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Taxonomy and nomenclature of the Conjugatophyceae (= Zygnematophyceae)

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The conjugating algae, an almost exclusively freshwater and extraordinarily diverse group of streptophyte green algae, are referred to a class generally known as the Conjugatophyceae in Central Europe and the Zygnematophyceae elsewhere in the world. Conjugatophyceae is widely considered to be a descriptive name and Zygnematophyceae ('Zygnemophyceae') a typified name. However, both are typified names and Conjugatophyceae Engler ('Conjugatae') is the earlier name. Additionally, Zygnemophyceae Round is currently an invalid name and is validated here as Zygnematophyceae Round ex Guiry. The names of orders, families and genera for conjugating green algae are reviewed. For many years these algae were included in the 'Conjugatae', initially used as the equivalent of an order. The earliest use of the name Zygnematales appears to be by the American phycologist Charles Edwin Bessey (1845-1915), and it was he who first formally redistributed all conjugating algae from the 'Conjugatae' to the orders Zygnematales and the Desmidiaceae. The family Closteriaceae Bessey, currently encompassing *Closterium* and *Spinoclosterium*, is illegitimate as it was superfluous when first proposed, and its legitimization is herein proposed by nomenclatural conservation to facilitate use of the name. The genus *Debarya* Wittrock, 1872 is shown to be illegitimate as it is a later homonym of *Debarya* Schulzer, 1866 (Ascomycota), and the substitute genus name *Transeauina* Guiry is proposed together with appropriate combinations for 13 species currently assigned to the genus *Debarya* Wittrock. The relationships between *Mougeotia*, *Mougeotiopsis*, *Mougeotiella*, and *Transeauina* require further resolution, as do many of the other genera referred to the Conjugatophyceae. Type species are designated for genera for which no types were formally selected previously. The number of currently described species of conjugating green algae in AlgaeBase is about 3,500, comprising about 10% of all algal species, with about one third of species referred to the Zygnematales and two-thirds to the Desmidiaceae. A corresponding 10% of all algal names at the species level and below have been applied to conjugating algae, although a large proportion of these are at the infraspecific level.

Key Words: Closteriaceae; Desmidiaceae; desmids; *Transeauina*; Zygnematales; Zygnematophyceae new class

INTRODUCTION

The conjugating green algae comprise an almost entirely freshwater group of streptophyte organisms many of extraordinary beauty. Other than the blue-green and red algae, they are unique in possessing no flagellated reproductive bodies and indeed any flagella at all, and they

lack centrioles suggesting that any putative flagella were not secondarily lost in the course of evolution. They are also unique amongst the algae in "internalizing" reproduction using a method of exchanging genetic material long known as conjugation (from the Latin verb *conju-*

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gare, to unite). This highly specialised reproductive feature is clearly a homoplasy otherwise known only in some groups of bacteria (genetic exchange in these bacteria is via a plasmid) and a phylum of fungi (the Zygomycota). Despite the seemingly advanced character of conjugation in the Conjugatophyceae, these algae actually have poorly differentiated gametes with the cell contents becoming only slightly modified and generally fusing entirely. The specialised gametes of other algae have not evolved, perhaps because there is no necessity for such modifications as the gametic material is not released and does not have to swim to or attract a partner.

In the course of collating published information on the

Conjugatophyceae for AlgaeBase (Guiry and Guiry 2013), it became apparent that there were unresolved problems associated with the nomenclature of the included algae at the class, family and genus level, and in the designation of types for genera (see Table 1 for summary of classification to generic rank). These essentially nomenclatural difficulties have the potential to create taxonomic complications now that molecular taxonomy is being increasingly applied to the conjugating algae (see McCourt et al. 2000 and Gontcharov 2008 for reviews, Park et al. 1996, Denboeh et al. 2001, Gontcharov et al. 2003, Hall et al. 2008, Kim et al. 2012).

Table 1. A classification of the orders, families and genera of Conjugatophyceae (= Zygnematophyceae) with a list of genera of uncertain placement

Order / Family	Genera
Zygnematales	
Mesotaeniaceae	<i>Ancylonema</i> Berggren, <i>Cylindrocystis</i> Meneghini, <i>Geniculus</i> Prescott, <i>Mesotaenium</i> Nägeli, <i>Netrium</i> (Nägeli) Izigshon & Rothe in Rabenhorst, <i>Nucleotaenium</i> Gontcharov & Melkonian, <i>Planotaenium</i> Petlovany & Palmar-Mordvinsteva, <i>Roya</i> West & G. S. West, <i>Spirotaenia</i> Brébisson, <i>Tortitaenia</i> A. J. Brook
Zygnemataceae	<i>Debarya</i> Wittrock, <i>Lloydina</i> Ahmad & Goldstein, <i>Mougeotia</i> C. Agardh, <i>Mougeotiella</i> T. Yamagishi, <i>Mougeotiopsis</i> Palla, <i>Neozygnema</i> T. Yamagishi, <i>Sangirellum</i> A. K. Mahato & P. Mahato, <i>Sirocladium</i> Randhawa, <i>Sirogonium</i> Kützing, <i>Spirogyra</i> Link, <i>Temnogametum</i> West & G. S. West, <i>Temnogyra</i> I. E. Lewis, <i>Trigonum</i> A. K. Mahato & P. Mahato, <i>Zygnema</i> C. Agardh, <i>Zygnemopsis</i> (Skuja) Transeau, <i>Zygonium</i> Kützing
Desmidiales	
Closteriaceae	<i>Closterium</i> Nitzsch ex Ralfs, <i>Spinoclosterium</i> C. Bernard
Desmidiaceae	<i>Actinotaenium</i> (Nägeli) Schellenberg, <i>Allorgeia</i> Gauthier-Lièvre, <i>Amscottia</i> Grönblad, <i>Bambusina</i> Kützing ex Kützing, <i>Bourrellyodesmus</i> Compère, <i>Brachythea</i> Gontcharov & M. Watanabe, <i>Cosmarium</i> Corda ex Ralfs, <i>Cosmocladium</i> Brébisson, <i>Croasdalea</i> Bicudo & Mercante, <i>Crucianguelum</i> D. B. Williamson, <i>Desmidium</i> C. Agardh ex Ralfs, <i>Docidium</i> Brébisson ex Ralfs, <i>Euastridium</i> West & G. S. West, <i>Euastrum</i> Ehrenberg ex Ralfs, <i>Groenbladia</i> Teiling, <i>Haplotaenium</i> Bando, <i>Heimansia</i> Coesel, <i>Hyalotheca</i> Ehrenberg ex Ralfs, <i>Ichtyocercus</i> West & G. S. West, <i>Ichthyodontum</i> A. M. Scott & Prescott, <i>Mateola</i> R. Salisbury, <i>Micrasterias</i> C. Agardh ex Ralfs, <i>Octacanthium</i> (Hansgirg) Compère, <i>Onychonema</i> Wallich, <i>Oocardium</i> Nägeli, <i>Phymatodocis</i> Nordstedt, <i>Pleurotaeniopsis</i> (Lundell) Lagerheim, <i>Prescottella</i> Bicudo, <i>Raphidiastrum</i> Palamar-Mordvintseva, <i>Sphaerosozma</i> Ralfs, <i>Spinocosmarium</i> Prescott & A. M. Scott, <i>Spondylosium</i> Brébisson ex Kützing, <i>Staurastrum</i> Meyen ex Ralfs, <i>Staurodesmus</i> Teiling, <i>Streptonema</i> Wallich, <i>Teilingia</i> Bourrelly, <i>Tetmemorus</i> Ralfs ex Ralfs, <i>Triplastrum</i> Iyengar & Ramanathan, <i>Triploceras</i> J. W. Bailey, <i>Vincularia</i> K. Fuciková & J. Kastovsky, <i>Xanthidium</i> Ehrenberg ex Ralfs
Gonatozygaceae	<i>Genicularia</i> De Bary, <i>Gonatozygon</i> De Bary
Peniaceae	<i>Penium</i> Brébisson ex Ralfs
Uncertain placement	<i>Astrocosmium</i> Stockmayer, <i>Baccinellula</i> H. Weyland [fossil], <i>Closterimopsis</i> L. M. Yin & Z. P. Li [fossil], <i>Desmidopsis</i> L. M. Yin & Z. P. Li [fossil], <i>Didymidium</i> Reinsch, <i>Paleospiralis</i> Edhorn [fossil], <i>Phycastrum</i> Kützing ex Kützing, <i>Phycoleda</i> Itzigsohn, <i>Polysolenia</i> Ehrenberg ex Kützing, <i>Schizospora</i> Reinsch, <i>Spirogyrites</i> V. B. Shukla [fossil], <i>Spirotaenia</i> Brébisson ex Ralfs, <i>Stenixys</i> T. M. Harris [fossil]

See text for authorities of orders and families.

OBSERVATIONS

The “type method”

A cornerstone of nomenclature and taxonomy is a simple (but frequently ignored or misconstrued) enabling principle, the “type method.” Thus every name has a type and the purpose of this type is, as clearly set out for algae by Silva (1952, p. 241 *et seq.*), is to provide stability, essential for effective communication, the *raison d'être* of taxonomy. The *International Code of Nomenclature for Algae, Fungi and Plants* (“Melbourne Code”; McNeill et al. 2012, hereafter referred to as the “Code”), formerly the *International Code for Botanical Nomenclature*, provides rules, agreed by the International Botanical Congresses (see Nicolson 1991 for a history of the various botanical codes), which should be followed by those working with algae, fungi and plants, and which are designed to provide stability.

Silva (1952, p. 241) likens names to: “boards in our nomenclatural structure, and like boards they must be nailed in place...”. In some geographical areas and in other languages, the word “board” may not be fully understood. A board for the purposes of this metaphor is a thin, flat piece of wood or other stiff material affixed to a wall or other flat surface. Roofing slates or shingles could also be used metaphorically. It should perhaps be strongly emphasized that fixing names by types has a taxonomic as well as a nomenclatural function. Thus, “drastic changes in [taxonomic] circumscription” (Silva 1952, p. 241) can be avoided by the proper application of the type method. Silva also emphasizes that “...driving a single nail through a board [by nominating a type] restricts rather than eliminates movement of that board; it may still be rotated, the nail acting as a pivot.” It should be stressed that the fixity provided by this single nail is critical for stability of the whole nomenclatural-taxonomic edifice. It should also be stressed that the metaphorical nail can be applied to any part of the board and not necessarily to the centre or any particular part.

That said, the Code is, like many a legal system, arcane and difficult for the neophyte; even with years of experience, it can be a minefield for the unwary.

Application of the Code to the Conjugatophyceae

The application of the Code to the Conjugatophyceae requires one to tread very carefully to avoid potential mines. In some languages the term “mine” may not be clear; a mine is a floating or buried explosive device, ef-

fective because of its danger to the unwary. A major mine is apparent in a Code-defined limitation of the principle of priority in Article 13.1 by which a “later starting-point” is set as Jan 1, 1848 for the “Desmidiaceae s.l.” (*sensu lato*; meaning in the broad sense), designating Ralfs’s *British Desmidiaceae* (Ralfs 1848, the date of publication of which is artificially designated as Jan 1) as the starting point for valid publication of desmid names. It should be stressed here that this later starting-point applies to all desmids, both saccoderm (the family Mesotaeniaceae of the Zygnematales) and placoderm (all families of the Desmidiaceae). The application of the Code-defined later starting point to the desmids renders all pre-starting-point names nomenclaturally invalid, and these are sporadically referred to as “devalidated” names. Unfortunately, it is not universally appreciated that such devalidated names cannot be used under the Code either as a current name or the basionym of such a name. While the later starting-point dates for algae were introduced with the best of intentions, the widespread lack of understanding of the correct application of the provision has resulted perhaps in more confusion than if these did not exist (see John et al. 2011b).

Another, perhaps less sensitive for the conjugating algae, “mine” is enshrined in Article 7.10: “For purposes of priority ... designation of a type is achieved only if the type is definitely accepted as such by the typifying author, if the type element is clearly indicated by direct citation including the term ‘type’ (typus) or an equivalent, and, on or after Jan 1, 2001, if the typification statement includes the phrase “designated here” (*hic designatus*) or an equivalent.” The specific difficulty here is the necessity to include a particular wording after Jan 1, 2001, and this is compounded by the fact that it is not entirely clear what “an equivalent” might be, so it is better to err on the side of caution and to accept before and after Jan 1, 2001 only an indication of a *selection* process and not merely a listing. While the indication of a type in the older literature by the use of the word “type” or “typus” is clearly sufficient to designate a type, the subsequent designation of a lectotype needs to be more deliberate than the mere use of the word “type”. Accordingly, I have chosen not to regard the listing in a table of a binomial under the heading “Type species” in Gerrath (1993, Table 1) and Gontcharov (2008, Table 1) as an active lectotypification as there is no evidence of a selection process.

Article 10.2 of the Code further provides that “If in the protologue of the name of a genus or of any subdivision of a genus the holotype or lectotype of one or more previously or simultaneously published species name(s) is

definitely included ... the type must be chosen ... from among these types unless the type was indicated ... or designated by the author of the name. If no type of a previously or simultaneously published species name was definitely included, a type must be otherwise chosen, but the choice is to be superseded if it can be demonstrated that the selected type is not conspecific with any of the material associated with the protologue." Thus, if a type of a genus or subdivision of a genus was not indicated by the author(s), then a lectotype must be selected from amongst the species included in the genus or subdivision of a genus. Needless to say, if a single species were included in the genus, then this automatically becomes the holotype (autotype).

Hence, any designation of a species as the lectotype must include the litmus-test of inclusion by the naming author. Article 10.5 of the Code further specifies that "The author who first designates ... a type of a name of a genus or subdivision of a genus must be followed, but the choice may be superseded if (a) it can be shown that it is in serious conflict with the protologue and another element is available which is not in conflict with the protologue ... , or (b) that it was based on a largely mechanical method of selection." An example of such a purely "mechanical" selection would be merely to choose a species as lectotype on the basis that it was listed or treated first by the author in question. A last, sometimes misunderstood, point is that a lectotypification cannot be rejected merely because a subsequent author does not consider the chosen species to be "typical" of the genus; such assertions are almost oxymoronic.

In a few instances the selection of conjugatophycean types has been less than clear. Additionally, a substantial number of entries for desmid genus names in the on-line version of *Index Nominum Genericorum* (<http://botany.si.edu/ing/>) give as type "*non designatus*" [not designated]. Where possible, and to avoid any undesirable taxonomic disruption, I have here followed the indicated names in ING and Gerrath (1993, Table 1).

Nomenclatural difficulties are apparent not only with genera and their type species but also with the names of classes, orders and families that are in current use for the Conjugatophyceae.

Names of classes

In general, "Conjugatophyceae" as a class name for conjugating algae is most commonly used in Central Europe and "Zygnematophyceae" is most often used elsewhere for the same class, although the latter is becoming

increasingly preferred, mainly because of its widespread use in papers describing molecular phylogenetic studies of conjugating algae.

Two kinds of class names are permitted by the Code: typified names and descriptive names. These names are formed in accordance with Article 16.1 of the Code: "The name of a taxon above the rank of family is treated as a noun in the plural and is written with an initial capital letter. Such names may be either (a) automatically typified names, formed by replacing the termination *-aceae* in a legitimate name of an included family based on a generic name by the termination denoting their rank (preceded by the connecting vowel *-o-* if the termination begins with a consonant), ... or (b) descriptive names, not so formed, which may be used unchanged at different ranks." Furthermore, Article 16.3 requires that, for automatically typified algae, class names should end in *-phyceae* [and subclasses as *-phycidae* (subclass)].

The following are, in alphabetical order, class names that have been applied to the Conjugatophyceae (see Silva 1980, pp. 27-28):

Akontae Blackman & Tansley (1902, pp. 2, 45) is a *descriptive* name that has not been used in recent years. It occasionally appears in dictionaries, such as the on-line Merriam-Webster (<http://www.merriam-webster.com/dictionary/>), as being coextensive with the Zygnematales.

Conjugatophyceae Engler (1892, p. 8, 'Conjugatae' corrected in accordance with Article 16.3) is a *typified* name (Silva 1980, p. 27) based on *Conjugata* Vaucher 1803, a rejected name in favour of *Spirogyra* Link in Nees 1820, *nom. cons.* This name was widely used, as 'Conjugatae', for many years. Fott (1971, p. 379) clearly preferred the Conjugatophyceae as a class name, as he placed 'Conjugatae' in parentheses. See Zygnematophyceae below.

Saccodermiae Pascher ex Kossinskaja (1952, p. 12) is a *descriptive* name for the saccoderm desmids (the family Mesotaeniaceae, currently referred to the Zygnematales) that has rarely been used. The name was coined to refer to the possession a cell wall consisting of a single piece and lacking vertical pores in the wall.

Zygnematophyceae Round (1971, p. 243, 'Zygnemaphyceae') is a *typified* class name but is presently an invalid name. Round (1971, p. 243), believing that the Conjugatophyceae was a descriptive name and, "since it is preferable to have class names based on genera...", proposed the name 'Zygnemaphyceae', based on *Zygnema* C. Agardh (1817, p. xxxii, 98), correctable to 'Zygnematophyceae' (Silva 1980, p. 28). As pointed out by Silva (1980, p. 28), the Zygnematophyceae must be considered a new class rather than a new name because *Conjugata* and

Zygnema are not nomenclatural synonyms. As Round (1971) did not provide a Latin diagnosis or description, this name is invalid. Whilst the name Zygnematophyceae is most frequently attributed to Van den Hoek et al. (1995, p. 461), who did much to popularize the use of the name, they did not provide a Latin description or diagnosis either. In order to permit the continued use of the name by those who prefer it, I here validate the name Zygnematophyceae with an English diagnosis as now permitted by the Code:

Zygnematophyceae Round, new class.

Diagnosis. Coccoid or filamentous streptophyte green algae; flagellated stages and centrioles entirely absent; sexual reproduction internalized by conjugation. Freshwater or occasionally subaerial. Type genus: *Zygnema* C. Agardh (1817, p. xxxii, 98).

It should be noted that Recommendation 16A of the Code is that “In choosing among typified names for a taxon above the rank of family, authors *should generally follow the principle of priority.*” [My emphasis.] Thus, whilst the use of the Conjugatophyceae Engler is preferred under the Code, the use of the Zygnematophyceae is not disallowed. Nevertheless, it would be best if the earlier typified name were to be used in future, and that a single class name be universally employed.

Zygophyceae Widder (1960, p. 167) is a *descriptive* name, a legitimate substitute for Conjugatophyceae. As it is a descriptive name and does not have a type, it does not require a diagnosis or description (Silva 1980, p. 28). I have not discovered any widespread use of the name subsequently (except again in some on-line dictionaries), probably because authors considered that the Zygnematophyceae was a descriptive name and the equivalent of the name Zygophyceae. The name Zygophyceae was originally introduced by Bessey (1907, p. 283), but as a *phylum* name, in which he included a single *class*, the Conjugatae. Accordingly, Bessey cannot be regarded as the originator of the name Zygophyceae as a class name.

Names of orders

For the present, there seems to be a consensus (see, for example, Gontcharov 2008) that the Conjugatophyceae should include two orders: the Zygnematales (also known as ‘Zygnemales’, e.g., Lewis and Entwisle 2007, but the stem should be augmented to “*zygnemat-*” as in the class and family names) and the Desmidiiales, although some recent authors (Brook and Williamson 2010) advo-

cate a single order, the Zygnematales, despite molecular studies (e.g., McCourt et al. 2000, Gontcharov et al. 2003, Gontcharov 2008) indicating that such an order would suffer from paraphyly.

Notwithstanding the widespread and frequent use of these two ordinal epithets, it has been very difficult to establish the correct nomenclatural authorities for them, partly because authors generally do not cite nomenclatural authorities for orders, and even when they do they tend to copy one another.

Temnogametales West & G. S. West 1897, p. 37. The Wests proposed that *Temnogametum* form the basis of a new order, the Temnogametales (as ‘Temnogametaceae’), on the basis of the “peculiar conjugation”, but this order has not found favour amongst taxonomists since.

Zygnematales Bessey 1907, p. 9. The name Zygnematales is often attributed to Borge and Pascher (1913, p. 1, ‘Zygnemales’), for example by Papenfuss (1955, p. 127), but the name appears to have been first employed by Bessey (1907, p. 283) as an order to include six families: Spirogyraceae, Zygnemataceae, Mesocarpaceae, Desmidiaceae, Closteriaceae, and Cosmariaceae (q.v., below).

Desmidiiales Bessey 1910, p. 87. Bessey (1910, pp. 87, 88) modified his concept of the “Phylum” Zygophyceae, with a single class the Conjugatae, to include two orders: the Zygnematales and the Desmidiiales. The latter is provided with a short description in English, sufficient to validate it under the Code. Bessey and Bessey (1914, p. 333) further elaborated his concept of the “Phylum” Zygophyceae by again including the Zygnematales with the families Mesocarpaceae, Zygnemataceae and Spirogyraceae, and the Desmidiiales with the families Desmidiaceae, Closteriaceae and Cosmariaceae. By and large, Bessey’s concepts were remarkably close to modern treatments of the Conjugatophyceae, and evolved considerably from an earlier treatment (Bessey 1901).

Conjugales G. M. Smith 1920, p. 183. Smith (1920, p. 183) included an unattributed Conjugales in his Division Akontae, and provided a description. In the order Conjugales, he included the Zygnemataceae and Desmidiaceae. Earlier references to conjugating algae as an order was as the “Conjugatae” (e.g., Bessey 1902, West 1904, p. xi, 114, “The order Conjugatae is one of the best defined and most natural groups of the Chlorophyceae”).

Mesotaeniales F. E. Fritsch in G. S. West & F. E. Fritsch 1927, p. 225. This ordinal name was introduced by Fritsch (in West and Fritsch 1927, p. 225): “The writer is therefore unable to share wholeheartedly the views of G. S. West ... and Lütekemüller as to the close relation of the Saccoderm and Placoderm desmids...”

Gonatozygales Kossinskaja 1952, pp. 8, 99. This ordinal name was in widespread use in the eastern European and Russian literature (e.g., Kossinskaja 1952, Fott 1958) for the Gonatozygaceae and the genus *Gonatozygon*. In most of the recent treatments, the Gonatozygaceae is included in the Desmidiaceae. I have experienced some difficulty in establishing a satisfactory authorship for the ordinal name, but the earliest justified use appear to be in Kossinskaja's 1952 monograph in which he says [in Russian] "Due to [the] different position of this group in the classification listed above and due to [its] distinctive features, we prefer to recognise this group as an independent order Gonatozygales" (Kossinskaja 1952, pp. 99, 100).

In relation to the nomenclatural validity of Bessey's and other authors' orders, it should be noted that Latin diagnoses or descriptions for algal names are not required by the Code prior to Jan 1, 1958 (Article 44.1).

Names of families

For the sake of completeness, the names of families of Conjugatophyceae are discussed, and this relies heavily on Silva (1980, pp. 27, 48) for exhaustiveness. The names are in alphabetical order for convenience. Whilst descriptive names are permitted by the Code *above* the level of family, descriptive names are not permitted for families except for some specified alternative names for a number of flowering-plant families (Article 18.5).

Archidemiaceae Blackman & Tansley 1902, p. 189, *nom. inval.* This descriptive and thus invalid name was applied to a family that included *Gonatozygon* and *Genicularia* (Silva 1980, p. 29).

Closteriaceae Bessey 1907, p. 283, *nom. illeg.* Silva (1980, p. 32) pointed out that this name was "initially superfluous" (Article 52.1) as it included *Penium*, the type of Peniaceae Haeckel, q.v., below. However, Bessey & Bessey (1914, p. 333) continued to include *Penium* in the Closteriaceae. Silva (1980, p. 13) discussed in detail the unfortunate difficulties attendant on the strict application of Article 52.1 to family names, and it is clear from this discussion that if the Closteriaceae is to be retained as a family name the name needs to be conserved nomenclaturally. Silva (1980) did not proceed do this as at the time, undoubtedly because the genus *Closterium* was then included in the Desmidiaceae. As *Spinoclosterium* is currently regarded as belonging to the same family as *Closterium*, an alternative course of action could be to propose a new family name, the Spinoclosteriaceae for *Spinoclosterium* and to include *Closterium*. In view of the widespread use of the name Closteriaceae, the preferable

option would be to propose it for nomenclatural conservation as follows:

Closteriaceae Bessey *Univ. Stud. Univ. Nebraska*. 1907, p. 283, *nom. cons. prop.*

T: *Closterium* Nitzsch ex Ralfs, 1848.

Conjugataceae Dumortier 1822, pp. 71, 97, 'Conjugateae' and 'Conjugées'. T: *Conjugata* Vaucher 1803, *nom. rejic.* vs *Spirogyra* Link in Nees 1820, *nom. cons.* This is a *typified* name; however, as pointed out by Silva (1980, p. 42) the Conjugataceae as a family name becomes available only if both *Conjugata* and *Spirogyra* are recognised as taxonomically valid entities, which is currently not the case.

Cosmariaceae Bessey 1907, p. 283. Type genus: *Cosmarium*, currently included in the Desmidiaceae.

Desmidiaceae Ralfs 1848, p. 49, 'Fam. Desmidieae'. T: *Desmidium* C. Agardh ex Ralfs 1848. Currently, the Desmidiaceae is regarded as including *Euastrum* Ehrenberg ex Ralfs 1848, p. 78, the type of Euastraceae Haeckel 1894, p. 97 (q.v.), and *Hyalotheca* Ehrenberg ex Ralfs 1848, p. 51, the type of Hyalothecaceae Okada 1953, *nom. illeg.*, a superfluous name applied to a family that included *Desmidium*.

Euastraceae Haeckel 1894, pp. 97, 112. 'Evastrea' [*sic*], 'Evastreen' [*sic*]. Type genus: *Euastrum* Ehrenberg ex Ralfs. See Desmidiaceae above.

Eudesmidiaceae Blackman & Tansley 1902, p. 189, *nom. inval.* This is a descriptive family name and hence invalid (Silva 1980, p. 34).

Gonatozygaceae F. E. Fritsch in G. S. West & F. E. Fritsch 1927, pp. 239, 240. T: *Gonatozygon* De Bary 1856, p. 105.

Hyalothecaceae Y. Okada 1953, p. 176, *nom. illeg.* Type genus: *Hyalotheca* Ehrenberg ex Ralfs 1848. See Desmidiaceae above.

Mesocarpaceae (De Bary) Wittrock 1869, p. 187, *adnot.*, based on 'Familie Conjugatae Unterabt. Mesocarpeae' De Bary (1858, p. 70), in turn based on *Mesocarpus* Hassall 1845, a substitute name for *Sphaerocarpus* Hassall 1843, *nom. illeg.*, *non Sphaerocarpus* Bulliard 1753 (Physaraceae, Myxomycetes). Nine species were included by Hassall (1845) in his *Mesocarpus*, all of which are referable to *Mougeotia* (see below under the genus name).

Mesotaeniaceae Oltmanns 1904, pp. 52, 53. Oltmanns included *Mesotaenium*, *Spirotaenia*, and *Cylindrocystis*.

Mougeotiaceae Blackman & Tansley 1902, p. 215, *nom. illeg.* T: *Mougeotia* C. Agardh 1824. Blackman and Tansley (1902, p. 215) included *Mougeotia*, *Mougeotiopsis*, *Debarya*, *Temnogametum*, and *Gonatonema* in the Mougeotiaceae. All are currently included in the Zygnemataceae. The name is illegitimate as it was initially superfluous as it

included *Temnogametum*, the type of Temnogametaceae West & G. S. West 1897. The name Mougeotiaceae could only be used after conservation, unnecessary at this time.

Peniaceae Haeckel 1894, p. 97; 'Peniacea', p. 112; 'Peniaceen'. T: *Penium* Brébisson ex Ralfs.

Spirogyraceae Blackman & Tansley 1902, p. 215. T: *Spirogyra* Link in Nees, 1820, *nom. cons.* See Zygnemataceae below. Blackman and Tansley (1902, p. 214) included only *Spirogyra* and *Sirogonium* in the Spirogyraceae. Both genera are currently included in the Zygnemataceae. Papenfuss (1955, p. 127) credits the family to Palla (1894, pp. 234, 235, 'Spirogyraceen') but Silva (1980, p. 40) recognizes Blackman and Tansley as the authorities.

Temnogametaceae West & G. S. West 1897. T: *Temnogametum*, currently included in the Zygnemataceae.

Zygnemataceae Kützing 1843, p. 179; 'Family Zygnemeae', p. 274; 'Familia XX. Zygnemeae'. T: *Zygnema* C. Agardh.

Taxonomic treatment and names of genera

In the following treatment, the types are given as in the current on-line version of *Index Nominum Genericorum* (ING). 'T', type; 'LT', lectotype; 'non designatus' indicates that a type has not been selected, at least according to the ING. The *Index Nominum Algarum* (Silva 2013) is referred to as 'INA' and AlgaeBase (Guiry and Guiry 2013) as 'AB'. A typified name is '*nom. typific.*' and a descriptive name is '*nom. descript.*' A nomenclaturally invalid name is '*nom. inval.*', and '*nom. deval.*' is a devalidated name. An illegitimate name is '*nom. illeg.*'. A conserved name is '*nom. cons.*' and a rejected name is '*nom. rej.*'.

Class Conjugatophyceae Engler 1892, p. 8 ('Conjugatae'), *nom. typific.*

Order Zygnematales Bessey 1907, p. 283 ('Zygnemales'), *nom. typific.*

Family Mesotaeniaceae Oltmanns 1904, p. 52

***Ancylonema* Berggren 1872, p. 865.**

T: *Ancylonema nordenskioeldii* Berggren.

The genus was monotypic when described and AB currently includes a single species.

***Cylindrocystis* Meneghini ex De Bary 1858, pp. 35, 74.**

T: *Cylindrocystis brebissonii* (Ralfs) De Bary.

A single species, *C. brebissonii* ('*Brebissonii*') was included initially (De Bary 1858, p. 35) but a second, new, species, *C. crassa* De Bary, was added on p. 37 and on p. 74 of the same publication. The INA, Gerrath (1993, Table 1) and Gontcharov (2008, Table 1) consider *Cylindrocystis*

brebissonii to be the 'type species' and it is formally designated here as lectotype. AB currently includes 15 species. ***Geniculus* Prescott 1967, p. 3.**

T: *Geniculus gatunensis* Prescott

Only the type (autotype) was included by Prescott (1967, p. 3) and no further species have since been described. The genus requires further taxonomic studies.

***Mesotaenium* Nägeli 1849, p. 108.**

T: *Mesotaenium endlicherianum* Nägeli.

Nägeli (1849, p. 108) specified *M. endlicherianum* ('*Endlicherianum*') as the type ('Typus') and this was the only species included (autotype). Gerrath (1993, p. 84) lists this as the type species, and he and Gontcharov (2008, Table 1) gives the current number of species as 12; AB currently includes 15 species.

Heterotypic synonym: *Entospira* Kuntze 1898, p. 404. *Entospira* Brébisson ex Kützing 1847, p. 24, *nom. deval.* was validated by Kuntze (1898, p. 404). Kützing (1847, p. 24) included a single species in the genus *Entospira* Kützing 1847, *nom. deval.*: *Entospira closteridia* Brébisson ex Kützing (1847, p. 24, Pl. 36, Fig. II), *nom. deval.* (autotype). This latter name was validated by Kützing (1849, p. 228) as *Palmogloea clostridia* Kützing, and the combination *Spirotaenia closteridia* (Kützing) Rabenhorst was effected by Rabenhorst (1868, p. 146). Nevertheless, the type of the validated genus *Entospira* Kuntze remains *Entospira closteridia*, the correct name for which is *Spirotaenia closteridia* (Kützing) Rabenhorst. The difficulties surrounding the name *Entospira* Kuntze are further complicated by the occasional use of the spelling *Endospira* and crediting this to Brébisson, for example in Desmazières in *Plantes Cryptogames de France* (1825-1851, fasc. XL, no. 1954, '*Endospira bryophila* Bréb.').

***Netrium* (Nägeli) Izigshon & Rothe in Rabenhorst 1856, no. 508.**

T: *Netrium digitus* (Brébisson ex Ralfs) Itzigsohn & Rothe.

The name *Netrium* was first introduced as a subgenus of *Closterium* by Nägeli (1849, p. 107) who nominated *Closterium digitus* Ehrenberg as the type ('Typus'). The subgenus *Netrium* Nägeli was raised to genus status by Itzigsohn & Rothe in Rabenhorst 1856, no. 508, *Netrium digitus*. ING, Gerrath (1993, p. 84) and Gontcharov (2008, Table 1) list *Netrium digitus* as type.

Gerrath (1993, p. 84) and Gontcharov (2008, Table 1) both give 10 as the number of species of *Netrium*; AB currently includes 5 species of the genus.

***Nucleotaenium* Gontcharov & Melkonian 2010, p. 349.**

T: *Nucleotaenium eifelense* Gontcharov & Melkonian.

Gontcharov and Melkonian (2010, p. 349) included two

species of *Nucleotaenium* in their original description and nominated *N. eifelense* as the type species. No further species of the genus have been named; AB includes two species.

***Planotaenium* Petlovany & Palmar-Mordvinsteva in Palamar-Mordvinsteva & Petlovany 2009, p. 100.**

T: *Planotaenium interruptum* (Brébisson ex Ralfs) Petlovany & Palmar-Mordvinsteva.

The genus *Planotaenium* Petlovany & Palmar-Mordvinsteva (2009, p. 100) was described as ‘gen. nov.’ by the authors and a Latin diagnosis was provided; whilst it was equated with *Netrium* section *Planotaenium* Ohtani (Ohtani 1990, p. 45), the genus name should be attributed solely to Petlovany & Palmar-Mordvinsteva. The type species *Planotaenium interruptum* (Brébisson ex Ralfs) Petlovany & Palmar-Mordvinsteva was designated by Petlovany & Palmar-Mordvinsteva (2009, p. 100).

The genus *Planotaenium* was proposed after the publication of Gontcharov (2008), but the genus was recognised by Gontcharov and Melkonian (2010), who also added a new species. Four species of *Planotaenium* are currently included in AB.

***Roya* West & G. S. West 1896a, p. 152.**

T: *R. obtusa* (Brébisson) West & G. S. West.

Two species were originally included in the genus *Roya* by West and West (1896a, p. 152): *Roya obtusa* (Brébisson) West & G. S. West and *Roya pseudoclosterium* (J. Roy) West & G. S. West. ING gives the former as the type, but a lectotype would have to have been selected from one of the originally included species, and this does not have appear to have been formally proposed. Gerrath (1993, p. 84) and Gontcharov (2008, Table 1) list *R. obtusa* as the “type species” and I here designate formally *R. obtusa* (Brébisson) West & G. S. West as lectotype.

Gerrath (1993, Table 1) and Gontcharov (2008, Table 1) credit *Roya* with four species; AB currently includes five.

***Spirotaenia* Brébisson in Ralfs 1848, p. 178.**

LT: *Spirotaenia condensata* Brébisson.

Two species, *S. condensata* Brébisson and *S. obscura* Brébisson, were included by Ralfs (1848, p. 179); the former was selected as lectotype by Silva (1952, p. 252), which ING gives as lectotype. Gerrath (1993, p. 84) and Gontcharov (2008, Table 1) indicated that the genus included 23 species; 20 are currently listed in AB.

***Tortitaenia* A. J. Brook 1998, p. 146.**

T: *Tortitaenia obscura* (Ralfs) A. J. Brook [= *Polytaenia obscura* (Ralfs) A. J. Brook].

Tortitaenia A. J. Brook was a substitute name for *Polytaenia* A. J. Brook 1997, p. 7, *nom. illeg.*, non A. P. De Candolle 1829 (Umbelliferae).

Tortitaenia was not included by Gontcharov (2008, p. 103). Nine species are currently included in *Tortitaenia* in AB.

Family Zygnemataceae Kützing 1843, pp. 179, 274 (‘Zygnemeae’)

[‘Zygnemaceae’ *auctorum*].

***Debarya* Wittrock 1872, p. 35, *adnot.*, *nom. illeg.*, non *Debarya* Schulzer in Schulzer, Kanitz & Knapp 1866, Hypocreaceae.**

T: *Mougeotia glyptosperma* De Bary = *Debarya glyptosperma* (De Bary) Wittrock.

Debarya was a substitute name for *Mougeotia* De Bary 1858, p. 78, *nom. illeg.*, non *Mougeotia* C. Agardh 1824, *nom. cons.* The type of *Mougeotia* De Bary and of *Debarya* Wittrock 1872, *nom. illeg.*, is *Mougeotia glyptosperma* De Bary, now known as *Debarya glyptosperma* (De Bary) Wittrock.

Debarya is an illegitimate name, sometimes attributed to Transeau (in Transeau et al. 1934); however, Transeau and ING correctly attribute *Debarya* to Wittrock. Because of the earlier homonym *Debarya* Schulzer in Schulzer et al. (1866, p. 60; T: *Debarya crustalina* Schulzer), a fungus, a new name is required:

***Transeauina* *nom. nov. pro Debarya* Wittrock 1872, p. 35, *adnot.* non *Debarya* Schulzer 1866.**

New combinations required for the algal species of *Debarya* are listed in Appendix 1.

Gontcharov (2008, Table 1) attributed 10 species to the genus *Debarya* Wittrock; 13 are listed in AB.

Homotypic synonym: *Mougeotia* De Bary 1858, p. 78, non *Mougeotia* C. Agardh 1824, *nom. cons.* T: *Mougeotia glyptosperma* De Bary.

Note: The two *Debarya* genera honour Heinrich Anton de Bary (1831-1888), German surgeon, plant pathologist and botanist, widely regarded as the “father” of modern mycology, and it is appropriate that a fungal generic name should be preserved in his honour rather than an algal one. The chosen name, *Transeauina* *nom. nov.* honours Edgar Nelson Transeau (1875-1960), American phycologist, plant ecologist and physiologist, whose 1951 monograph of the Zygnemataceae, including *Debarya* Wittrock, remains one of the most important and insightful on the family. Hoshaw (1983) reports on his slide collection, now at the University of Arizona, and achievements.

***Lloydina* Ahmad & Goldstein 1972, p. 217.**

[= *Lloydina* Ahmad & Goldstein 1971, non *Lloydina* Bresadola 1901, nec *Lloydina* P. A. Saccardo & P. Sydow 1902].

T: *Lloydina kankensis* (Ahmad & Goldstein) Ahmad & Goldstein (= *Lloydia kankensis* Ahmad & Goldstein).

Only one species of *Lloydina* is known to date.

***Mougeotia* C. Agardh 1824, pp. xxvi, 83, nom. cons.**

T: *Mougeotia genuflexa* (Roth) C. Agardh.

A single species *M. genuflexa*, was at first included by Agardh (1824, p. xxvi) and five further names were added later in the same work (Agardh 1824, p. 83 *et seq.*). According to INA, Chevallier (1836, p. 24) was the first author to select *Mougeotia genuflexa* (Roth) C. Agardh as lectotype.

Gontcharov (2008, Table 1) indicates that 140 species of the genus are currently recognised and AB currently includes 166 species.

Homotypic synonyms: *Serpentinaria* S. F. Gray 1821, *nom. rej.* LT: *Serpentinaria genuflexa* (Roth) S. F. Gray (*Conferva genuflexa* Roth). The lectotype was selected by Silva (1952, p. 252).

Genuflexa Link 1833, p. 261. T: *Genuflexa vulgaris* Link (*Conferva genuflexa* Roth). Link chose a new name for the type of his new genus presumably to avoid a tautonym; thus *Mougeotia* C. Agardh and *Genuflexa* Link are typified by the same taxonomic entity.

Mougeotella Gaillon 1833, p. [6], *nom. illeg.* T: *Mougeotella genuflexa* (Roth) Gaillon (*Conferva genuflexa* Roth). *Mougeotella* Gaillon represents an unwarranted change of name for *Mougeotia* C. Agardh 1824, and is thus illegitimate.

Heterotypic or potentially heterotypic synonyms: *Agardhia* S. F. Gray 1821, p. 279 ('*Agardia*'). T: *Agardhia coerulea* (Borrer ex Smith) S. F. Gray (*Conferva coerulea* Borrer ex Smith). The type is generally referred to *Mougeotia capucina* C. Agardh.

Sphaerocarpus Hassall 1843, p. 185, *nom. illeg., non Sphaerocarpus* Bulliard 1791, Physaraceae, Mycetozoa. Eight species were included by Hassall (1843). While a lectotype has not been selected (ING), all of these names are presently referred to *Mougeotia*. Selection of a lectotype will require a more extensive study of these species and of Hassall's protologue.

Staurocarpus Hassall 1843, p. 183. This was proposed by Hassall (1843) as a substitute name for *Staurospermum* Kützing 1843, *nom. illeg.*; see below. A lectotype has not been selected. Selection of a lectotype will require a more extensive study of these species and of Hassall's protologue.

Staurospermum Kützing 1843, *nom. illeg., non Staurospermum* Thonning in H. C. F. Schumacher 1827, Rubiaceae. Two species were included by Kützing (1843): *Staurospermum caerulea* (Smith) Kützing and *S. viride* Kützing, both of which are currently referred to *Mougeo-*

tia. Selection of a lectotype will require a more extensive study of these species and of Kützing's protologue.

Mesocarpus Hassall 1845, p. 166, is a substitute name for *Sphaerocarpus* Hassall 1843, above. Nine species were included by Hassall (1845), all of which are referable to *Mougeotia*. Selection of a lectotype will require a more extensive study of these species and of Hassall's protologue.

Craterospermum A. Braun 1855, p. 60 (*adnot.*). T: *Craterospermum laetevirens* A. Braun. A single species was included (autotype), which is usually referred to *Mougeotia*.

Pleurocarpus A. Braun 1855, p. 60 (*adnot.*). T: *Pleurocarpus mirabilis* A. Braun. A single species was included (autotype), which is generally referred to *Mougeotia*.

Goniothrix J. E. Gray 1864, p. 63. T: *Goniothrix notabilis* (Hassall) J. E. Gray (*Mougeotia notabilis* Hassall).

Plagiospermum Cleve 1868, pp. 12, 35. T: *Plagiospermum tenue* Cleve. A single species was included (autotype), which is currently referred to *Mougeotia* as a section by Wittrock (1872, p. 39).

Sphaerospermum Cleve 1868, pp. 12, 35. T: *Sphaerospermum calcareum* Cleve. A single species was included (autotype), which is currently referred to *Mougeotia* Wittrock (1872, p. 40) as *Mougeotia calcarea* (Cleve) Wittrock.

Gonatonema Wittrock 1878, p. 15. T: *non designatus*. *Gonatonema* was based on two species: *G. ventricosum* Wittrock and *G. notabile* (Hassall) Wittrock (*Mougeotia notabilis* Hassall), both of which have been referred to *Mougeotia*. Selection of a lectotype will require a more extensive study of these species and of Wittrock's protologue.

***Mougeotiella* T. Yamagishi 1963, p. 205.**

T: *Mougeotiella sphaerocarpa* (Wolle) Yamagishi.

Yamagishi (1963, p. 205) designated *Mougeotiella sphaerocarpa* (Wolle) Yamagishi as the type, and included a total of nine species in the genus. *Mougeotiella* is not included by Kadlubowska (1984) or listed by Gontcharov (2008, Table 1). There are nine species currently in AB that have been variously referred to *Mougeotia* and *Debarya*. Given the number of heterotypic names referred to *Mougeotia* (above) the complex requires reinvestigation preferably with molecular data.

***Mougeotiopsis* Palla 1894, p. 228.**

T: *Mougeotiopsis calospora* Palla.

Palla (1894) included a single species, *M. calospora* Palla, which is automatically the type. No further species of the genus have been described.

Potentially homotypic synonym: *Mesogerron* F. Brand 1899, p. 181. T: *Mesogerron fluitans* F. Brand. A single species was included by Brand (1899), which was referred to

Mougeotiopsis calospora by Krieger (1941, p. 200).

***Neozygnema* T. Yamagishi 1963, p. 206.**

T: *Neozygnema laevisporum* (C. -C. Jao) T. Yamagishi.

A single species, *Neozygnema laevisporum* (C. -C. Jao) Yamagishi, originally described from Massachusetts, USA as *Zygnema laevisporum* C. -C. Jao, was included in *Neozygnema* by Yamagishi (1963, p. 207). No further species have been described. The basis for *Neozygnema* was that the cell contents are not transformed entities into “gametes”.

Neozygnema is not included by Gontcharov (2008, Table 1). Only one species has to date been referred to the genus.

***Sangirellum* A. K. Mahato & P. Mahato 1994, p. 114.**

T: *Sangirellum taeniforme* A. K. Mahato & P. Mahato.

A single species, *Sangirellum taeniforme*, was included in *Sangirellum* by Mahato and Mahato (1994), automatically typifying the genus.

Sangirellum is not included by Gontcharov (2008). No further species of the genus have been described.

***Sirocladium* Randhawa 1941, p. 196.**

T: *Sirocladium kumaoense* Randhawa (*'kumaoensis'*).

A single species was included by Randhawa (1941, p. 196) in the original description. Gontcharov (2008, Table 1) includes five species and AB lists six.

Sirogonium* Kützing 1843, p. 278, *nom. cons.

T: *Sirogonium sticticum* (Smith) Kützing.

Sirogonium has been conserved over the earlier genus name *Choopsis* S. F. Gray (see below). A single species, *S. sticticum*, was included by Kützing (1843, p. 278) in his original description. Gontcharov (2008, Table 1) did not include the genus. AB currently lists 23 species.

The (unfortunately) very similarly spelled genus *Spirogonium* Pascher is referred currently to the Chlamydomonadaceae.

Homotypic synonym: *Choapis* S. F. Gray (1821, p. 299 *'Choapes'*), *nom. rejic.* T: *Choapis serpentina* S. F. Gray (1821, p. 299), *nom. illeg.* *Choapis serpentina* represents an unwarranted change of name for *Conferva stictica* Smith, the basionym of *Sirogonium sticticum*.

Spirogyra* Link in Nees 1820, p. 5, *nom. cons.

LT: *Spirogyra porticalis* (O. F. Müller) Cleve.

A lectotype of *Spirogyra porticalis* [*Conjugata porticalis* (O. F. Müller) Vaucher], “... in keeping with Link's intentions”, was selected by Silva (1952, pp. 252, 253).

Dumortier (1822, pp. 98, 99) used the name *'Spirogera'* and listed 8 names under the headings of *spira unica*, *spirae duae*, and *spirae plures* [one spiral, two spirals, many spirals]. It is not clear if this was an orthographical correction, a typographical error or an intended new genus.

Gontcharov (2008, Table 1) considers that more than 400 species of *Spirogyra* have been described. Currently, 507 *Spirogyra* species are listed in AB, nearly 40% of which are known only from China (Jao 1988). INA includes about 1,022 entries for the genus (including some double entries, infraspecific names, invalid names and homonyms), and the final tally will probably be about 600 species.

Chen et al. (2012) have recently described high genetic diversity in 130 *Spirogyra* sequences which they found split into eight independent lineages. Any reorganization of the genus should take account of the names below.

Heterotypic and potentially heterotypic synonyms:

Conjugata Vaucher 1803, p. 37, LT: *Conjugata princeps* Vaucher, against which *Spirogyra* Link is conserved, and upon which the Conjugatophyceae is based. Silva (1952, p. 252) first lectotypified *Conjugata* Vaucher with *Conjugata princeps* Vaucher (1803, p. 64, Pl. IV, Figs 1-6). Plate IV of this work clearly shows in remarkable detail (for the time) the morphology (Vaucher 1803, Figs 1 & 2), conjugation (Vaucher 1803, Fig. 3) together with zygote formation (Vaucher 1803, Fig. 3), zygote germination (Vaucher 1803, Fig. 5), and aplanospore formation (Vaucher 1803, Fig. 4) of a species of *Spirogyra*. *Conjugata princeps* Vaucher was referred to *Spirogyra* by Meyen (1827, p. 412) citing 'Lk.' [Link].

Jugalis Schrank 1814, p. 17. According to INA, this represents “merely a change in name for *Conjugata* Vaucher”, and thus is illegitimate.

Salmacis Bory de Saint-Vincent 1822, p. 596. T: *non designatus*. According to the ING, Bory de Saint-Vincent (1822, p. 596) designated “le *Conferva jugalis ou nitida* de [O. F.] Müller” as type, but in a later work (Bory de Saint-Vincent 1829, p. 77) he applied the two names to two different species, both referable to *Spirogyra*.

Salmacisella Gaillon 1833, p. [7], *nom. illeg.* This was an unwarranted and thus illegitimate change of name for *Salmacis* Bory de Saint-Vincent 1822.

Spirochroma J. E. Gray 1864, p. 64. T: *Spirochroma mirabile* (Hassall) J. E. Gray (*Zygnema mirabile* Hassall). The type is currently treated as a species of *Spirogyra*, *Spirogyra mirabilis* (Hassall) Kützing (see John et al. 2011, p. 597).

***Temnogametum* West & G. S. West 1897, p. 37.**

T: *Temnogametum heterosporum* West & G. S. West.

A single species was originally included in the genus *Temnogametum* by West and West (1897, p. 37).

Gontcharov (2008, Table 1) gives the number of described species of the genus as 16; 17 are presently included in AB.

***Temnogyra* I. F. Lewis 1925, p. 355.**

T: *Temnogyra collinsii* I. F. Lewis.

Lewis (1925, p. 355) referred a single species, *Temnogyra collinsii*, to the genus. The type was referred to *Spirogyra* by Printz (1927, p. 372). However, *Tementogyra* was recognised by Yamagishi (1963, p. 207) who referred 14 species to the genus, mostly previously described species of *Spirogyra*. Seventeen species are currently included in AB.

***Trigonum* A. K. Mahato & P. Mahato 1994, p. 118.**

T: *Trigonum indicum* A. K. Mahato & P. Mahato.

A single species, *Trigonum indicum*, was included in *Trigonum* by Mahato and Mahato (1994). No further species have been described.

***Zygnema* C. Agardh 1817, pp. xxxii, 98, nom. et typ. cons.**

T: *Zygnema cruciatum* (Vaucher) C. Agardh, typ. cons.

The genus *Zygnema* included 14 species when originally proposed as a segregate genus from *Conjuga* Vaucher (C. Agardh 1817). An included species, *Z. cruciatum* (Vaucher) C. Agardh, was proposed by Silva (1952, p. 253) as lectotype. An earlier typification of *Zygnema* by Bory de Saint-Vincent (1822) with *Conferva genuflexa* Roth [= *Mougeotia genuflexa* (Roth) C. Agardh] is discussed and regarded as “hardly tenable” by Silva (1952, p. 253), but this and other factors necessitated the conservation of *Zygnema cruciatum* as the type.

Gontcharov (2008, Table 1) gives 139 as the number of species of *Zygnema*. AB currently lists 181 species of the genus, and the final tally is likely to be higher.

Heterotypic synonyms: *Lucernaria* Roussel 1806, p. 84, nom. rejic. T: *Lucernaria pellucida* Roussel [currently assigned to *Zygnema stellinum* (Vaucher) C. Agardh]. *Zygnema* C. Agardh has been conserved against *Lucernaria* Roussel. Kuntze (1891) adopted *Lucernaria* as the earliest available name and made many combinations (see Silva 1952, p. 253).

Globulina Link in Nees 1820, p. 4. No species were included. According to ING, “This genus was based on Vaucher’s *Conjuguées à étoile* (*Hist. Conf.* 73. 1803), all six species of which have been referred to *Zygnema* C. A. Agardh 1817 (nom. cons.)” Dumortier (1822, p. 98) listed seven names, again all of which are based on species included in *Conjugata* Vaucher (1803, p. 37). A lectotype has not been selected, and should await further study.

Tyndaridea Bory de Saint-Vincent 1822, p. 595 (“*Tendaridea*’, *orth. mut.*, Harvey 1833, p. 361). T: *Conferva stellina* O. F. Müller (1788, p. 93, Pl. 2, Fig. 1), = *Zygnema stellinum* (O. F. Müller) C. Agardh. Harvey (1833, p. 361) pointed out that Bory’s name was “incorrectly spelled” and adopted ‘*Tyndaridéa*’ as the correct name derived from “...

constellations so called of *Castor* and *Pollux*...” in turn named for *Tyndareus* of Greek mythology. However, Harvey (1833, p. 361, adnot.) also intimated that his concept of the genus was different from that of Bory’s.

Stellulina Link 1833, p. 261. T: *non designatus*. *Stellulina* included two species, *S. cruciata* (Vaucher) Link (*Conjugata cruciata* Vaucher) and *S. pectinata* (Vaucher) Link (*Conjugata pectinata* Vaucher), both of which have been referred to *Zygnema* as *Zygnema cruciatum* (Vaucher) J. Agardh and *Z. pectinatum* (Vaucher) C. Agardh, respectively. Selection of a type requires further study.

Tendaridella Gaillon (1833, p. [6]) is an illegitimate substitute name for *Tyndaridea* Bory de Saint-Vincent (above). Gaillon however only included *Tendaridella irradiata* Gaillon.

Thwaitesia Montagne 1845, p. 925. T: *Thwaitesia duriaei* Montagne (Montagne 1846, p. 175). The type was referred to *Zygnema* by De Bary (1858, p. 78), and probably represents *Z. stellinum* (Vaucher) C. Agardh.

Rhynchonema Kützing 1849, p. 443. T: *non designatus*. Fifteen species of *Rhynchonema* were included by Kützing (1849, pp. 443, 444), all of which were described originally as species of *Zygnema* by Hassall (1845). As *Zygnema* may be polyphyletic, and *Rhynchonema* may represent a segregate genus, it would be premature at this time to select a lectotype, and any such selection should of course have regard to Kützing’s protologue. A lectotype is required to be selected from the 15 species included by Kützing (1849, pp. 443, 444).

Pleurodiscus Lagerheim 1895, p. 15. T: *Pleurodiscus purpureum* (Wolle) Lagerheim. A single species was included by Lagerheim (1895), currently referred to *Zygnema* as *Zygnema purpureum* Wolle.

As *Zygnema* is probably polyphyletic in a manner similar to *Mougeotia* and *Spirogyra*, the above heterotypic synonyms will have to be given due consideration in any reassignment of the species.

***Zygnemopsis* (Skuja) Transeau in L. C. Li 1934, p. 74? [not seen].**

T: *Zygnemopsis reticulata* (Hallas) Transeau.

Transeau (in Li 1934, p. 74 and / or in Transeau et al. 1934, p. 214) proposed that *Debarya* section *Zygnemopsis* Skuja (1930, p. 44) be recognised as a genus. Skuja (1930, p. 44) listed four species in *Debarya* section *Zygnemopsis* Skuja including *Debarya reticulata* (Hallas) Transeau (= *Zygnema reticulata* Hallas).

Gontcharov (2008, Table 1) credits *Zygnemopsis* with 43 species; 50 are currently included in AB.

Heterotypic synonyms: *Hallasia* Rosenvinge (1924, p. 212) was established for *Zygnema reticulatum* Hallas

(Hallas 1895, p. 10, Pls 1 & 2), although no combination within *Hallasia* for this entity seems to have been made. In view of the widespread use of *Zygnemopsis* over *Hallasia* a case for conservation of *Zygnemopsis* exists.

Ghosella Randhawa (1934, p. 14) included two species: *Ghosella indica* (F. E. Fritsch) Randhawa and *Ghosella indica* Randhawa, both of which are currently referred to *Zygnemopsis* as *Zygnemopsis indica* (Randhawa) Randhawa and *Zygnemopsis spiralis* (F. E. Fritsch) Transeau. *Ghosella indica* (F. E. Fritsch) Randhawa is here designated as the type. *Zygnemopsis* and *Ghosella* were published in the same year and priority has not yet been established.

***Zygonium* Kützing 1843, p. 280, nom. cons.**

T: *Zygonium ericetorum* Kützing.

Three species were included by Kützing (1843, pp. 280, 281) in *Zygonium*: *Z. ericetorum* Kützing, *Z. torulosum* Kützing and *Z. nivale* Kützing. Silva (1952, p. 253) selected *Zygonium ericetorum* as lectotype.

Conferva ericetorum Roth (1800, p. 507), which Kützing (1833, p. [2]) references, is a later homonym of *Conferva ericetorum* Bory de Saint-Vincent (1797, p. 36) and is thus illegitimate; it cannot therefore act as the basionym for *Zygonium ericetorum*, which should thus be attributed solely to Kützing. The fact that this is a relatively uncommon epithet suggests to me that *C. ericetorum* Roth, *C. ericetorum* Bory de Saint-Vincent and *Leda ericetorum* Bory de Saint-Vincent must surely be connected, but Roth (1800, pp. 507, 508) makes no reference to Bory's names.

Zygonium Kützing is conserved against *Leda* Bory de Saint-Vincent (1822, p. 595), lectotypified by Silva (1952, p. 253) with *Leda ericetorum* Bory de Saint-Vincent.

Gontcharov (2008, Table 1) credits *Zygonium* with 29 species; 34 are currently included in AB.

Homotypic synonym: *Leda* Bory de Saint-Vincent 1822, p. 595, *nom. rej.* LT: *Leda ericetorum* Bory de Saint-Vincent, selected by Silva (1952, p. 253).

Heterotypic and potentially heterotypic synonyms: *Euzygonium* Itzigsohn in Rabenhorst 1854, no. 398. T: *non designatus*. No valid name had been ascribed to the genus and the material seemingly represents conjugating *Zygonium*.

Pyxispora West & G. S. West 1897, p. 39. T: *Pyxispora mirabilis* West & G. S. West. Transeau (1933, p. 158) transferred the type to *Zygonium*.

Genera incertae sedis

Paleospiralis Edhorn 1973, p. 52. T: *Paleospiralis canadensis* Edhorn. The type is a fossil from the Middle Precambrian.

Phycoleda Itzigsohn in Rabenhorst 1854, no. 398. T: *non designatus*. This name may represent a change of name for *Leda* Bory de Saint-Vincent.

Order Desmidiaceae Bessey 1910, p. 88

Family Closteriaceae Bessey 1907, p. 283, nom. cons. prop.

***Closterium* Nitzsch ex Ralfs 1848, p. 159.**

LT: *Closterium lunula* Ehrenberg & Hemprich ex Ralfs.

Ralfs (1848, p. 159) includes 22 species of *Closterium* of which *Closterium lunula* Ehrenberg & Hemprich ex Ralfs was selected as lectotype by Silva (1952, p. 255).

Gerrath (1993, Table 1) gives 140 species; Gontcharov (2008, Table 1) gives 190. Currently, 137 species are included in AB, but revision of the names is currently incomplete.

Heterotypic synonym: *Echinella* Acharius in Weber and Mohr 1810, p. 340, *nom. deval.* T: *Echinella radiosa* Acharius is also a devalidated name, and is probably synonymous with *Closterium lunula*; Nordstedt (1906, p. 97).

Stauroceras Kützing ex Kützing 1849, p. 166. T: *non designatus*. When originally described by Kützing (1845, p. 133, as a devalidated name), two entities were included: *Stauroceras acus* (Nitsch) Kützing, *nom. deval.* and *S. subulatum* (Kützing) Kützing, *nom. deval.* A third was added in Kützing (1849, p. 166), *S. intermedium* Kützing, wherein the genus name was validated. All three taxa are currently included in *Closterium*; a lectotype should be chosen having regard to the validating protologue.

***Spinoclosterium* C. Bernard 1909, p. 30.**

T: *Spinoclosterium curvatum* C. Bernard.

A single species, *C. curvatum* C. Bernard (autotype), was included in the original description of *Spinoclosterium*. A second species, *S. cuspidatum* (Bailey) Hirano [= *Closterium cuspidatum* Bailey in Ralfs (1848, p. 219, Pl. XXXV, Fig. 11)] was added by Hirano (1949).

Gerrath (1993, Table 1) included a single species; Gontcharov (2008, Table 1) recognizes two species, as does AB.

Family Desmidiaceae Ralfs 1848, p. 49 ('Desmideae')

***Actinotaenium* (Nägeli) Schellenberg 1897, p. [10] ('*Aktinotaenium*').**

T: *Dysphinctium regelianum* Nägeli = *Actinotaenium curtum* (Brébisson ex Ralfs) Teiling.

The genus *Actinotaenium* was proposed by Schellenberg (1897, p. [10]) based on *Disphinctium* subgenus *Actinotaenium*, Nägeli 1849, p. 109; the proposal is often

attributed to Teiling (1954).

Gerrath (1993, Table 1) and Gontcharov (2008, Table 1) credit the genus *Actinotaenium* with 50 species; 51 are currently included in AB.

***Allorgeia* Gauthier-Lièvre 1958, p. 97.**

T: *Allorgeia valiae* Gauthier-Lièvre.

A single species, *Allorgeia valiae*, was included in the original description. A second species, *Allorgeia mirabilis* (Grönblad, Prowse & Scott) Thomasson was added by Thomasson (1960) based on *Micrasterias mirabilis* Grönblad, Prowse & Scott (1958, p. 19).

Gontcharov (2008, Table 1) credits the genus *Allorgeia* with two species, as does AB.

***Amscottia* Grönblad 1954, p. 433.**

T: *Amscottia mira* (Grönblad) Grönblad.

Amscottia is a substitute name for *Scottia* Grönblad in Grönblad & Kallio 1954, non *Scottia* R. Brown ex W. Aiton & W. T. Aiton 1812 (Fabiaceae).

A single species, *Amscottia mira* from Brazil, was included in the original description. A second species, *Amscottia gulungulana* H. U. Ling & P. A. Tyler (1985, p. 335), was described from Australia. AB currently includes two species.

***Bambusina* Kützing ex Kützing 1849, p. 188, nom. cons.**

T: *Bambusina brebissonii* Kützing ex Kützing [= *Bambusina borneri* (Ralfs) Cleve].

A single species, *Bambusina brebissonii*, was included in the original validating publication. Gontcharov (2008, Table 1) lists “*Bambusina borneri* Delponte” as the “type species”. This is not quite correct: the type species (auto-type) is *Bambusina brebissonii* Kützing ex Kützing, which is currently treated as a taxonomic synonym of *Bambusina borneri* (Ralfs) Cleve (= *Desmidium borneri* Ralfs).

Gontcharov (2008, Table 1) credits the genus *Bambusina* with 6 species; AB currently includes 4 species.

Heterotypic synonyms: *Gymnodesmus* Trevisan 1848, p. 99 adnot., nom. rej. T: *Gymnodesmus bambusinus* Trevisan.

Gymnozyga Ehrenberg ex Kützing 1849, p. 188. T: *Gymnozyga moniliformis* Ehrenberg ex Kützing. Nom. rej. vs *Bambusina* Kützing ex Kützing 1849, nom. cons.

Haplozyga (Nordstedt) Raciborski 1895, p. 32 (*Haplozyga*; see ING for correction of the orthography). T: *Haplozyga armata* (A. Löfgren & Nordstedt) Raciborski (*Gymnozyga armata* A. Löfgren & Nordstedt). The genus *Haplozyga* represents genus status for *Gymnozyga* section *Haplozyga* Nordstedt 1889, p. 1.

***Bourrellyodesmus* Compère 1977a, p. 340.**

T: *Bourrellyodesmus heimii* (Bourrelly) Compère.

A single species, *Bourrellyodesmus heimii*, was includ-

ed in *Bourrellyodesmus* by Compère (1977a). Gontcharov (2008, Table 1) gives five as the number of species described; AB lists six.

***Brachythea* Gontcharov & M. Watanabe 1999, pp. 345, 346.**

T: *Brachythea sulcata* Gontcharov & M. Watanabe.

A single species, *Brachythea sulcata* from the highlands of New Guinea, was originally included by Gontcharov and Watanabe (1999). A second species from New Zealand was added by Fumanti and Alfinito (2004). AB currently includes these two species.

***Cosmarium* Corda ex Ralfs 1848, p. 91.**

LT: *Cosmarium margaritifera* Ralfs.

Gontcharov and Melkonian (2008, p. 1089) discuss the selection of a lectotype: “The Index Nominum Genericorum ... recognizes *C. margaritifera* as the type although in the earlier version of ING *C. undulatum* had been suggested (Silva 1952). The designation of *C. margaritifera* as the type is credited to Nägeli (1849, p. 114). However, Nägeli considered *Cosmarium* as the subgenus of *Euastrum* and referred to *E. margaritifera* Ehr. Ehrenberg (1835 [actually 1836]) regarded his alga identical with *Ursinella margaritifera* Turpin (1820) [*sic*, meaning Turpin 1828], so the correct citation should be *Euastrum margaritifera* (Turpin) Ehr. Because the publications by Turpin and Ehrenberg were published before the starting point of desmid taxonomy (Ralfs 1848), Nägeli’s designation of the type species is invalid (ICBN, Article 7.7). Obviously, Nägeli was not familiar with Ralfs’s publication at that time, and his typification had no relation to the genus *Cosmarium* Corda ex Ralfs. Moreover, the alga described by Turpin is not identifiable and obviously not identical to two or likely three species illustrated by Ralfs under the name *C. margaritifera* (1848, Tables XVI, XXXIII, Figs 2d, 3a & b). In contrast, the choice of *C. undulatum* as the type of *Cosmarium* was prompted by the fact that it is the most clearly known of the species included in the genus by Corda (Silva 1952). We agree with Silva that Nägeli’s typification should be rejected because it is based on an invalidly published name, and following Silva (1952), we regard *C. undulatum* as the type species of the genus *Cosmarium*.”

The selection of *C. undulatum* Corda ex Ralfs as lectotype by Silva (1952, p. 255) is also favoured here for the reasons outlined above by Gontcharov & Melkonian. The ING (February 2013) currently lists the lectotype as *Cosmarium margaritifera* Ralfs.

Gontcharov (2008, Table 1) credits the genus with more than 1,100 species, whilst AB currently lists 1,051. In view of the likely polyphyly of *Cosmarium* the decision of

which species is the lectotype is critical to the taxonomy of the genus.

Heterotypic synonyms: *Ursinella* Turpin 1828, p. 316. T: *Ursinella margaritifera* Turpin, *nom. deval.* [= *Cosmarium margaritifera* Meneghini ex Ralfs], is a devaluated name (see Silva 1952, p. 255).

Pithiscus Kützing 1849, p. 162. T: *Pithiscus angulosus* Kützing. The type was included in the synonymy of *Cosmarium cucumis* Corda ex Ralfs by Ralfs (1848, p. 93).

Disphinctum Nägeli 1849, p. 109 [also as '*Disphinctum*', '*Disphinctium*']. T: *Dysphinctium meneghinianum* Nägeli. Nägeli (1849, p. 112) specified *D. meneghinianum* as the type of *Dysphinctium* subgenus *Dysphinctium*. This is currently treated as a synonym of *Cosmarium conatum* Brébisson ex Ralfs.

Calocylindrus (Nägeli) O. Kirchner 1878, p. 142. T: *Calocylindrus annulatus* (Nägeli) O. Kirchner; the genus name was based on *Dysphinctium* subgenus *Calocylindrus* Nägeli 1849, p. 110, the type of which was *Dysphinctium annulatum* Nägeli. Ten species of desmids were included in *Calocylindrus* by Kirchner (1878, pp. 142, 143); the type is currently referred to *Cosmarium*.

Nothocosmarium Raciborski 1889, p. 98. T: *Nothocosmarium obliquum* (Nordstedt) Raciborski. Raciborski (1889, p. 98) included a single species in the original description of *Nothocosmarium* and *N. obliquum*. This species is currently treated as a species of *Cosmarium* (see Kouwets 1999).

The likely polyphyly of *Cosmarium* may soon result in a reassessment of the above generic synonymy.

***Cosmocladium* Brébisson 1856, p. 133.**

T: *Cosmocladium pulchellum* Brébisson.

A single species, *Cosmocladium pulchellum*, was included by Brébisson (1856, p. 133).

Gontcharov (2008, Table 1) credits *Cosmocladium* with six species, and AB lists seven species.

***Croasdalea* Bicudo & Mercante 1993, p. 271.**

T: *Croasdalea marthae* (Grönblad) C. E. M. Bicudo & C. T. J. Mercante.

A single species, *Croasdalea marthae*, was included in the original description by Bicudo and Mercante (1993, p. 271).

This genus was not included by Gontcharov (2008). No additional species are currently included in AB.

***Crucianguelum* D. B. Williamson 1999, p. 60.**

T: *Crucianguelum lateroprominens* D. B. Williamson.

A single species, *Crucianguelum lateroprominens* from South Africa, was included in the original description by Williamson (1999).

This genus was not included by Gontcharov (2008). No

further species are included in AB.

***Desmidium* C. Agardh ex Ralfs 1848, p. 60.**

LT: *Desmidium swartzii* C. Agardh ex Ralfs.

Two species, *Desmidium swartzii* and *D. quadrangulum* Ralfs ex Ralfs were included in the original valid description of the genus (Ralfs 1848). The lectotype species was chosen by Nägeli (1849, p. 130).

Gontcharov (2008, Table 1) credits *Desmidium* with 20 species, and AB currently lists 18 species.

Heterotypic synonyms: *Aptogonum* Ralfs (1848, p. 63). T: *non designatus* [not included in ING]. Only *Aptogonum desmidium* Ralfs was included in the original description in the main body of Ralfs's text and is currently referred to *Desmidium* as *Desmidium aptogonum* Brébisson ex Kützing; a further species from North America, *Aptogonum baileyi* is included in Ralfs's Appendix (Ralfs 1848, p. 208). Lectotypification is required and Ralfs's protologue suggests that it is appropriate to designate here *Aptogonum desmidium* as the lectotype. In the event of *Desmidium* proving to be polyphyletic, this genus name will have to be taken into consideration.

Didymoprium Kützing ex Ralfs 1848, p. 55. LT: *Didymoprium grevillei* Kützing ex Ralfs. Two species were included by Ralfs (1848): *Didymoprium grevillei* Kützing ex Ralfs and *Didymoprium grevillei* Ralfs ex Ralfs. The lectotype was selected by Greuter et al. (1994, p. 347), and is presently referred to *Desmidium grevillei* (Kützing ex Ralfs) De Bary (Kouwets 1999, p. 68).

***Docidium* Brébisson ex Ralfs 1848, p. 155.**

T: *non designatus*.

The ING currently (February 2013) currently lists *Docidium* as not having a designated type. Gerrath (1993, Table 1) and Gontcharov (2008, Table 1) list *Docidium baculum* Brébisson ex Ralfs as the "type species". Ralfs (1848, pp. 155-159) included seven species of *Docidium*, of which *D. nodulosum*, *D. truncatum*, *D. baculum*, and "*D. asperum*" were communicated to him by Brébisson "*in lit. cum icone*" (in a letter with an illustration) and can be considered to be the essence of the concept of *Docidium* Brébisson. It thus seems appropriate to follow Gerrath (1993, Table 1) and to designate here *Docidium baculum* Brébisson ex Ralfs as the lectotype of *Docidium*.

Gontcharov (2008, Table 1) gives 8 as the number of species of the genus currently recognised; AB currently lists 16.

***Euastridium* West & G. S. West 1908, p. 199.**

T: *Euastridium prainii* West & G. S. West.

A single species was included in *Euastridium* by West and West (1908, p. 200).

This genus was not included by Gerrath (1993) or

Gontcharov (2008), but is recognised by Prasad and Misra (1984), who described a new forma from the Andaman Islands in the Indian Ocean. Two additional species, *E. staurastroides* N. Carter and *E. verrucosum* N. Carter, have been described from India and British Columbia, respectively (Carter 1926, 1935). AB currently includes three species.

***Euastrum* Ehrenberg ex Ralfs 1848, p. 78.**

T: *non designatus*.

The ING currently (Feb 2013) currently lists *Euastrum* as not having a designated type. Gontcharov (2008, Table 1) gives *Euastrum ansatum* Ehrenberg ex Ralfs as the “type species”, but with an unexplained question mark. Ralfs (1848, pp. 79-91) included 18 species in his account of *Euastrum*, of which only *E. verrucosum*, and *E. ansatum* were species attributed to Ehrenberg. It is appropriate that the lectotype be chosen from one of these two species, to follow Gontcharov’s (2008, p. 103) listing of this species, and to designate here *Euastrum ansatum* Ehrenberg ex Ralfs as the lectotype species.

Gontcharov (2008, Table 1) gives 265 as the number of species of the genus currently recognised. AB currently lists 189.

***Groenbladia* Teiling 1952, p. 275.**

T: *non designatus*.

The ING currently (Feb 2013) currently lists *Groenbladia* as not having a designated type. Gontcharov (2008, Table 1) gives *Groenbladia neglecta* (Raciborski) Teiling as the “type species”. Teiling (1952, p. 276) included two species: *Groenbladia neglecta* and *G. fennica* (Grönblad) Teiling. It seems appropriate to support Gontcharov’s nomination and to designate here *Groenbladia neglecta* (Raciborski) Teiling as the lectotype.

Gontcharov (2008, Table 1) gives five as the number of species of the genus currently recognised; AB currently lists three.

***Haplotaenium* Bando 1988, p. 176.**

T: *Haplotaenium minutum* (Ralfs) Bando.

Bando (1988, p. 176) designated *Haplotaenium minutum* (Ralfs) Bando as the generitype when describing the genus.

Gontcharov (2008, Table 1) and AB give three as the number of species currently recognised.

***Heimansia* Coesel 1993, p. 107.**

T: *Heimansia pusilla* (L. Hilse) Coesel.

Coesel (1993, p. 107) designated *Heimansia pusilla* (L. Hilse) Coesel as the type species when describing the genus.

Gontcharov (2008, Table 1) list only the type species, whereas AB lists two species of the genus, both of which

were included in the original description.

***Hyalotheca* Ehrenberg ex Ralfs 1848, p. 51.**

T: *non designatus*.

The ING currently (February 2013) currently lists *Hyalotheca* as not having a designated type. Gontcharov (2008, Table 1) gives “*Hyalotheca mucosa* (Mert.) Ehrenb. ex Ralfs” as the “type species”. Ralfs (1848, pp. 51-54) included two species of *Hyalotheca* in the main body of his text: *H. dissilens* Brébisson ex Ralfs [‘in lit.’] and *H. mucosa* Ehrenberg ex Ralfs, and an additional species in the Appendix (Ralfs 1848, p. 207), *H. dubia* Kützing ex Ralfs from Germany. Since the genus is clearly attributed to Ehrenberg (Ehrenberg 1841, devalidated name) by Ralfs, and this is the only species described by Ehrenberg included, it is appropriate to accept Gontcharov’s “type species” and to designate here *Hyalotheca mucosa* as the lectotype species of the genus *Hyalotheca* Ehrenberg ex Ralfs.

***Ichthyocercus* West & G. S. West 1897, p. 80.**

T: *Ichthyocercus angloensis* West & G. S. West.

West and West (1897, p. 80) included a single species, *Ichthyocercus angloensis* from Angola, in the original description. Gontcharov (2008, Table 1) listed “*Ichthyocercus anglensis* [sic] West & G. S. West” as the type species. The genus name has also been the source of some confusion being variously rendered ‘*Ichthyocercas*’ and ‘*Ichthyocercus*’; the spelling used here is the original one.

Gontcharov (2008, Table 1) gives six as the number of species, whereas AB lists only three.

***Ichthyodontum* A. M. Scott & Prescott 1956, p. 105.**

T: *Ichthyodontum sachlanii* A. M. Scott & Prescott.

Scott and Prescott (1956, p. 105) included a single species, *Ichthyodontum sachlanii* A. M. Scott & Prescott from Sumatra, in the original description. No other species have been described (Gontcharov 2008, Table 1, AB).

***Mateola* R. Salisbury 1936, p. 60.**

T: *Mateola acutiloba* R. Salisbury.

Salisbury (1936) described this genus based on *Mateola acutiloba* R. Salisbury from Florida. A further species, *Mateola curvata* (Nordstedt) Coesel was added by Coesel (1997).

Gerrath (1993, Table 1) and Gontcharov (2008, Table 1) do not include *Mateola*. Two species are currently included by AB.

***Micrasterias* C. Agardh ex Ralfs 1848, p. 68.**

T: *non designatus*.

Ralfs (1848, pp. 69-77) includes 13 species in the genus *Micrasterias* “Ag.” and a further five in his Appendix (Ralfs 1848, pp. 209-211), of which *M. furcata* C. Agardh ex Ralfs and *M. radiata* C. Agardh ex Ralfs were species described by C. Agardh. The ING (Feb 2013) lists *Micrasterias* as not

having a designated type species, although Gontcharov (2008, Table 1) lists *M. furcata* as the “type species” but does not indicate a source of this lectotypification. As *Micrasterias furcata* C. Agardh *nom. deval.* was the only species initially included by C. Agardh (1827, p. 643) in *Micrasterias* C. Agardh 1827, p. 642, *nom. deval.* and was included by Ralfs (1848, p. 73), it is appropriate that *Micrasterias furcata* C. Agardh ex Ralfs be designated here as the lectotype species of *Micrasterias* C. Agardh ex Ralfs.

Gontcharov (2008, Table 1) gives 75 as the number of species, of which AB recognised 56, but revision of the names is currently incomplete.

Heterotypic synonyms: *Tetrachastrum* R. V. Dixon 1859, p. 465. T: *non designatus*. Three species were included in the original description of *Tetrachastrum* R. V. Dixon: *T. mucronatum* R. V. Dixon, *T. oscitans* (Ralfs) R. V. Dixon, and *T. pinnatifidum* (Ralfs) R. V. Dixon. All three of Dixon’s species are presently regarded as a species of *Micrasterias*. In view of the possible polyphyly of *Micrasterias* as currently treated, it would be premature to select a lectotype at this time.

Holocystis Hassall ex Wallich 1860, p. 274. T: *non designatus*. *Holocystis* Hassall 1845, p. 386, *nom. deval.* T: *Holocystis oscitans* Hassall is a devalidated name. Although the valid name *Holocystis* Hassall ex Wallich included two species, *H. oscitans* (Ralfs) Wallich and *H. incisa* (Ralfs) Wallich, it would be logical to designate here *H. oscitans* (Ralfs) Wallich as the lectotype of *Holocystis* Hassall ex Wallich. *Holocystis oscitans* is currently regarded as a species of *Micrasterias*.

***Octacanthium* (Hansgirg) Compère 1996, p. 502.**

T: *Octacanthium octocorne* (Ralfs) Compère.

Compère (1996, p. 502) proposed that *Arthrodesmus* section *Octacanthium* Hansgirg 1886, p. 203 be raised to genus status, and designated *Octacanthium octocorne* (Ralfs) Compère as the type. He also provide a diagnosis and specified “gen. nov.”

Nine species of the genus are included in AB.

Note: Compère (1996) and other authors give the date as 1888 but the title page of vol. 6 part 5 has “1886”.

***Onychonema* Wallich 1860, pp. 186, 194.**

T: *Onychonema uncinatum* Wallich.

A single species, *Onychonema uncinatum* from India, was included by Wallich (1860, p. 195). The type species was referred to *Sphaerosozma* by Bourrelly (1964).

Only the type species is currently included in AB.

***Oocardium* Nägeli 1849, p. 74.**

T: *Oocardium stratum* Nägeli.

Nägeli (1849, p. 75) designated *Oocardium stratum* Nägeli as the type species.

Gontcharov (2008, Table 1) includes a single species, the type; AB also included the little-known species *Oocardium depressum* Wallner (Wallner 1935).

***Phymatodocis* Nordstedt 1878, p. 18.**

T: *Phymatodocis alternans* Nordstedt.

Nordstedt (1878, p. 19) included a single species in *Phymatodocis*.

Gontcharov (2008, Table 1) gives “3-4” as the number of species; AB currently includes three species.

***Pleurotaeniopsis* (Lundell) Lagerheim 1887, p. 194.**

T: *non designatus*.

Lagerheim (1887, p. 197) raised *Cosmarium* subgenus *Pleurotaeniopsis* Lundell 1871, p. 51 to genus level. Seven species were included by Lundell in *Cosmarium* subgenus *Pleurotaeniopsis*, and three were included by Lagerheim: *Pleurotaeniopsis cucumis* (Corda ex Ralfs) Lagerheim, *Pleurotaeniopsis pseudoconnata* (Nordstedt) Lagerheim, of which only *Cosmarium cucumis* Corda ex Ralfs was included by Lundell (1871). It thus seems appropriate therefore to designate here *Pleurotaeniopsis cucumis* (Corda ex Ralfs) Lagerheim as the lectotype species.

Gay (1884, p. 340) included *Cosmarium* subgenus *Pleurotaeniopsis* Lundell in the synonymy of his new genus *Cosmaridium* to which he referred one un-named species.

Gerrath (1993, Table 1) and Gontcharov (2008, Table 1) did not include the genus; AB currently includes 7 species as current and these will have to be assessed in terms of the lectotype, which Kouwets (1999, p. 35) included in *Cosmarium*.

***Pleurotaenium* Nägeli 1849, p. 104.**

T: *Pleurotaenium trabecula* Nägeli.

Nägeli (1849, p. 104) designated “*Pleurotaenium Trabecula* (*Closterium Trabecula* Ehrenb.)” as the generitype. As *Closterium trabecula* Ehrenberg is a devalidated name, the correct name for the generitype is *Pleurotaenium trabecula* Nägeli (cf. Gontcharov 2008, Table 1).

Gontcharov (2008, Table 1) includes 50 species of the genus; AB currently included 52 species.

Heterotypic synonym and a potentially heterotypic synonym: *Arthrorhabdium* Ehrenberg 1869, p. 43. T: *Arthrorhabdium moluccense* Ehrenberg. Initially flagged as a diatom (‘mikroskopischen Bacillarien’) from Mexico, Turner (1893, p. 34) suggested a relationship to *Docidium verrucosum* Ralfs, now *Pleurotaenium verrucosum* (Ralfs) H. C. Wood.

Docidiopsis Raciborski 1889, p. 107. T: *Docidiopsis nodosa* (J. W. Bailey ex Ralfs) Raciborski (*Docidium nodosum* J. W. Bailey ex Ralfs). The type is currently referred

to *Pleurotaenium nodosum* (J. W. Bailey ex Ralfs) Lundell. ***Prescottella* Bicudo 1976, p. 23.**

T: *Prescottella sudanensis* (Grönblad, Prowse & E. M. Scott) Bicudo.

Prescottella sudanensis was selected as type species by Bicudo (1976, p. 22, Summary), and was the only species included in the original description (Bicudo 1976, p. 23). It is currently the only species of the genus (Gontcharov 2008, AB).

***Raphidiastrum* Palamar-Mordvintseva [Palamar-Mordvintzeva] 1976, p. 398 [not seen].**

T: *Raphidiastrum brasiliense* (Nordstedt) Palamar-Mordvintseva (*Staurastrum brasiliense* Nordstedt).

In ING this genus is attributed solely to Palamar-Mordvintseva although the name was perhaps originally proposed as a subgenus of *Staurastrum* by Turner (1893, p. 133) where he names as “Typ. sp.” “*St. echinatum, teliferum, geminatum*”. However, the species seemingly chosen as type species by Palamar-Mordvintseva (1976) is not amongst these. Other species referred to the genus are listed in INA as invalid.

***Sphaerosozma* Ralfs 1848, p. 65, nom. et typ. cons.**

T: *Sphaerosozma vertebratum* Ralfs.

Sphaerosozma Ralfs has been conserved against *Sphaerosozma* Corda (1842, p. 27) (Gerloff 1976), the type of which is referable to the Fungi (Pyronemataceae). Gerloff (1976, p. 201) has further explained why the genus should be typified by *Sphaerosozma vertebratum* Ralfs. Gontcharov (2008, Table 1) lists as type “*Sphaerosozma vertebratum* [sic] Bréb. ex Ralfs”.

Gontcharov (2008, Table 1) lists 13 species; AB currently includes 10.

Heterotypic synonym: *Leuronema* Wallich 1860, p. 186. T: *Leuronema nitens* Wallich. The type is currently referred to *Sphaerosozma nitens* (Wallich) De Toni (De Toni 1889, pp. 788, 794).

***Spinocosmarium* Prescott & A. M. Scott 1942, p. 16.**

T: *non designatus*.

Two species (and a forma) were included in the original description of *Spinocosmarium* (Prescott and Scott 1942, p. 16-19). A lectotype has not been formally proposed; Gontcharov (2008, Table 1) gave *Spinocosmarium quadridens* (H. C. Wood) Prescott & A. M. Scott, which was one of the included species, as the “type species” and it is appropriate to designate here this species as the lectotype.

Gontcharov (2008, Table 1) and AB include two species in the genus.

***Spondylosium* Brébisson ex Kützing 1849, p. 189.**

T: *non designatus*.

Two species were included by Kützing (1849, p. 189) in the original description, *Spondylosium depressum* Brébisson ex Kützing and *S. stomatophorum* Kützing. The latter was referred to *Sphaerosozma stomatophorum* (Kützing) Rabenhorst by Rabenhorst (1868, p. 151). Gontcharov (2008, Table 1) named *Spondylosium depressum* Brébisson ex Kützing as the “type species” and it is designated here as the lectotype species.

Gontcharov (2008, Table 1) give 34 as the number of species, whereas AB lists 18 species of the genus.

***Staurastrum* Meyen ex Ralfs 1848.**

T: *non designatus*.

Ralfs (1848, pp. 119-144) included thirty-eight species of *Staurastrum* found in Britain, of which twenty were ascribed to Brébisson, eleven to Ralfs (newly or previously published), five to Ehrenberg, one to Kützing and one to Meyen. In an Appendix, Ralfs (1848, pp. 213-217) a further eighteen species not known from Britain: eight described by Brébisson, six by Ehrenberg, two by Corda, and one each by himself (from the USA) and one by Kützing. The genus was originally named by Meyen (1829, p. 777), and included only *Staurastrum paradoxum* Meyen, nom. deval. As *Staurastrum paradoxum* Meyen ex Ralfs is a widespread and well-known species and is currently included as a species of the genus *Staurastrum*, it is designated here as the lectotype of the genus. The type locality for *Staurastrum paradoxum* is Potsdam, Germany and is illustrated by Meyen (1829, Pl. XLIII, Figs 37 & 38), which can serve as an iconotype. Gontcharov (2008, Table 1) listed *Staurastrum gracile* Ralfs as the “type species” but included a question mark before the name indicating some doubt. While this is an included species in the genus *Staurastrum* as treated in Ralfs (1848), it was not named by Meyen, and *S. paradoxum* Meyen ex Ralfs is a more consistent choice.

Gontcharov (2008, Table 1) gives 800 as the number of species, whereas AB lists 376 species of the genus, but the names have not been systematically polled to date.

Heterotypic and potentially heterotypic synonyms: *Pentasterias* Ehrenberg 1836, p. 173, nom. deval. T: *Pentasterias margaritacea* Ehrenberg, nom. deval. *Pentasterias* Ehrenberg does not seem to have been validated, and *Pentasterias margaritacea* has been treated as a synonym of *Staurastrum margaritaceum* Meneghini ex Ralfs; Ralfs (1848, p. 134) in fact attributed the name to Ehrenberg.

Didymocladon Ralfs 1848, p. 144. T: *Didymocladon furcigerus* Ralfs. This genus was monotypic when described (Ralfs 1848); the type is currently referred to *Staurastrum* as *S. furcigerum* (Brébisson) W. Archer in Pritchard (1861, p. 743).

Stephanoxantium Kützing 1849, p. 184. T: *non designatus*. Kützing (1849, p. 184) included four species: *Stephanoxantium senarium* Kützing, *S. eustephanum* Kützing, *S. monticlosum* Kützing, and *S. sexcostatum* Kützing. All are currently referred to *Staurastrum*; however, a lectotype has not been selected. Further investigation of the protologue and of the included species is necessary prior to selecting a lectotype.

Amblyactinium (Nägeli) Cramer in Rabenhorst 1863, no. 1445. T: *Phycastrum orbiculare* (Ralfs) Kützing (*Staurastrum orbiculare* Meneghini ex Ralfs) according to ING. The genus was based on *Phycastrum* subgenus *Amblyactinium* Nägeli 1849, p. 125, and the type is currently included in *Staurastrum*.

Pleurenterium (Lundell) Lagerheim 1888, p. 10. T: *non designatus*. *Staurastrum* subgenus *Pleurenterium* Lundell 1871, p. 72. Lundell (1871, p. 72) included *Staurastrum tumidum*, *S. grande*, *S. longispinum*, *S. brasilense*, and *S. sexcostatum* in his *Staurastrum* subgenus *Pleurenterium*. However, Lagerheim (1888, p. 10) included only *Pleurenterium longispina* (J. W. Bailey) Lagerheim [*Staurastrum longispinum* (Bailey) W. Archer]. Thus I designate here *Pleurenterium longispina* (J. W. Bailey) Lagerheim as lectotype.

Dichotomum West & G. S. West 1896b, p. 270. T: *non designatus*. Two species were included by West and West (1896b, p. 270), a new species, *Dichotomum elegans* West & G. S. West (1896b, p. 270, Pl. 16, Fig. 33) and *D. bibrachiatum* (Reinsch) West & G. S. West. The latter is considered by Kouwets (1999, p. 107, and included authors) as a *Staurastrum*. The identity of the new species named by the Wests is uncertain, so it would be best not to designate a type until this entity is examined further.

Cosmoastrum Palamar-Mordvinsteva [Palamar-Mordvintzeva] 1976, p. 397. T: *Cosmoastrum polytrichum* (Perty) Palamar-Mordvintzeva. The type species is currently referred to *Staurastrum* as *Staurastrum polytrichum* (Perty) Rabenhorst by some authors (e.g., Stastny 2009).

Cylindriastrum (W. B. Turner) Palamar-Mordvinsteva 1976, p. 396. T: *Cylindriastrum pileolatum* (Brébisson) Palamar-Mordvinsteva. Palamar-Mordvinsteva (1976, p. 396) proposed raising *Staurastrum* subgenus *Cylindriastrum* W. B. Turner 1893, p. 113, to genus level. Three species, including *Staurastrum pileolatum*, were included in *Staurastrum* subgenus *Cylindriastrum* by Turner (1893, p. 133 “Typ. sp.”) but no type species was named by Turner. *Staurastrum pileolatum* is still included as a species of *Staurastrum* in recent studies (e.g., Kouwets 1999, Martello 2006).

Cosmoastrum and *Cylindriastrum* will require careful reconsideration in any reorganization of the species of *Staurastrum*.

Stauroidesmus Teiling 1948, p. 76.

T: *non designatus*.

Compère (1977b, p. 263) lectotypified *Stauroidesmus* with *Stauroidesmus triangularis* (Lagerheim) Teiling, a species included in the original description by Teiling (1948), although ING currently (February 2013) lists the type as “*non designatus*”. This is also the “type species” listed by Gontcharov (2008, Table 1).

Gontcharov (2008, Table 1) gives 100 as the number of species of *Stauroidesmus* recognised taxonomically; AB lists 64.

Heterotypic synonym: *Arthrodesmus* Ehrenberg ex Ralfs 1848, p. 50. Two species were included in *Arthrodesmus* by Ralfs (1848, p. 118) in the main body of his text: *Arthrodesmus convergens* Ehrenberg ex Ralfs and *A. incus* Hassall ex Ralfs, both of which species are currently included in *Stauroidesmus*. Two further species were included by him in his Appendix (Ralfs 1848, p. 213): *Arthrodesmus minutus* Brébisson ex Kützing and *Arthrodesmus truncatus* Ehrenberg ex Ralfs. In view of the possible polyphyly of *Stauroidesmus* it would be rash to choose a lectotype from these four species for *Arthrodesmus* at this time.

Streptonema Wallich 1860, pp. 186, 196.

T: *Streptonema trilobatum* Wallich.

A single species, *Streptonema trilobatum* Wallich from Bengal, India, was included by Wallich (1860, p. 196).

Gontcharov (2008, Table 1) gives two as the number of species; AB includes three species of *Streptonema* currently.

Teilingia Bourrelly 1964, p. 190.

T: *Teilingia excavata* (Ralfs ex Ralfs) Bourrelly.

Eight species were included in the original description of *Teilingia* by Bourrelly (1964) of which *Teilingia excavata* (Ralfs ex Ralfs) Bourrelly was selected by him as the type species.

Gontcharov (2008, Table 4) gives seven as the number of species; AB includes four currently.

Tetmemorus Ralfs ex Ralfs 1848, p. 145.

T: *non designatus*.

Three species were included by Ralfs (1848, pp. 145-148): *T. brebissonii* Ralfs ex Ralfs, *T. laevis* Ralfs ex Ralfs, and *T. granulatus* Ralfs ex Ralfs; all three were included in *Tetmemorus* Ralfs 1844, *nom. deval.* (Ralfs 1844), and are still recognised as species of the genus. *Tetmemorus granulatus* was named by Gontcharov (2008, Table 1) as “type species”, and is here designated as the lectotype.

***Triplastrum* Iyengar & Ramanathan 1942, p. 228.**

T: *non designatus*.

Three species were originally included in the genus *Triplastrum* by Iyengar and Ramanathan (1942, p. 228): *T. indicum* Iyengar & Ramanathan, *T. abbreviatum* (W. B. Turner) Iyengar & Ramanathan and *T. simplex* (Allorge) Iyengar & Ramanathan. *Triplastrum abbreviatum* is listed as the “type species” by Gontcharov (2008, Table 1), and is here designated as the lectotype species of the genus *Triplastrum*. Škaloud et al. (2012, p. 1282) review the taxonomic difficulties associated with all three species.

Gontcharov (2008, Table 1) and AB give three as the number of species.

***Triploceras* J. W. Bailey 1851, p. 37.**

T: *non designatus*.

Two species were originally included in the genus *Triploceras* by Bailey (1851, p. 37): *T. verticillatum* (J. W. Bailey) J. W. Bailey and *T. gracile* J. W. Bailey. Gontcharov (2008, Table 1) gives *T. verticillatum* as the “type species”, and this is here designated as the lectotype species.

Gontcharov (2008, Table 1) gives three as the number of species; seven species are included in AB.

***Vincularia* K. Fučíková & J. Kastovsky 2009, p. 51.**

T: *Vincularia roraimae* K. Fuciková & J. Kastovsky.

Vincularia was described with a single species *Vincularia roraimae* K. Fuciková & J. Kastovsky from Venezuela. No other species have been described.

Vincularia Defrance 1829, a genus of fossil Bryozoa from the Eocene (Voigt 1968), has not been treated as a plant—at least it is not to be found in ING.

***Xanthidium* Ehrenberg ex Ralfs 1848, p. 111.**

T: *non designatus*.

Six species were initially included by Ralfs (1848, pp. 111–117): *X. armatum* Ehrenberg ex Ralfs, *X. aculeatum* Ehrenberg ex Ralfs, *X. brebissonii* Ralfs, *X. fasciculatum* Ehrenberg ex Ralfs, *X. cistatum* Brébisson ex Ralfs, and *X. octocorne* Ehrenberg ex Ralfs. The last was queried by Ralfs (1848, pp. 112, 116) as a species of the genus, and should not be selected as a lectotype, even though it is currently included in the genus. A further two species were included by Ralfs (1848, pp. 212, 213, Appendix): *X. artiscon* Ehrenberg ex Ralfs and *X. furcatum* Ehrenberg ex Ralfs. Three species were included originally by Ehrenberg (1834, pp. 317, 318) in *Xanthidium* Ehrenberg, *nom. deval.*: *X. hirsutum* Ehrenberg, *nom. deval.*, *X. aculeatum* Ehrenberg, *nom. deval.* and *X. furcatum* Ehrenberg, *nom. deval.*, and all three are presently included in the genus. A lectotype should be chosen from amongst these three species, since Ralfs (1848) adopted Ehrenberg’s name. Gerrath (1993, Table 1) lists *Xanthidium aculeatum* Eh-

renberg ex Ralfs as the “Type species” and I here designate this species as lectotype.

Gontcharov (2008, Table 1) gives 115 as the number of species; 75 species are currently included in AB.

Heterotypic and potentially heterotypic synonyms: *Asteroxanthium* Kützing 1849, p. 183. T: *non designatus*. Seven species were referred to *Asteroxanthium*, mostly referred now to *Xanthidium* species. It would be premature to select a lectotype at this time.

Holacanthum (Lundell) Wille 1890, pp. 7, 11. T: *non designatus*. In raising *Xanthidium* subg. *Holacanthum* Lundell (1871, p. 74) to genus level, Wille included two species, *Holacanthum aculeatum* (Ehrenberg ex Ralfs) Wille and *H. cristatum* (Brébisson ex Ralfs) Wille, both of which are currently referred to the genus *Xanthidium*. Again, it would be premature to select a lectotype at this time.

Schizacanthum (Lundell) Wille 1890, pp. 7, 11. T: *S. armatum* (Brébisson ex Ralfs) Wille (*Xanthidium armatum* Brébisson ex Ralfs). Wille (1890) raised *Xanthidium* subgenus *Schizacanthum* Lundell 1871, p. 74, to genus level. The type is currently treated as a species of *Xanthidium*.

Genera incertae sedis***Phycastrum* Kützing ex Kützing 1849, p. 178.**

T: *non designatus*.

Phycastrum Kützing 1845, p. 137, *nom. deval.* included 15 species; the genus name was validated by Kützing (1849, p. 178) when 29 species were included (and one treated as dubious). The genus was also included by Nägeli (1849, p. 124). Kützing’s *Species algarum* appeared on Jul 23 or 24, 1849, whilst Nägeli’s *Gattungen einzelliger Algen* seemingly appeared later in the same year. Neither author indicated a type, and the genus does not appear to have been typified since. ING includes *Phycastrum* in the Desmidiaceae.

Until a lectotype is selected, preferably from the 15 species originally listed by Kützing (1845), despite their invalidity, and subsequently included by Kützing (1849), I have treated this genus as of uncertain status in AB.

Family Gonatozygaceae F. E. Fritsch in G. S. West & F. E. Fritsch 1927, p. 239***Genicularia* De Bary 1858, p. 77.**

T: *Genicularia spirotaenia* (De Bary) De Bary.

A single species, *Genicularia spirotaenia* (De Bary) De Bary, was included by De Bary (1858, p. 77) in the original description of the genus *Genicularia*.

Genicularia is not included in Gontcharov (2008, Table

1); two species are currently included in AB: the type species and *G. elegans* West & G. S. West.

Gonatozygon De Bary 1856, p. 105.

T: *non designates*.

Two species, *Gonatozygon spirotaenium* De Bary and *G. monotaenium* De Bary were included in the original description by De Bary (1856, p. 106). Gontcharov (2008, Table 1) lists *G. monotaenium* De Bary as the “type species” and this is designated here as the type species.

Gontcharov (2008, Table 1) gives 11 as the number of species; AB lists 9.

Heterotypic synonym: *Leptocystinema* W. Archer 1858, p. 250. LT: *Leptocystinema kinahanii* W. Archer. Three species were originally included by Archer (1858, p. 250): *L. kinahanii* W. Archer (*‘Kinahani’*), *L. asperum* (Brébisson) W. Archer and *L. portei* W. Archer (*‘Portii’*). A lectotype of *Leptocystinema kinahanii* W. Archer was chosen by Ralfs in Pritchard (1861, p. 722). Rabenhorst (1868, p. 156) has referred the type to *Gonatozygon* as *Gonatozygon kinahanii* (W. Archer) Rabenhorst.

Family Peniaceae Haeckel 1894, pp. 97 (*‘Peniaceae’*), 112

Penium Brébisson ex Ralfs 1848, p. 148.

T: *non designates*.

Seven species were listed in Ralfs (1848, pp. 148-154), of which three were included by Brébisson in his communication of his new genus to Ralfs (*‘in lit.’*): *P. margaritaceum* Brébisson ex Ralfs, *P. cylindrus* Brébisson ex Ralfs (*‘Cylindrus’*), and *P. digitus* Brébisson ex Ralfs. A lectotype does not appear to have been selected. *Penium digitus* is now considered a species of *Netrium*. Ralfs (1848, p. 150) refers to *P. cylindrus* as resembling *‘... P. margaritaceum in form, ...’*; thus *P. margaritaceum* Brébisson is an appropriate choice as lectotype of the genus *Penium* Brébisson ex Ralfs and is formally here designated as such. This species was listed by Gontcharov (2008, Table 1) as the “type species”.

Gontcharov (2008, Table 1) gives 16 as the number of species whilst AB lists 23.

Homotypic synonym: *Pleurosicyos* Corda ex Kuntze 1898, p. 421, *nom. illeg.* This is an illegitimate substitute name for *Penium* Brébisson ex Ralfs 1848.

Genus classis incertae sedis

Spirotaenia Brébisson ex Ralfs 1848, p. 178.

LT: *Spirotaenia condensata* Brébisson ex Ralfs.

Two species were originally included in *Spirotaenia* Brébisson in Ralfs (1848, p. 179); of these Silva (1952, p.

252) selected *S. condensata* Brébisson in Ralfs as the “... only species in Brébisson’s manuscript.” The other species, *Spirotaenia obscura* Ralfs, was added by Ralfs (1848, p. 179, Pl. XXXIV, Fig. 2a-e) and is now referred to *Tortitaenia* as *Tortitaenia obscura* (Ralfs) A. J. Brook (Brook 1998).

Gontcharov (2008, Table 1) places *Spirotaenia* in the Mesotaeniaceae and includes 23 species; AB lists 21 species.

Some recent studies (Gontcharov and Melkonian 2004, Gontcharov 2008) strongly suggest that *Spirotaenia* may not be related to other members of the Zygnematophyceae but is more closely related to *Chlorokybus* (currently referred to the Klebsormidiaceae, Klebsormidiophyceae).

Genera with unresolved affinities

These are in alphabetical order. A number of these are based on fossil taxa that can be difficult to ascribe to any particular family.

Astrocosmium Stockmayer 1888, p. 85. T: *non designatus*. Stockmayer (1888, p. 85) named a genus which he considered related to *Cosmarium* and *Cosmaridium* but differed from these genera in having stellate chloroplasts. I have found no further publication on this genus, nor have I been able to discover any species that have been referred to it.

Baccinellula H. Weyland 1963, p. 35. T: *Baccinellula cosmarioides* H. Weyland. *Baccinellula cosmarioides* is a fossil from the Pliocene, thought to be related to the Desmidiaceae.

Closterimopsis L. M. Yin & Z. P. Li 1978, pp. 94, 101. T: *Closterimopsis curvus* L. M. Yin & Z. P. Li. A Precambrian fossil thought to be related to the Desmidiaceae.

Desmidopsis L. M. Yin et Z. P. Li 1978, pp. 94, 101. T: *Desmidopsis prima* L. M. Yin & Z. P. Li. *Desmidopsis prima* is a fossil from the Precambrian, said to be related to the Desmidiaceae.

Didymidium Reinsch 1867, pp. 104, 106. ING remarks that this is an “illegitimate name applied to [a] comprehensive genus including *Cosmarium* Ralfs 1848, *Euastrum* Ralfs 1848, *Micrasterias* Ralfs 1848, *Staurastrum* Ralfs 1848, and *Xanthidium* Ralfs 1848.” INA lists 213 specific and infraspecific names allocated to the genus by Reinsch.

Polysolenia Ehrenberg ex Kützing 1849, p. 169. T: *Polysolenia closterium* Ehrenberg ex Kützing. According to the ING “... material upon which the generic description was based is usually interpreted as a desmid parasitized by a fungus.”

Schizospora Reinsch 1875, p. 87. T: *non designatus*. In

a review of *Contributiones ad algologiam et fungologiam* shortly after publication, William Archer (*Quarterly Journal of Microscopical Science*, New Series, 16: 101, 1876) dismissed the genus *Schizospora* as "... untenable, or, at least, unnecessary." That certainly was a clear opinion.

Spirogyrites V. B. Shukla 1950, p. 29. T: *non designatus*. The species are fossils from the Tertiary, and require further investigation.

Stenixys T. M. Harris 1938, p. 14. T: *S. cosmarioides* T. M. Harris. This is a fossil species from the Upper Rhaetic (Triassic or Lias), said to be related to the Desmidiaceae.

CONCLUSIONS

The number of currently described species of conjugating green algae in AlgaeBase is about 3,500, comprising about 10% of all algal species. About one third of conjugating algae are referred to the Zygnematales and two-thirds to the Desmidiales. About 10% of all algal names at the species level and below have been applied to conjugating algae.

Extensive molecular studies are required in the class Conjugatophyceae to establish the taxonomic status of the generic names used. This work cannot be carried out in any logical way without careful reference to the type species of all the generic names above, otherwise the "boards" (see p. 3) cannot be nailed down.

A difficulty that relates to the Conjugatophyceae and many other algae, particularly the diatoms, is that a considerable proportion of the entities described are known only from the type material, and relatively few are to be found in culture collections. A further difficulty is that some of the isolates in the self-same culture collections may bear no relationship to the types, even though many such names are treated by various molecular taxonomists as in some way sacrosanct.

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Appendix 1.

The following new combinations are required (see p. 8):

***Transeauina ackleyana* (Transeau) comb. nov.**

Basionym: *Debarya ackleyana* Transeau *Papers from the Department of Botany of the Ohio State University* 44, p. 244, 1944.

***Transeauina columbiana* (Transeau) comb. nov.**

Basionym: *Debarya columbiana* Transeau in W. R. Taylor *Proceedings of the Academy of Natural Sciences of Philadelphia* 80, p. 96, Fig. 3, 1928.

***Transeauina costata* (Randhawa) comb. nov.**

Basionym: *Debarya costata* Randhawa *Proceedings of the Indian Academy of Sciences, Section B* 8, p. 121, Fig. 2, 1938.

***Transeauina formosa* (Transeau) comb. nov.**

Basionym: *Debarya glyptosperma* f. *formosa* Transeau *Ohio Journal of Science* 16, p. 18, 1916 ('1915').

Synonym: *Debarya formosa* (Transeau) Krieger, in Kolkwitz & Krieger *Kryptogamen-Flora von Deutschland und der Schweiz*. 13, p. 204, 1941.

***Transeauina glabra* (Woodhead & Tweed) comb. nov.**

Basionym: *Debarya glabra* Woodhead & Tweed *Biologisch Jaarboek* 22, p. 243, Fig. 5: a, b, 1955.

***Transeauina glyptosperma* (De Bary) comb. nov.**

Basionym: *Mougeotia glyptosperma* De Bary *Untersuchungen über die Familie der Conjugaten*, p. 78, Pl. VIII, Figs 20-25, 1858.

Synonym: *Debarya glyptosperma* (De Bary) Wittrock in Kjellman *Points-förteckning öfver Skandinaviens växter. Enumeratur plantae scandinaviae*, p. 24 (*vide* De Toni 1889: 727), 1880.

***Transeauina hardyi* (G. S. West) comb. nov.**

Basionym: *Debarya hardyi* G. S. West *Journal of Linnean Society (Botany)* 39, p. 51, Pl. 2, 1909.

***Transeauina immersa* (West) comb. nov.**

Basionym: *Mougeotia immersa* West *Journal of Botany, British and Foreign* 40, p. 144, 1902.

Synonym: *Debarya immersa* (West) West *Journal of Botany, British and Foreign* 41, p. 58, 1903.

***Transeauina jogensis* (Iyengar) comb. nov.**

Basionym: *Debarya jogensis* Iyengar in Randhawa *Zygnemataceae*. New Delhi: Indian Council for Agriculture. Research Monographs on Algae, p. 111, Fig. 7A: a-f, 1959.

***Transeauina madrasensis* (Iyengar) comb. nov.**

Basionym: *Debarya madrasensis* Iyengar in Randhawa *Zygnemataceae*. New Delhi: Indian Council for Agriculture. Research Monographs on Algae, p. 113, Fig. 7B, 1959.

***Transeauina polyedrica* (Skuja) comb. nov.**

Basionym: *Debarya polyedrica* Skuja, *Algae. In Botanische Ergebnisse der Expedition der Akademie der Wissenschaften in Wien nach Südwest-China 1914/1918*. (Handel-Mazzetti, H. Eds). J. Springer, Wien 1, p. 84, Fig. 11: 3-8, 1937.

***Transeauina sierra-leonensis* (Woodhead & Tweed) comb. nov.**

Basionym: *Debarya sierra-leonensis* Woodhead & Tweed *Biologisch Jaarboek* 22, p. 243, Fig. 1: a-c, 1955.

***Transeauina smithii* (Transeau) comb. nov.**

Basionym: *Debarya smithii* Transeau in Transeau, Tiffany, Taft & L. C. Li *Transactions of the American Microscopical Society* 53, p. 216, 1934.