overlooked the earlier choice of Nötzold (1976: 121) who effectively designated a neotype using a different specimen.

Finally, two suprageneric names derived from the illegitimate (unavailable in zoological nomenclature) Gyrogonites, tribe Gyrogonoideae Grambast (1956: 280) and subfamily Gyrogonoideae Zhen Wang (Z. Wang, 1978a: 67), as well as tribe Brachychareae Grambast (1956: 335), based again on the illegitimate and nomenclaturally superfluous generic name Brachychara Grambast & N.Grambast (1954: 666), should be also rejected as illegitimate. No suprageneric names derived from the correct generic name Gyrogonites were formed. Since in modern classification of charophytes (Doweld, 2005; Feist & al., 2005) both names, Gyrogonoideae and Gyrogonoideae, are synonyms of extant Nitellopsideae Doweld and Charoideae S.F.Baird respectively, the necessity of the formation of correct suprageneric entities derived from the base of the legitimate generic fossil name (Gyrogonites) does not exist.

Had anyone used ICN’s 1820 starting point for plant fossils (only if the modern version of ICN would be modified in further), Gyrogonites and its sole species G. medicaginulus, were both first validly published by Bowdich (16–23 Feb 1822) as a zoological name for extinct shells prior to Lamarck (9 Sep 1822), as it has been erroneously accepted in modern palaeoalgalogy (Horn af Rantzien, 1956; Singh, 1980; Grambast & Grambast-Fessard, 1981; Feist & al., 2005: 125), than either Brongniart (1822a–d), as it has been treated in an old authoritative treatise on fossil Charophytes (Groves, 1933: 24), Fleming (Jun 1822: 434) or Parkinson (Jul 1822: 170). The presumably first use of Gyrogonites after ICN’s 1820 starting point for plant fossils, as again zoological name, was found in Fleming’s Philosophy of zoology (10 Jun 1822, 2: 434); and since it was published later than Bowdich’s treatise with Gyrogonites (16–23 Feb 1822), it has no standing for nomenclatural purposes at all; its type is Gyrogonites medicaginulus (Lam. ex Bowdich) Bronn (1824: 49), Chara medicaginula (Lam. ex Bowdich) Brongn. (20 May 1822a: 616) was also published before Lamarck’s publication of G. medicaginulus (9 Sep 1822), nevertheless it was evidently published after Bowdich’s (16–23 Feb 1822) publication of G. medicaginulus.

■ BECHERA, A SUPERFLUOUS NAME FOR GYROGONITES

French cryptogamist Léman’s (1812) demonstration that Lamarck’s material of Gyrogonites were not mollusk remnants but rather calcified charophycean reproductive structures was widely accepted by botanists (Léman, 1817; Vaucher, 1821; Brongniart, 1822a–e, 1823; Brongniart, 1822a–e, 1823, 1825; Prévost, 1826) but not zoologists (Desmarest, 1812: 353; Bronn, 1824: 49; Lamarck, 1822: 613). Sternberg, perhaps unaware of Léman’s revelation that a gyrogonite was a fossil charophycean reproductive structure, proposed the genus Bechera Sternb. (Sternberg, 1825: xxx) to accommodate fossil plant remains of various primarily articulate and secondarily verticillate vegetative structures as well as reproductive structures termed “carpolithes” (i.e., gyrogonites represented by three species previously described as Chara L. and Gyrogonia [= Gyrogonites]). It is noteworthy that Sternberg diagnosed axes only for Bechera, with no mention of its fructification in the description. Among the species included in Bechera was Gyrogonites medicaginulus (as Bechera medicaginula (Lam.) Sternb.; Sternberg 1825: xxxi). The inclusion of G. medicaginulus, shown above to be the type of the earlier generic name Gyrogonites, thus rendered Bechera a superfluous and hence illegitimate name (ICN, Art. 52.1), automatically typified by the type of Gyrogonites (Art. 7.5). Thus, the selection by Andrews (1955: 116) of B. ceratophyloides Sternb. as the type of Bechera has no standing.

This incorrect interpretation of the generic type of Bechera resulted in the formal proposal (Vogellehner, 1967; cf. Stafleu & Voss, 1969: 104; Stafleu & Voss, 1972: 125; Voss, 1973: 153) and accepted listing of Bechera as a nomen rejiciendum under Asterophyllites Brongn. (nom. cons.) in the ICN Appendix. However, at present the nomenclatural reason for the inclusion of the illegitimate Bechera in Appendix III F of the ICN is lost. It is worth noting that Bechera has largely disappeared from the systematic and palaeobotanical literature, having been little used since Bronn (1838: 846) when fossil species based on foliage were synonymized with fossil Asterophyllites Brongn., but gyrogonites were considered as fossil charophycean remains with no relationships with fossil higher articulate plants.

■ GYROGONITES TAXONOMY

When Gyrogonites was restored in charophycean systematics by Pia (in Hirmer, 1927), he recombined ca. 60 species of former fossil species of Chara into Gyrogonites. Grambast (1956; in Grambast & Grambast-Fessard, 1981) restricted the genus to 8 fossil species, excluded other species into different genera of fossil Charophyta. Newly described fossil species of Gyrogonites after Pia (1927), being associated with the invalidly published generic name (Rao & Rao, 1939; Horn af Rantzien, 1959; Feist-Castel, 1972; Musacchio, 1972; Castel, 1972; Z. Wang, 1978a, b; S. Wang & al. 1978; Grambast & Grambast-Fessard, 1981; Lu & Luo, 1990; Tang & Di, 1991; Liu, 1992; Zhamangara & Lucas, 2003), were re-classified and transferred into Gyrogonites; 6 former fossil species of Gyrogonites were validated as new Gyrogonites since their authors failed to provide necessitated holotype designation, and these names remained over a long time invalidly published. Lecto- and neotypification of some old Gyrogonites fossil species were also provided for the first time. All new nomenclatural acts were registered through a pilot registration version in the International Fossil Plant Names Index (IFPNI, 2014– [http://fossilplants.info/about]), with unique registration persisting barcodes (LSIDs) listed under each newly proposed fossil plant taxon.


Species circumscription (after Grambast in Grambast & Grönhart-Fessard, 1981, modified):


Note. – Since the locus classicus in the outskirts of Paris (Saint-Ouen, Seine-Saint-Denis) is inaccessible at present, being occupied by buildings, a neotype is designated from the analogous sediments of different geographical point.


**Gyrogonites shannanicus** Doweld, sp. nov. – “Gyrogona shannanensis” Zhen Wang in Xizang Gushengwu 5: 194. 1982, nom. inval. (sine holotypo indic.) – Holotype: Longgahe, Qusong County, Xizang (Tibet), China; Oligocene (Luobusha Group) (PB 7294, Nanjing Institute of Geology and Palaeontology, Nanjing, China [figured in Z. Wang in Xizang Gushengwu 5: pl. 1, fig. 13. 1982]). IFPNI: 5644CA41-CA1B-40CF-9322-DB62B65191E3.

Gyrogonites oblate spheroid to ovoid; apex wide and flat, base slightly bulged, the terminal flat, 656–787 µm long and wide, with the maximal width at slightly over the middle part. Spiral cells depressed or slightly bulged, often with the suture on the inter-ridges. Spiral rings 9 in number on lateral view, 82–98 µm wide, becoming narrow at the apical periphery; depression on the apical periphery very wide, and cells on the apical centers forming short tubercle enations. Bottom holes pentagonal, outer holes 82–148 µm wide; bottom plugs inverted trapezoidal in a longitudinal profile, upper 131 µm wide, lower 66 µm wide and 66 µm thick. Lateral walls 98–113 µm thick, microstratification indistinct, oolemma up to 22 µm thick. [Modified from Z. Wang, 1982.]


**Gyrogonites wubaoensis** Doweld, sp. nov. – “Gyrogona wubaoensis” Zhen Wang & X.D.Lin in S. Wang & al., Jiangsu Diqiu Baiei-Disiji Lunzao Huashi: 24. 1982, nom. inval. (sine holotypo indic.) – Holotype: Jiangdu County, Jiangsu Province, China; Palaeocene (Taizhou Formation) (PB 5656, Nanjing Institute of Geology and Palaeontology, Nanjing, China [figured in S. Wang & al., Jiangsu Diqiu Baiei-Disiji Lunzao Huashi: pl. 10, fig. 1a–c]). IFPNI: 30DB05D8-A64C-4C73-BD16-49EDA7356B47.

**Gyrogonites xindianensis** (Zhen Wang) Doweld, *comb. nov.*


### TAXONOMIC LITERATURE: ADDENDA

In connection with this nomenclatural analysis, a historical-bibliographic study was conducted to determine the exact dates of Brongniart’s and Lamarck’s publications on gyrogonites, lacking in *Taxonomic literature II*, as well as palaeontological and zoological treatises of 1822 in which the use of *Gyrogonites* or *Gyrogonina* were noticed.

**Bowdich.** — The exact date of publication of Bowdich’s *Elements of conchology* (16–23 Feb 1822), published in Paris in English, has been established from the weekly records of newly published books in France, *Bibliographie de la France* 11: 125. 23 Feb 1822 (the range of dates [16–23 Feb 1822] reflecting the interval between the issuance of consecutive numbers).

**Brongniart.** — The sequence of publication of several Brongniart’s (1822a–e) works were obtained from various sources in order to correctly reconstruct their exact appearance in print and to compare them as for priority with competing Bowdich’s (1822), Lamarck’s (1822) and Parkinson’s (1822) treatises. Brongniart’s *Sur la classification et la distribution des végétaux* has been published in two parts in the journal *Mémoires du Muséum d'Histoire naturelle, Paris*, vol. 8, in Cahier (= Part) 3, pp. 203–240 (25 May–1 Jun 1822) and Cahier 4, pp. 297–348 (21–28 Sep 1822), and as a separate offprint of 91 pp. (24 Jun 1822) which combined first and second part into one single publication, which was published ahead the publication of the second part of his work in the above-mentioned journal (28 Sep 1822). Dates were established via dates of registration of newly published books and serials in France by weekly records in *Bibliographie de la France* 11: 339. 25 May–1 Jun 1822 & 11: 591. 21–28 Sep 1822 (the range of dates reflecting the interval between the issuance of consecutive numbers). The documented date of the earliest appearance of the offprint was obtained from the archival date of presentation of the work to the French Academy at its session on that day (Procès-verbaux des séances de l'Académie tenues depuis la fondation de l’Institut jusqu’au mois d’aout 1835. Hendaye: Impr. de l’observatoire d’Abbadia, 7: 339. 1916: “préstentes”). The exact date of publication of Brongniart’s initial short contribution “Végétaux fossiles des terrains de Paris” to Cuvier’s *Recherches sur les ossemens fossiles* was established from the archival date (20 May 1822) of Cuvier’s presentation of the published work (vol. 2(2)) to the French Academy at its session on that day (Procès-verbaux des séances de l'Académie tenues depuis la fondation de l’Institut jusqu’au mois d’aout 1835. Hendaye: Impr. de l’observatoire d’Abbadia, 7: 328. 1916: “Cuvier présente”); his full work “Description des végétaux fossiles du terrain de sédiment supérieur, cités dans la description géologique du bassin de Paris” was published later (1 Jul 1822) as it was established again from the archival date of Cuvier’s presentation of the published next volume to the French Academy at its session on that day (Procès-verbaux des séances de l’Académie tenues depuis la fondation de l’Institut jusqu’au mois d’aout 1835. Hendaye: Impr. de l’observatoire d’Abbadia, 7: 345. 1916: “Cuvier présente”). These dates are different from offered Publisher’s intension (advertisement) to publish vol. 2(2) on 20 Apr 1822, and vol. 3 on 30 Apr 1822 respectively (*Bibliographie de la France* 11: 209. 6 Apr 1822); however, the exact publication of both volumes was later, and no documentary records are available to confirm these planned Publisher’s dates, otherwise, all official bibliographic records were later (*Bibliographie de la France* 11: 346. 8 Jun 1822 & 22: 411. 6 Jul 1822, respectively).

**Fleming.** — The precise date of publication of Fleming’s *Philosophy of zoology* (10 Jun 1822) in Edinburgh has been obtained from the dates of publications via Publisher’s advertisement in the newspaper *The Caledonian Mercury* (No. 15722, p. 1: “this day is published”, 10 Jun 1822), published daily in Edinburgh, which is confirmed as published in June of 1822 in the publishing records of Peddie & Waddington’s *The English catalogue of books, 1801–1836* (p. 208).

**Lamarck.** — The exact date of publication of Lamarck’s *Système des animaux sans vertèbres* (1801) has been established from the weekly records of newly published books in France, *Journal typographique et bibliographique* 4: 130. 30 Pluviôse (20 Jan)–5 Nivôse (25 Jan) (1801) (the range of dates reflecting the interval between the issuance of consecutive numbers [20–25 Jan 1801]). The exact date of publication of Lamarck (1805) has been established from the monthly lists of newly published books and serials in France for only February of 1805 (*Journal général de la littérature de France* 8: 34. Feb 1805), although the date was often erroneously ascribed to 1804. The precise date of publication of Lamarck’s *Histoire naturelle des animaux sans vertèbres* (1822) has been obtained from the date of presentation (9 Sep 1822) of the printed copy to the session of the Academy of Sciences in Paris on that day (Procès-verbaux des séances de l’Académie tenues depuis la fondation de l’Institut jusqu’au mois d’aout 1835, 7: 365. 1916: “L’Académie reçoit”); this is confirmed in later weekly records of all newly published books in France, *Bibliographie de la France* 22: 569. 21 Sep 1822.
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LITERATURE CITED


