Phytoplankton dynamics from the Cambrian Explosion to the onset of the Great Ordovician Biodiversification Event: a review of Cambrian acritarch diversity

Hendrik Nowak[a], Thomas Servais[a,*], Claude Monnet[a], Stewart G. Molyneux[b], Thijs R. A. Vandenbroucke[a]

[a] Evo-Eco-Paleo, UMR 8198, CNRS-University of Lille, Avenue Paul Langevin, bâtiment SN5, 59655 Villeneuve d'Ascq Cedex, France

[b] Honorary Research Associate, British Geological Survey Environmental Science Centre, Nicker Hill, Keyworth, Nottingham, NG12 5GG, United Kingdom

* Corresponding author. Tel.: +33 320337220.
E-mail addresses: hendrik.nowak@etudiant.univ-lille1.fr (H. Nowak), thomas.servais@univ-lille1.fr (T. Servais), claude.monnet@univ-lille1.fr (C. Monnet), sgm@bgs.ac.uk (S.G. Molyneux), thijs.vandenbroucke@univ-lille1.fr (T.R.A. Vandenbroucke).

Abstract: Most early Palaeozoic acritarchs are thought to represent a part of the marine phytoplankton and so constituted a significant element at the base of the marine trophic chain during the 'Cambrian Explosion' and the subsequent 'Great Ordovician Biodiversification Event.' Cambrian acritarch occurrences have been recorded in a great number of studies. In this paper, published data on Cambrian acritarchs are assembled in order to reconstruct taxonomic diversity trends that can be compared with the biodiversity of marine invertebrates. We compile a database and calculate various diversity indices at global and regional (i.e. Gondwana or Baltica) scales. The stratigraphic bins applied are at the level of the ten Cambrian stages, or of fourteen commonly used biozones in a somewhat higher resolved scheme. Our results show marked differences between palaeogeographical regions. They also indicate limitations of the data and a potential sampling bias, as the taxonomic diversity indices of species are significantly correlated with the number of studies per stratigraphic bin. The total and normalized diversities of genera are not affected in the same way. The normalized genus diversity curves show a slow but irregular rise over the course of the Cambrian. These also are the least biased. A radiation of species and to a lesser extent of genera in the 'lower' Cambrian Series 2 appears to mirror the 'Cambrian Explosion' of metazoans. This radiation, not evident on Gondwana, is followed by a prominent low in species diversity in the upper Series 3 and lower Furongian. Highest diversities are reached globally, and on both Baltica and Gondwana, in the uppermost Cambrian Stage 10, more precisely in the *Peltura* trilobite Zone, preceding a substantial phase of acritarch species extinction below and at the Cambrian/Ordovician boundary. Nearly all the genera present in Stage 10 survived into the Ordovician. The forms that emerged during the Cambrian therefore became the foundation for the more rapid radiation of acritarchs during the 'Great Ordovician Biodiversification Event'.

Keywords: phytoplankton; acritarchs; Cambrian; biodiversity; paleobiogeography

1. Introduction

The Cambrian fossil record is marked by the well-known 'Cambrian Explosion' (or radiation), which is characterized by the appearance of most metazoan phyla in a seemingly short interval (e.g. Conway Morris, 2000). Although molecular clock estimates now indicate a Proterozoic origin for many lineages (Erwin et al., 2011), the Cambrian Explosion is still considered to be one of the most important periods in the history of life. It was followed in the Ordovician by the 'Great Ordovician Biodiversification Event' (GOBE), an episode of rising taxonomic diversity in most marine organisms and of increasingly complex ecosystems that were more diverse and differentiated than those of the Cambrian, with a wider range of ecological niches (Webby et al., 2004; Bambach et al., 2007). Whether these two episodes were in fact separate, or should be considered as one long period of diversification, is currently debated (Alroy et al., 2008), as are their possible causes and mechanisms.

Phytoplankton is an important constituent at the base of the foodweb today and in this capacity may have played a key role in the early Palaeozoic diversification events (Debrenne and Zhuravlev, 1997; Butterfield, 1997). It has been argued that a higher concentration of phytoplankton in the early Palaeozoic oceans triggered the major evolutionary events and had an important impact on metazoan diversification. Butterfield (1997), for example, argued that the interaction between phytoplankton and metazoans fuelled the Cambrian Explosion after the appearance of mesozooplankton. Similarly, Servais et al. (2008, 2010) argued that the evolution of the phytoplankton triggered a 'plankton revolution' through the Cambrian–Ordovician boundary interval at the beginning of the GOBE. The expanding and increasingly diverse phytoplankton could have served as food for the developing zooplankton, but also for various clades of suspension feeders and detritus feeding organisms. Detailed knowledge on the development of biomass, taxonomic and morphological diversity of phytoplankton would be useful to test this hypothesis. Here we concentrate on taxonomic diversity.

The phytoplankton of early Palaeozoic oceans is generally considered to be present among the acritarchs, which are defined as organic-walled microfossils of uncertain biological affinity (Evitt, 1963). Consequently, the acritarchs are a polyphyletic group and have a long stratigraphical range. A number of organisms originally considered to be acritarchs now have established affinities with other groups, including prasinophycean and zygnematacean green algae, cyanobacteria, dinoflagellates, multicellular algae (Butterfield, 2004; Mendelson, 1987), fungi (Butterfield, 2005) and even metazoans (e.g. schizomorphitae: Van Waveren, 1992; Van Waveren and Marcus, 1993; *Ceratophyton*: Kiryanov *in* Volkova et al. 1979; Fatka and Konzalová, 1995; large spinose Ediacaran microfossils: Cohen et al., 2009). Although technically no longer acritarchs (Evitt, 1963), they are still occasionally referred to as such. Nevertheless, most of the remaining Palaeozoic acritarchs are considered to be cysts of marine, generally planktonic unicellular algae, which are often globally distributed. We here use the term 'acritarchs' to include all organic-walled microfossils of possible phytoplankton origin, including acritarchs *s.s.* and organic microfossils that are now attributed to the green algae and cyanobacteria. Where preserved, they are often recovered in large numbers, even from small samples, resulting in an abundant record and frequent application in biostratigraphy (e.g. Martin and Dean, 1981; 1988; Moczydłowska, 1991; 1998; Vanguestaine and Van Looy, 1983).

Biomarker evidence suggests that Palaeozoic acritarchs may include forms that have a close biological affinity with (or be evolutionary precursors of) dinoflagellates (Moldowan and Talyzina, 1998; Talyzina et al., 2000). However, the oldest unambiguous dinoflagellates in the fossil record are from the Triassic (e.g. Fensome et al., 1993) and an alternative view is that the Palaeozoic acritarchs represent a "green" phytoplankton lineage (Martin et al., 2008). Observations of recent dinoflagellates have shown that only some species form organic-walled cysts with the potential to fossilise (Dale, 1976), and may do so at more than one stage in their life cycle (Fensome et al., 1996a). If, by analogy, Palaeozoic acritarchs are also cysts, perhaps of various algal groups, there is a clear implication that they only represent a part of the phytoplankton.

A further difficulty is that acritarch taxa are morphospecies rather than true biological species. In some instances, morphological gradations from one Palaeozoic acritarch taxon to another have been demonstrated, suggesting ecophenotypic variation rather than speciation (Servais et al., 2004b). If so, the number of taxa recorded would overestimate the number of biological species. Conversely, for the rather featureless sphaeromorph acritarchs, often identified simply as 'sphaeromorphs' or '*Leiosphaeridia* spp.', the number of taxa recorded probably underestimates biological diversity. Despite these limitations, acritarchs remain the main source of information for phytoplankton in the

Cambrian, long before the appearance of planktonic algae forming calcitic and siliceous skeletons during the Mesozoic (Bown, 2005; Sims et al., 2006).

Various Palaeozoic acritarch diversity curves have been published previously. Detailed global curves are available for the Carboniferous (Mullins and Servais, 2008), Lochkovian to Tournaisian (Klug et al. 2010) and the Permian (Lei et al., 2013). Regional diversity curves have been published for the Ordovician on the Yangtze Platform (South China) and North Africa (Algeria, Tunisia and Libya; also including the latest Cambrian; Servais et al. 2004a), for 'northern Gondwana' (including North Africa, Turkey, Saudi Arabia and several peri-Gondwanan microcontinents; Vecoli and Le Hérissé, 2004) and for Baltica (Hints et al., 2010). Li et al. (2007) published a diversity curve for genera in the Ordovician of South China, North China and Tarim.

Acritarch diversity curves that include the Cambrian have been published by Tappan and Loeblich (1972; 1973; genera, Precambrian to present), Vidal and Knoll (1982; species, upper Riphean to lower Cambrian), Knoll (1994; species, Proterozoic to lower Cambrian), Strother (1996; Precambrian and Phanerozoic, using data of Downie, 1984, and Fensome et al., 1990), Vidal and Moczydłowska (1997; species, Proterozoic to Cambrian), Moczydłowska (1998; species, Cambrian in Upper Silesia; and 2011; species, Ediacaran to basal Ordovician, global and Baltica), Zhuravlev (2001; genera, Cambrian to Tremadocian), Katz et al. (2004; species, Proterozoic to Neogene, and genera, Cambrian to Neogene), Huntley et al. (2006a; 2006b; genera, Proterozoic to Cambrian), Michaud in Strother (2008; genera, Phanerozoic), and Servais et al. (2008; species, middle Cambrian to Llandovery). Katz et al. (2004) and Michaud in Strother (2008) used the Palynodata database (see Fensome et al., 1996b) to create their diversity curves. Palynodata had been compiled by a consortium of oil companies and scientific institutions over the course of three decades and was discontinued in 2006. Mullins et al. (unpublished) compiled the PhytoPal database of acritarch occurrences covering the interval from the Cambrian to the Triassic (mainly Ordovician to

Devonian), data that were partly used by Servais et al. (2008), Klug et al. (2010) and Moczydłowska (2011).

All these publications present a (usually global) total diversity (see 2.3). Knoll (1994) and Knoll et al. (2006) also discussed the diversity of species in single assemblages through time between the Proterozoic and the early Cambrian. The resolution varies between a single value for the whole Cambrian (Tappan and Loeblich, 1972; 1973; Strother, 1996) and more than 20 intervals (Zhuravlev, 2001).

Acritarch diversity analyses that include the Proterozoic-Cambrian transition at sufficient resolution show fairly high global total diversities in the late Neoproterozoic, followed by decreasing diversity towards the end of the Ediacaran (Vidal and Knoll, 1983; Knoll, 1994; Vidal and Moczydłowska, 1997; Knoll et al., 2006). Several studies found a diversification during the early Cambrian to a peak around the late early/early middle Cambrian (Strother, 1996; Vidal and Moczydłowska, 1997; Moczydłowska, 1998; Zhuravlev, 2001). The Ordovician, when it is included, is marked by generally higher diversity than the Cambrian.

Diversity studies on Cambrian acritarchs published so far have had limitations in the choice of sources and in the analytical methods they applied, which may have allowed possible biases to go undetected, making them vulnerable to a certain degree of criticism. The goal of this study is to produce a robust database of acritarch occurrences in the Cambrian by compiling as much data as is feasible, in order to approximate their standing diversity using various methods, to identify evolutionary trends, and to test the results for biases. In particular, we address whether the Cambrian Explosion is reflected in acritarch diversity and whether the GOBE was preceded by a diversification of acritarchs, a temporal relation which would be a primary requirement in support of a cause-and-effect hypothesis. If phytoplankton had an effect on or was affected by these radiations, it might be expected that this would be reflected in acritarch diversity, and that, in turn, acritarch diversity might indicate general trends in phytoplankton biodiversity, assuming that other effects could be ruled out.

2. Materials and Methods

2.1. Source data

The literature on Cambrian acritarchs includes over 500 publications, but many studies do not include descriptions or precise biostratigraphical data. Occurrence data for acritarchs in this study are derived from 103 studies (see supporting material S1, S2). All available publications with consistent information on the presence of acritarch taxa in the Cambrian were included in the database, but only 72 of these studies reported assemblages with stratigraphic information that could be correlated precisely to any of the stratigraphic units we use (see 2.2., Fig. 1). We only included the latter in our subsequent diversity analysis.

Of the 72 source publications, 39 describe data from Gondwana (including various microcontinents on its periphery, most importantly 12 from Avalonia), 31 from Baltica, 11 from Laurentia, 11 from South China, 5 from Bruno-Silesia (or the Brunovistulicum), 4 from the Holy Cross Mountains (or the Małopolska 'Block'), 2 each from Tarim and Siberia, 1 from Kara and 1 from North China. Figure 2 shows the palaeogeographical positions of study areas of publications included in our analysis, using the base maps of Torsvik and Cocks (2013). The only distinct regions with sufficiently extensive records to allow individual diversity analyses for most of the Cambrian are Baltica and that part of (peri-)Gondwana that includes northwestern Africa, Avalonia, Iberia and Sardinia and which was positioned near the South Pole during the Cambrian (Hartz and Torsvik, 2002).

Many published studies only list selected, biostratigraphically useful taxa or those typical of an assemblage. As a consequence, it is possible that we have undersampled the full range of species and, by the nature of the fossil record, their actual stratigraphical ranges in the Cambrian. Nevertheless, we consider our database to be representative of the current state of research.

2.2. Database

Our database (supplementary material S1) contains exactly 6000 entries reporting the presence/absence (not abundance) of acritarch taxa within the studied stratigraphic intervals. Each entry contains information on the identification of the taxon in question, the entry's source study, study area and stratigraphic position (with lower and upper limits). Taxonomic information includes genus name; species epithet or placeholder; qualifiers such as '?', 'cf.' and 'aff.', where applicable, for either the genus or species; authorship; and the original identification if it has been revised. Generally, we relied on the identifications and age-assignment in the original studies or published later revisions. Obvious and reported synonymies were taken into account (see supplementary material S3). The applied names follow the latest usage, without any intention on our part to validate or revise them. This approach purely serves to create a taxonomic framework that reflects the current state of research with as much consistency and as little redundancy as possible.

We use two schemes of stratigraphic subdivisions or bins in the database. One scheme corresponds to the ten stages of the International Chronostratigraphic Chart (state 2014; Cohen et al., 2013, updated), and the other to fourteen biozones (Fig. 1). The latter are mainly trilobite biozones. The Terreneuvian ('pre-trilobite' Cambrian) stages are dated by trace fossils or small shelly fossils (Peng et al., 2012). The first appearance of the trace fossil *Trichophycus* (or alternatively *Treptichnus*, *Phycodes* or *Manykodes*) *pedum* marks the base of the Cambrian System, the Terreneuvian Series and the Fortunian Stage (Brasier et al., 1994); the base of the upper stage in the Terreneuvian Series (Cambrian Stage 2) has not yet been defined. The choice of stratigraphic bins was a compromise guided by the resolution required to address our research question, the available data, and the maximal precision with which data can be attributed to a given stratigraphic interval in the Cambrian. Due to imperfect correlation, some data sets could be assigned to biozones but not stages or *vice versa*.

In order to calculate origination and extinction (see section 2.3.) for the basal and top Cambrian bins, we had to consider the presence of acritarch taxa during Proterozoic and post-Cambrian times. Data were derived from some of the sources mentioned above (section 2.1., Figs. 1, 2), the acritarch and prasinophyte index of Fensome et al. (1990), and, for the post-Cambrian, the unpublished PhytoPal database by Mullins et al.

2.3. Methods

Diversity can be measured in different ways and for any taxonomic rank. In the case of acritarchs, treated as *incertae sedis*, only species and genera have a formal rank. Both are included in our analysis. Acritarch genera counted herein include reports of species assigned under open nomenclature (e.g. as 'sp.') to a genus or with an uncertain specific identification, but exclude species that are only tentatively assigned to a genus (see supplementary material S3). Species counted exclude those with uncertain identification, but include records that are only tentatively assigned to any particular genus (see supplementary material S6-S11). After this selection process and under the stratigraphic constraints discussed above (see section 2.2.), our dataset records the ranges of 173 genera and 404 species.

Taxa are counted as present in a stratigraphic interval in one of four ways (Fig. 3): as crossovers ranging through the entire interval; ranging into and going extinct in that interval; originating within the interval and ranging beyond its upper boundary; and as singletons, with a range confined to an interval, meaning that they originate and go extinct within the interval (Foote, 2000).

The actual number of coexisting taxa is the standing diversity (Sepkoski, 1975), and can only be estimated for palaeontological data. The sampled-in-bin diversity (Figs. 4, 5) gives the total count of taxa reported from a given stratigraphic interval. This index often underestimates diversity due to the incompleteness of the fossil record and sampling bias. Total diversity (Figs. 4, 5, 8, 9) is calculated by interpolating discontinuous taxon ranges from established occurrences (Foote, 2000), i.e. taxa not recorded from an interval are counted as being present if they occur in intervals below and above. With complete data, total diversity is likely to exceed the standing diversity at any specific point in time, because it does not account for extinctions within an interval (Cooper, 2004). Normalized diversity (Figs. 4, 5, 9) is calculated as the number of species ranging through an interval (crossovers), plus half the number of taxa that originate and/or become extinct in that stage (Sepkoski, 1975; Cooper, 2004). According to Cooper (2004), normalized diversity is a good approximation of the mean standing diversity in a stratigraphic bin.

Indices of origination and extinction represent, respectively, the number of species originating and becoming extinct in a stratigraphic interval. Turnover in an interval is the sum of origination and extinction events. These indices of taxonomic change can be calculated as including or excluding singletons. In Figure 6, singletons are excluded.

The use of stages and trilobite zones as the stratigraphic divisions in our analysis means that bins in both schemes are inevitably of different durations, and longer bins may have a higher diversity than shorter bins simply because they are sampling longer intervals, while at the same time obscuring short-term excursions. As the Cambrian stages vary in duration from about three million years (e.g. Guzhangian, Paibian) to twelve million years (Fortunian), a considerable effect may be expected. To correct for a possible bias resulting from these unequal interval lengths, rates of origination, extinction and turnover have been computed. They are equal to the origination, extinction and turnover indices divided by the stage duration in Myr (from Peng et al., 2012; Fig. 6 B, D).

Vidal and Moczydłowska (1997) first applied poly-cohort survivorship to Cambrian acritarchs. Poly-cohort survivorship measures the percentage of species in a cohort, i.e. species present in a given stratigraphic interval that are still present in later intervals (Fig. 7A). In contrast, poly-cohort prenascence (also called backward survivorship) measures the proportion of a cohort present in earlier intervals (Fig. 7B; e.g. Raup, 1978; Foote, 2001). Poly-cohorts of survivorship and prenascence respectively are calculated for all stratigraphic bins considered herein and plotted on a logarithmic scale. The slope of the cohort curves then represents the rate of extinction or origination for each cohort, with a linear curve (on a logarithmic scale) implying constant rates, while changes over time or between cohorts can reveal changes in rates or biases.

We evaluate the effect of sampling bias and test for evolutionary links between acritarchs and marine invertebrates (diversity values for marine invertebrate taken from the supporting information of Na and Kiessling, 2015) by calculating Spearman's ρ (*rho*) or r_s – a non-parametric rank order correlation coefficient (e.g. Press et al., 1992) – for correlations between diversity indices and the number of studies per interval (Fig. 9) and between the sampled-in-bin genus diversities of acritarchs and animals (Fig. 11), respectively. This metric is commonly used to identify bias in the fossil record (e.g. Dunhill et al., 2012; Na and Kiessling, 2015). The value of r_s varies between -1 and 1 for perfect negative and positive correlation, respectively, with 0 indicating absence of correlation. The statistical significance is given by the probability value p, which is derived from permutation tests. A correlation is accepted as strong if the coefficient is high (> 0.75) and significant if the probability value is low (< 0.05). In this case, a bias is possible. The results are here rounded to two and to three significant digits for r_s and p, respectively. We also investigate the changing strength of correlation through the studied stratigraphic intervals by applying a moving-window approach (Fig. 11B).

Subsampling methods are often used in biodiversity analyses in order to address sampling bias. These methods standardize for number of occurrences, number of studies, taxon frequency, or rock volume (Alroy, 2010; Hannisdal and Peters, 2011). The resulting trends are usually less biased than diversity based on raw counts, but they can introduce new distortions, depending on the premise of the respective approach (Alroy, 2010). The applicability of such methods on the Cambrian acritarch record might be explored in the future. Here we test for the existence of biases with other methods.

The analyses are performed with a customised program using the statistical environment R (version 3.0.2; R Core Team 2013).

3. Results

3.1. Global

3.1.1. Diversity by stages

Global diversity curves through the ten Cambrian stages are shown in Figures 4A and 4B, for species and genera respectively. Relatively few species range from the Proterozoic into the Cambrian and global total species diversity (Fig. 4A) is at its lowest in the Terreneuvian Series (Fortunian Stage and Stage 2). It is high in Stages 3, 4 and 5 and in Stage 10. The upper Series 3 (Drumian and Guzhangian stages) and the lower Furongian Series (Paibian and Jiangshanian stages) are marked by low global species diversity. Normalized species diversity peaks are present in Stages 5 and 10. The number of crossover species rises unsteadily over the course of the Cambrian. Singletons are mostly minor constituents, except in Stage 10 where they constitute more than a third of the total diversity.

Sampled-in-bin genus diversity (Fig. 4B) follows trends similar to those of the sampled-in-bin species diversity (Fig. 4A). The total genus diversity, incorporating a high number of range-through extensions for genera that are not present in a stage, but which are present in underlying and overlying stages, rises more or less steadily from Stage 2 onwards, with a minor drop between Stage 5 and the Drumian, barely hinting at the main trends of the species curve. This effect is even more conspicuous in the normalized diversity curve. The highest point of global genus diversity is reached in Stage 10. The proportion of crossovers is high in relation to the total genus count and in comparison to taxonomic changes. Singletons are rare or absent. Perhaps somewhat counter-intuitively, total genus diversity is higher than total species diversity in the Terreneuvian stages and the Guzhangian Stage (see Discussion). They are equal in the Jiangshanian Stage.

3.1.2. Diversity by biozones

The biozonal curves are similar to the stage curves. Using trilobite biozones as stratigraphic bins above Stage 2 (Fig. 5), total and sampled-in-bin species diversity rises from the base of the Cambrian to highs between the *Holmia* and *Paradoxides paradoxissimus* zones, followed by low values between the *Paradoxides forchhammeri* and *Leptoplastus* zones, with a peak in the *Olenus* Zone, and reaching another peak in the *Peltura* Zone. Diversity drops slightly from the *Holmia* Zone to the *Protolenus* Zone, in the Jiangshanian between the *Parabolina spinulosa* and *Leptoplastus* zones, and from the *Peltura* Zone to the *Acerocare* Zone in Stage 10. The first two falls in diversity are also evident on the stage curves, although not so pronounced; the last, in Stage 10, is not. The high number of singletons in Stage 10 on the stage scale is reduced to moderate numbers on the biozone scale.

In six of fourteen biozones (corresponding to the Terreneuvian stages and parts of Series 3 and the Furongian), total genus diversity is higher than total species diversity (Fig. 8). In two more (the *Schmidtiellus mickwitzi* and *Olenus* zones), it is barely lower.

3.1.3. Taxonomic changes

Origination indices for species and genera reach peaks in Stages 3 and 10 (Figs. 6A, C). The rate of origination per Myr is only moderate for Stage 3, and that for Stage 10 appears higher in comparison (Figs. 6B, D). The number of originating genera is also high in the Fortunian, while the rate of origination is relatively low. Otherwise, the rates of taxonomic changes per Myr are similar to the raw indices. Species extinctions are by far highest in Stage 5, discounting the extraordinarily high number of singletons in Stage 10 (Fig. 4A). Almost no extinctions of species or genera occur in the Fortunian, Stage 3 and Guzhangian stages. Stages 5 and 10 contain the highest number of species turnovers from the raw data (Fig. 6A). Corrected for stage duration, turnover is also high in the Paibian Stage (Fig. 6B).

Poly-cohorts of survivorship and prenascence produce almost parallel and relatively straight curves (Fig. 7), indicating that rates of origination and extinction are relatively constant throughout the Cambrian. The poly-cohorts of survivorship for the Terreneuvian stages have a gentler slope than younger ones, indicating a greater number of long-ranging species. Otherwise the poly-cohorts show no drastic differences in diversification or extinction trends between cohorts or over time.

3.2. Regional trends

The regional diversity curves are incomplete due to the limited sources and difficulties in correlations. The curves for genera are not figured or discussed separately, as they are very similar to the species curves, albeit with lower values (supplementary material S12, S13).

3.2.1. Baltica

The diversity curve for Baltica (Figs. 4C, 5C) mostly mirrors the global trends. Notable differences from the global curve are the overall lower diversity, its exceptionally low and unchanging values in the Fortunian Stage and Stage 2, and a slight rise in the Jiangshanian Stage, preceding the ultimate diversity maximum in Stage 10. No data could be assigned to the Drumian. In the biozonal curve, the *Olenus* Zone marks a minor diversity peak and is separated by a gap in the record in the *Parabolina spinulosa* Zone and a minor diversity low in the *Leptoplastus* Zone from the point of maximum diversity in the *Peltura* Zone. This is followed by a lowered diversity in the latest Cambrian *Acerocare* Zone.

3.2.2. Gondwana

There are no published data from the Terreneuvian Series of Gondwana, so acritarch diversity at that level cannot be evaluated. Also, we could not assign any data with certainty to Stage 3, the *Schmidtiellus mickwitzi* Zone and the *Leptoplastus* Zone. Species diversity on the Gondwana margin (Figs. 4D, 5D) is very low in Stages 4 and 5, in contrast to the high diversity of the Baltic and global curves. Above Stage 5, Gondwanan diversity is similar to, or higher than that on Baltica. Diversity peaks in the Drumian Stage (Fig. 4D) or in the *Paradoxides paradoxissimus* Zone (Fig. 5D), but corresponds to declining diversity in the global and Baltica curves. In parallel to the situation on Baltica, the Guzhangian and Paibian stages are marked by relatively low diversities, followed by a slight rise in the Jiangshanian Stage and a strong rise to an overall maximum in Stage 10 (Fig. 4D). The same trend is seen on the biozonal curve (Fig. 5D), except that the late Cambrian peak in the *Peltura* Zone is followed by a fall in the *Acerocare* Zone.

3.3. Distribution of studies over time

The number of studies in each of the stratigraphic intervals considered is very irregular and particularly low for Stage 2, the *Agnostus pisiformis* Zone, the *Leptoplastus* Zone and the *Acerocare* Zone (Fig. 8). The distribution of studies over the Cambrian has a conspicuous correlation with species diversity (Fig. 8), as shown by the strong and significant correlation for both total ($r_s = 0.95$; $p < 0.001$) and normalized ($r_s = 0.93$; $p < 0.001$) species diversity based on stages (Figs. 9A, B). The correlation is weaker, but significant for species on a biozonal level (total: r_s = 0.76; p = 0.002; normalized: r_s = 0.57; p = 0.032, Fig. 9C) and for genus total diversity based on stages (r_s = 0.78; p = 0.008). In contrast, the correlation is both weak and insignificant for normalized diversity of genera by stage (r_s = 0.52; p = 0.121) and total diversity of genera by biozone (r_s = 0.35; p = 0.214). The Gondwanan total species diversity based on biozones (r_s = 0.55; p = 0.098) and normalized species diversity based on stages (r_s = 0.58; p = 0.306) also only show weak and not significant correlations. Global normalized genus diversity by biozone shows no correlation (r_s = -0.11; p = 0.708, Fig. 9D).

4. Discussion

4.1. Global diversity

The total species diversity curve presented here is strikingly similar to that published by Vidal and Moczydłowska (1997), although the latter was based on fewer sources and diversity levels are mostly higher in our curves (Fig. 8). The same basic trends – rising diversity in the ‘lower’ Cambrian followed by low diversity and subsequent rise at the end of the Cambrian – also appear in Strother's (1996) and Zhuravlev's (2001) diversity curves. This does not exclude the possibility of biases, but would at least imply consistent biases, such as the concentration of productive studies in certain areas and stratigraphic intervals. In particular, the northwestern part of Baltica is disproportionally well studied and studies on Gondwana are essentially limited to the western and southern margins (Fig. 2). Also, studies on the pre-trilobite Cambrian are usually poorly dated. In fact, the uneven availability of index fossils in general might present a bias, since an important amount of data remains simply unusable due to a lack of stratigraphic constraints.

Considering the low number of studies that deal specifically with Stage 2 and the *Agnostus pisiformis*, *Leptoplastus* and *Acerocare* zones, all of which coincide with decreased diversity, results from these units should be regarded with some caution. The conspicuous correlation between total species diversity and the number of studies per stratigraphic bin (Figs. 8, 9) suggests the influence of an important sampling and/or preservational bias.

The same would be true for the sampled-in-bin genus diversity, but in this case the interpolation of ranges in the total diversity curve changes the picture profoundly. A high number of genera that are missing from the low diversity intervals of Stage 2 and from the Drumian to Jiangshanian stages (and the corresponding biozonal units) are present in the preceding and succeeding higher diversity intervals. These genera are inferred to range through the low diversity intervals and so are also inferred to contribute to total generic diversity in those intervals. The result is a decoupling of the total and sampled-in-bin diversity curves (Figs. 4B, 5B), indicating a significant incompleteness of the record. This would certainly also affect species diversity and perhaps even more severely.

As a consequence of the obvious incompleteness of the record, it is conceivable that the total genus diversity in the affected intervals is still underestimated and that the diversification of genera actually continued throughout the whole Cambrian at a more or less constant rate (Figs. 4B, 5B). A further consequence of the interpolation of generic occurrences to construct the total global genus diversity curves is that the total genus diversity actually exceeds total species diversity in the less extensively studied intervals of the Terreneuvian Series and parts of Series 3 and the Furongian Series (Fig. 8). This is an artefact of the data, as well as highlighting some of the limitations, and is explained by the generally longer ranges of genera being more likely to span gaps in the record. It might be argued that if a genus is inferred to be present in a low diversity interval, based on its interpolated range, then at least one species of that genus should also be present. The anomaly of genus diversity exceeding species diversity would be removed by inferring the presence of at least one species per genus, but the true number of missing species would be unknown.

The normalized genus diversity curve also indicates a more or less steady, if slow, diversification

(Fig. 4B). Regression analysis indicates that normalized genus diversity is the least biased (Fig. 9D). Genera are typically easier to identify than species since they are defined by broader characteristics, and can often be determined when the species is unknown to the author or the preservation is too poor to identify it. Taxonomic inflation may also be less of a problem at the generic level for the same reasons. This means that the record of genera is potentially more complete and the ranges more accurate than those of species. Generic diversity can therefore be considered more robust than species diversity. However, it cannot show the full range of diversity and may be a poor proxy for species diversity, because the number of species in a genus varies greatly and is not constant over time. Furthermore, the possibility of polyphyly needs to be considered for genera even more so than for species. Even so, based on current knowledge, the generic record hints at an increasing diversification trend through the Cambrian. Prenascence analysis of species also suggests an overall stable origination pattern (Fig. 7 B).

Global sea level is generally considered to have risen more or less constantly throughout the Cambrian (Miller et al., 2005; Haq and Schutter, 2008), a plausible cause being the formation of mid-ocean ridges following the breakup of Pannotia in the late Neoproterozoic (Miller et al., 2005; Scotese, 2009). A correlation between long-term sea-level changes on Palaeozoic and Mesozoic phytoplankton diversity has previously been reported, based on diversity curves for various groups, including acritarchs (Katz et al., 2004). During transgressions, flooded continental areas, which are the most favorable habitats for phytoplankton, increase and so provide more niche space and opportunities for diversification, following a species-area relationship (e.g. Sepkoski, 1976; Katz et al., 2004). The Cambrian acritarch record would be consistent with that idea. Flooding of continental shelves also controls the accumulation of sedimentary rocks and provides a general explanation for the correlation between biodiversity in the fossil record and available rock volume (Hannisdal and Peters, 2011).

Bambach et al. (2004) noted that proportional extinction among metazoan genera during most of the Cambrian and Early Ordovician was unusually high compared to the rest of the Phanerozoic. They identified two phases of declining diversity due to low origination; the late Botomian and the early late 'Middle' Cambrian. Na and Kiessling (2015) found that per-capita rates of extinction exceeded origination in Stage 3, the Drumian, and Stage 10. Acritarch genera show such a signal only in the Guzhangian and Drumian. The sampled-in-bin diversities of Cambrian animal (based on Na and Kiessling, 2015) and acritarch genera are neither strongly nor significantly correlated ($r_s = 0.55$; $p = 0.098$; Fig. 11A), which means there currently is no evidence for a continuous, strong evolutionary link between the two groups.

4.2. Regional trends

As shown in this paper and previously by others (Yin and Xue, 2002; Molyneux et al., 2013) from more limited sources, regional differences do exist in the currently available data. Even for acritarchs in the Cambrian, the global diversity does not necessarily reflect regional trends (or *vice versa*), as for example on Gondwana in stages 4 and 5, where diversity is particularly low, in contrast to the high contemporary diversity on Baltica (Figs. 4, 5, supplementary material S15). Such differences are not evident above Stage 5. In a similar fashion, Moczydłowska's (1998) curve for Upper Silesia shows diversification in the lower part of the Cambrian up to the *A. oelandicus* biochron, with no earlier peak (see supplementary material S15). As pointed out by Molyneux et al. (2013), important taxa were present on both Baltica and Avalonia. The primary difference between Gondwana and Baltica, at least for the Cambrian, therefore lies not in the differentiation of microfloras. The differences in diversity are quite probably at least enhanced by poor sampling of the lower Cambrian of Gondwana. They may also indicate differences in the local palaeoenvironment, rather than discrete provinces (see e.g. Lei et al., 2012, and references therein).

4.3. Cambrian Explosion

The apparent rapid diversification of acritarch species in Stage 3 parallels the radiation of metazoans (Sepkoski, 1997, Na and Kiessling, 2015; Fig. 10). Such a correlation could point to a link between phytoplankton and metazoans. For the Cambrian in total, the correlation between metazoans and acritarchs is moderate (r_s = 0.55) and not significant (p = 0.098) (Fig. 11A). In contrast, applying a moving window to each set of eight successive stages results in a good and significant correlation (r_s = 0.88, p = 0.004) for the interval from Stage 2 to the Jiangshanian Stage (9), inclusive (Fig. 11B). This correlation thus supports the presence of a more or less partial, but important link between acritarch and metazoan diversities during the time of the Cambrian Explosion. This result may be more or less modulated by a possible sampling bias, because most acritarch diversity indices are strongly and significantly correlated with the distribution of studies over time (Fig. 9). The dramatic increase in diversity in Stage 3 follows the particularly poorly covered Stage 2, one of the stages where total genus diversity exceeds species diversity (Fig. 8). The latter proves that this unit is critically undersampled and the following increase in diversity at least exaggerated. The normalized genus curve, which we find to be the least biased, indicates that acritarchs diversified without a notable peak. These trends, supported by the prenascence cohorts (Fig. 7B), suggest that there is no evidence for a distinct or sudden origination phase in the first half of the Cambrian. This does not negate the possibility of important interactions between certain groups of acritarch-producing organisms and metazoans, but the relation between the Cambrian Explosion and the diversity of the acritarchs as a whole remains unclear.

4.4. Furongian diversification and the GOBE

Servais et al. (2008) perceived a rise in phytoplankton diversity and disparity following the SPICE $\delta^{13}C_{carb}$ event, which broadly coincides with the Paibian Stage and the *Olenus* trilobite Zone (Saltzman et al., 2011). In our results, the Jiangshanian Stage, which follows the SPICE event, is indeed marked by a slight rise in diversity in the regional species curves for both Baltica and Gondwana (Fig. 4 C, D). This rise is not reflected on the global curves (Fig. 4A), which show a decline in diversity from the Paibian Stage to the Jiangshanian Stage, but it is in the origination index, which exceeds the extinction even at a global scale (Fig. 6A). It does not show up in the total or sampled-in-bin diversity curves on a global scale because more species went extinct within or at the end of the Paibian but are still counted in that stage, and because these are minor fluctuations (Figs. 4A, 5A). There is no evidence that the Jiangshanian was a time of great innovation, the amount of originating genera being very low. Many new genera with innovative morphologies that reach into the Ordovician do appear later in Stage 10, several million years after the SPICE event and without any obvious connection. The biozonal curve even shows a time of exceptionally low origination (and extinction) in the upper Jiangshanian *Leptoplastus* Zone, separating the minor lower Jiangshanian diversification from the massive origination phase in Stage 10, although this is certainly related to the very low number of studies treating the *Leptoplastus* Zone as such (Fig. 8). By contrast, the diversity maximum in Stage 10 appears globally and on both Baltica and Gondwana (Figs. 4C, D), which makes this short-lived phenomenon credible. It is tempting to see the sudden rise in diversity as a precursor of the GOBE, but at the finer scale of trilobite biozones, the diversity is already seen to fall from the *Peltura* Zone to the *Acerocare* Zone (Fig. 5B, C). Only about half of the species recorded from Stage 10 range into the Tremadocian. Thus the Cambrian seems to end with a phase of species extinction. However, few genera go extinct at the Cambrian/Ordovician boundary. Animal genera do show a comparatively high per-capita extinction rate in Stage 10 (Na and Kiessling, 2015). Metazoan and acritarch genus extinctions seem to be generally unrelated in the Cambrian (see 4.1.). Among the acritarch genera surviving the transition, several bore morphological traits that emerged during the late Cambrian (Servais et al., 2008) and would be important contributors to later assemblages (such as the 'galeate' acritarchs: Servais and Eiserhardt, 1995; Servais et al., 2004). The latest Cambrian can be seen as a time of phytoplankton turnover, preceding but distinct from the radiation of acritarchs during the Ordovician.

5. Conclusions

Our new, more complete dataset on Cambrian acritarchs provides new insights into the global and regional diversification of phytoplankton in the Cambrian oceans. Global acritarch species diversity starts on a comparatively low level at the base of the Cambrian, rises in parallel to the radiation of metazoans to a high in stages 3 to 5 (or the *Holmia* to *Paradoxides paradoxissimus* zones), then drops considerably to an extended low until it peaks sharply in Stage 10 (more precisely in the *Peltura* Zone). Genera show an irregular increase in total and normalized diversity throughout the Cambrian, indicating that the low species diversity in Stage 2 and the upper Series 3 to lower Furongian interval is at least in part due to an incomplete record. Correlation analysis shows normalized genus diversity to be the least biased. The regional curves are markedly different in Series 2 and Stage 5; while diversity is high on Baltica, it is low on Gondwana. This difference may be attributed to the limited record on Gondwana and perhaps palaeoenvironmental differences rather than distinct provinces. After Stage 5, the regional diversities are similar. A diversity maximum in the *Peltura* Zone and subsequent fall in the *Acerocare* Zone is mirrored on both Baltica and Gondwana. The end of the Cambrian is marked by an extinction of species, while nearly all genera present in Stage 10 survived into the Ordovician.

Our acritarch diversity curves mirror the diversity curves of marine invertebrates to some extent. The correlation between both diversities has statistical significance only when the first and last stage of the Cambrian are excluded. Taken at face value, rising diversity in Stage 3 mirrors that of the metazoans (Cambrian Explosion), but the acritarch diversity trends can mostly be attributed to sampling bias. The relationship between the two groups remains uncertain. Similarly, although the end of the Cambrian coincides with an extinction-led turnover of acritarch species, morphological innovations from the Cambrian, particularly among genera, might well have paved the way for the rapid diversification of acritarchs during the Ordovician that can be viewed as a part of the Great Ordovician Biodiversification Event.

Acknowledgements

Literary sources were provided by the palaeontology department of the University of Liège, Monika Masiak (Polish Academy of Science), Melesio Quijada-Hermoso (University Lille 1) and Wang Wen-hui (Nanjing University). We thank the two anonymous reviewers for their helpful comments and suggestions. The study was funded by the ANR (Agence Nationale de la Recherche, France) as part of the project RALI ("Rise of Animal Life", reference ANR-11-BS56-0025). This paper is a contribution to the IGCP project 591 "The Early to Middle Paleozoic Revolution". SGM publishes with the permission of the Executive Director, British Geological Survey, NERC.

Appendix A. Supplementary data

Supplementary material S1.
Database of Cambrian acritarch occurrences. (CVS)

Supplementary material S2.
List of source references, including bibliography, countries and palaeogeographical units corresponding to study areas. (DOC)

Supplementary material S3.
List of acritarch genera and species reported from the Cambrian System, with marked known synynomies and homonymies, including references. (DOC)

Supplementary material S4.

Global species range charts based on stages, blue = presence reported; green = presence inferred; white = absence. (EPS)

Supplementary material S5.

Global species range charts based on biozones, blue = presence reported; green = presence inferred; white = absence. (EPS)

Supplementary material S6.

Baltica species range charts based on stages, blue = presence reported; green = presence inferred; white = absence. (EPS)

Supplementary material S7.

Baltica species range charts based on biozones, blue = presence reported; green = presence inferred; white = absence. (EPS)

Supplementary material S8.

Gondwana species range charts based on stages, blue = presence reported; green = presence inferred; white = absence. (EPS)

Supplementary material S9.

Gondwana species range charts based on biozones, blue = presence reported; green = presence inferred; white = absence. (EPS)

Supplementary material S10.

Global genus range chart based on stages; blue = presence reported; green = presence inferred; white = absence. (EPS)

Supplementary material S11.

Global genus range chart based on biozones; blue = presence reported; green = presence inferred; white = absence. (EPS)

Supplementary material S12.

Values of diversity indices based on stages. (CVS)

Supplementary material S13.

Values of diversity indices based on biozones. (CVS)

Supplementary material S14.

Spearman's r_s and probability value p for correlations between acritarch diversity indices and the number of studies per stage, and between global sampled-in-bin genus diversities of acritarchs and marine invertebrates (values for marine invertebrates were taken from the supporting information of Na and Kiessling, 2015). (CVS)

Supplementary material S15.

Comparison of regional species diversities based on biozones; Baltica and Gondwana: this study, sampled-in-bin diversity; Upper Silesia: Moczydłowska (1998), total? diversity. (EPS)

References

Alroy, J., 2010. Geographical, environmental and intrinsic biotic controls on Phanerozoic marine diversification. Palaeontology 53, 1211–1235. http://dx.doi.org/10.1111/j.1475-4983.2010.01011.x

Alroy, J., Aberhan, M., Bottjer, D.J., Foote, M., Fürsich, F.T., Harries, P.J., Hendy, A.J.W., Holland, S.M., Ivany, L.C., Kiessling, W., Kosnik, M.A., Marshall, C.R., McGowan, A.J., Miller, A.I., Olszewski, T.D., Patzkowsky, M.E., Peters, S.E., Villier, L., Wagner, P.J., Bonuso, N., Borkow, P.S., Brenneis, B., Clapham, M.E., Fall, L.M., Ferguson, C.A., Hanson, V.L., Krug, A.Z., Layou, K.M., Leckey, E.H., Nürnberg, S., Powers, C.M., Sessa, J.A., Simpson, C., Tomašových, A., Visaggi, C.C., 2008. Phanerozoic Trends in the Global Diversity of Marine Invertebrates. Science 321, 97–100. http://dx.doi.org/10.1126/science.1156963

Albani, R., Bagnoli, G., Bernárdez, E., Gutíerrez-Marco, J.C., Ribecai, C., 2006. Late Cambrian acritarchs from the "Túnel Ordovícico del Fabar", Cantabrian Zone, N Spain. Rev. Palaeobot. Palynol. 139, 41–52. http://dx.doi.org/10.1016/j.revpalbo.2005.07.005

Albani, R., Massa, D., Tongiorgi, M., 1991. Palynostratigraphy (Acritarchs) of some Cambrian beds from the Rhadames (Ghadamis) basin (Western Libya—southern Tunisia). Boll. Della Soc. Paleontol. Ital. 30, 255–280.

Bambach, R.K., Knoll, A.H., Wang, S.C., 2004. Origination, extinction, and mass depletions of marine diversity. Journal Information 30, 522–542. http://dx.doi.org/10.1666/0094-8373(2004)030<0522:OEAMDO>2.0.CO;2

Bambach, R.K., Bush, A.M., Erwin, D.H., 2007. Autecology and the Filling of Ecospace: Key Metazoan Radiations. Palaeontology 50, 1–22. http://dx.doi.org/10.1111/j.1475-4983.2006.00611.x

Baudet, D., Aitken, J.D., Vanguestaine, M., 1989. Palynology of uppermost Proterozoic and lowermost Cambrian formations, central Mackenzie Mountains, northwestern Canada. Can. J. Earth Sci. 26, 129–148. http://dx.doi.org/10.1139/e89-011

Bown, P.R., 2005. Calcareous nannoplankton evolution: a tale of two oceans. Micropaleontology 51, 299–308. http://dx.doi.org/10.2113/gsmicropal.51.4.299

Brasier, M., Cowie, J., Taylor, M., 1994. Decision on the Precambrian-Cambrian boundary stratotype. Episodes 17, 3–8.

Brück, P.M., Vanguestaine, M., 2004. Acritarchs from the Lower Palaeozoic succession on the south County Wexford coast, Ireland: new age constraints for the Cullenstown Formation and the Cahore and Ribband Groups. Geol. J. 39, 199–224.

Buła, Z., Jachowicz, M., 1996. The Lower Paleozoic sediments in the Upper Silesian Block. Geol Q 40, 299–336.

Butterfield, N.J., 1997. Plankton ecology and the Proterozoic-Phanerozoic transition. Paleobiology 23, 247–262.

Butterfield, N.J., 2004. A vaucheriacean alga from the middle Neoproterozoic of Spitsbergen: implications for the evolution of Proterozoic eukaryotes and the Cambrian explosion. Paleobiology 30, 231–252.

Butterfield, N.J., 2005. Probable Proterozoic fungi. Paleobiology 31, 165–182.

Chen, J., Qian, Y., Lin, Y., Zhang, J., Wang, Z., Yin, L., Erdtmann, B.-D., 1985. Study on Cambrian-Ordovician Boundary Strata and Its Biota in Dayagcha, Hunjiang, Jilin, China: Contribution to the Calgary Cambrian-Ordovician-Boundary Meeting. China Prospect Publishing House.

Clendening, J.A., Wood, G.D., 1981. *Thymadora*, a new acritarch genus from the middle Cambrian Rogersville shale of Tennessee, U.S.A. Palynology 5, 153–158. http://dx.doi.org/10.1080/01916122.1981.9989223

Cocks, L.R.M., Torsvik, T.H., 2005. Baltica from the late Precambrian to mid-Palaeozoic times: The gain and loss of a terrane's identity. Earth-Sci. Rev. 72, 39–66. http://dx.doi.org/10.1016/j.earscirev.2005.04.001

Cocks, L.R.M., Torsvik, T.H., 2007. Siberia, the wandering northern terrane, and its changing geography through the Palaeozoic. Earth-Sci. Rev. 82, 29–74. http://dx.doi.org/10.1016/j.earscirev.2007.02.001

Cohen, P.A., Knoll, A.H., Kodner, R.B., 2009. Large spinose microfossils in Ediacaran rocks as resting stages of early animals. Proc. Natl. Acad. Sci. 106, 6519–6524. http://dx.doi.org/10.1073/pnas.0902322106

Conway Morris, S., 2000. The Cambrian "explosion": Slow-fuse or megatonnage? Proc. Natl. Acad. Sci. 97, 4426–4429. http://dx.doi.org/10.1073/pnas.97.9.4426

Cooper, R.A., 2004. Measures of diversity, in: Webby, B.D., Paris, F., Droser, M.L., Percival, I.G. (Eds.), The Great Ordovician Biodiversification Event. Columbia University Press, New York, pp. 52–57.

Dale, B., 1976. Cyst formation, sedimentation, and preservation: Factors affecting dinoflagellate assemblages in recent sediments from Trondheimsfjord, Norway. Rev. Palaeobot. Palynol. 22, 39–60. http://dx.doi.org/10.1016/0034-6667(76)90010-5

Debrenne, F., Zhuravlev, A.Y., 1997. Cambrian food web: A brief review. Geobios 30, Supplement 1, 181–188. http://dx.doi.org/10.1016/S0016-6995(97)80023-X

Di Milia, A., Ribecai, C., Tongiorgi, M., 1989. Late Cambrian acritarchs from the *Peltura scarabaeoides* Trilobite Zone at Degerhamn (Öland, Sweden). Palaeontogr Ital 76, 1–56.

Ding, L., Li, Y., Chen, H., 1992. Discovery of *Micrhystridium regulare* from Sinian–Cambrian boundary strata in Yichang, Hubei, and its stratigraphic significance. Acta Micropalaeontologica Sin. 9, 303–309.

Downie, C., 1984. Acritarchs in British stratigraphy, Geological Society London, Special Report.

Dunhill, A.M., Benton, M.J., Twitchett, R.J., Newell, A.J., 2012. Completeness of the fossil record and the validity of sampling proxies at outcrop level. Palaeontology 55, 1155–1175. http://dx.doi.org/10.1111/j.1475-4983.2012.01149.x

Eklund, C., 1990. Lower Cambrian acritarch stratigraphy of the Bårstad 2 core, Östergötland, Sweden. Geol. Fören. Stockh. Förh. 112, 19–44. http://dx.doi.org/10.1080/11035899009453157

Erwin, D.H., Laflamme, M., Tweedt, S.M., Sperling, E.A., Pisani, D., Peterson, K.J., 2011. The Cambrian conundrum: early divergence and later ecological success in the early history of animals. Science 334, 1091–1097.

Evitt, W.R., 1963. A discussion and proposals concerning fossil dinoflagellates, hystrichospheres, and acritarchs, II. Proc. Natl. Acad. Sci. U. S. A. 49, 298–302.

Fatka, O., Konzalová, M., 1995. Microfossils of the Paseky Shale (Lower Cambrian, Czech Republic). J. Czech Geol. Soc. 40, 55–66.

Fatka, O., Kordule, V., Szabad, M., 2004. Stratigraphical distribution of Cambrian fossils in the Příbram-Jince Basin (Barrandian area, Czech Republic). Senckenberg. Lethaea 84, 367–381. http://dx.doi.org/10.1007/BF03043477

Fensome, R.A., Williams, G.L., Barss, M.S., Freeman, J.M., Hill, J.M., 1990. Acritarchs and fossil prasinophytes: an index to genera, species and infraspecific taxa, AASP Contributions Series. American Association of Stratigraphic Palynologists Foundation.

Fensome, R.A., Riding, J.B., Taylor, F.J.R., 1996a. Chapter 6. Dinoflagellates, in: Palynology: Principles and Applications. American Association of Stratigraphic Palynologists Foundation, Salt Lake City, pp. 107–170.

Fensome, R.A., Williams, G.L., MacRae, R.A., Moldowan, J.M., Taylor, F.J.R., 1996b. The early Mesozoic radiation of dinoflagellates. Paleobiology 22, 329–338. http://dx.doi.org/10.1666/0094-8373-22.3.329

Foote, M., 2000. Origination and extinction components of taxonomic diversity: general problems. Paleobiology 26, 74–102. http://dx.doi.org/10.1666/0094-8373(2000)26[74:OAECOT]2.0.CO;2

Foote, M., 2001. Evolutionary rates and the age distributions of living and extinct taxa, in: Jackson, J.B.C., McKinney, F.K., Lidgard, S. (Eds.), Evolutionary Patterns: Growth, Form, and Tempo in the Fossil Record. University of Chicago Press, Chicago, pp. 245–294.

Ghavidel-syooki, M., 2006. Palynostratigraphy and Palaeogeography of the Cambro-Ordovician strata in southwest of Shahrud (Kuh-e-Kharbash), North Iran. JSUT 32, 13–27.

Ghavidel-syooki, M., Vecoli, M., 2008. Palynostratigraphy of Middle Cambrian to lowermost Ordovician stratal sequences in the High Zagros Mountains, southern Iran: Regional stratigraphic implications, and palaeobiogeographic significance. Rev. Palaeobot. Palynol. 150, 97–114.

Hannisdal, B., Peters, S.E., 2011. Phanerozoic Earth system evolution and marine biodiversity. Science 334, 1121–1124.

Haq, B.U., Schutter, S.R., 2008. A chronology of Paleozoic sea-level changes. Science 322, 64–68.

Hartz, E.H., Torsvik, T.H., 2002. Baltica upside down: A new plate tectonic model for Rodinia and the Iapetus Ocean. Geology 30, 255–258. http://dx.doi.org/10.1130/0091-7613(2002)030<0255:BUDANP>2.0.CO;2

Hints, O., Delabroye, A., Nõlvak, J., Servais, T., Uutela, A., Wallin, Å., 2010. Biodiversity patterns of Ordovician marine microphytoplankton from Baltica: comparison with other fossil groups and sea-level changes. Palaeogeogr. Palaeoclimatol. Palaeoecol. 294, 161–173.

Huntley, J.W., Xiao, S.-H., Kowalewski, M., 2006. 1.3 billion years of acritarch history: an empirical morphospace approach. Precambrian Res. 144, 52–68.

Huntley, J., Xiao, S.-H., Kowalewski, M., 2006. On the morphological history of Proterozoic and Cambrian acritarchs, in: Xiao, S., Kaufman, A.J. (Eds.), Neoproterozoic Geobiology and Paleobiology, Topics in Geobiology. Springer Netherlands, pp. 23–56.

Jachowicz, M., 1994. Occurrence of the microfossils belonging to Acritarcha in the older Palaeozoic of the NW border of the Upper Silesia Coal Basin (SW Poland). Przegl. Geol. 42, 631–637.

Jachowicz-Zdanowska, M., 2013. Cambrian phytoplankton of the Brunovistulicum – taxonomy and biostratigraphy. Pol. Geol. Inst. Spec. Pap. 28, 1–150.

Jagielska, L., 1965. Nowe dane o mikroflorze eokambru i najniższego kambru antyklinorium klimontowskiego [New data on the Eocambrian and lowermost Cambrian microflora from the Klimontów Anticlinorium]. Kwart. Geol. 9, 499–509.

Jago, J.B., Zang, W.-L., Sun, X., Brock, G.A., Paterson, J.R., Skovsted, C.B., 2006. A review of the Cambrian biostratigraphy of South Australia. Palaeoworld 15, 406–423. http://dx.doi.org/10.1016/j.palwor.2006.10.014

Jankauskas, T., 1972. Biostratigrafiya nizhnego kembriya Litvy (po akritarkham) [Stratigraphical subdivision of the Lower Cambrian of Lithuania (using acritarchs)]. Akad. Nauk SSSR Dokl. Earth Sci. Sect. 205, 1186–1189.

Jankauskas, T., Lendzion, K., 1992. Lower and Middle Cambrian acritarch-based biozonation of the Baltic Syneclise and adjacent areas (East European Platform). Przegląd Geol. 40, 519–525.

Katz, M.E., Finkel, Z.V., Grzebyk, D., Knoll, A.H., Falkowski, P.G., 2004. Evolutionary trajectories and biogeochemical impacts of marine eukaryotic phytoplankton. Annu. Rev. Ecol. Evol. Syst. 35, 523–556. http://dx.doi.org/10.1146/annurev.ecolsys.35.112202.130137

Klug, C., Kröger, B., Kiessling, W., Mullins, G.L., Servais, T., Frýda, J., Korn, D., Turner, S., 2010. The Devonian nekton revolution. Lethaia 43, 465–477. http://dx.doi.org/10.1111/j.1502-3931.2009.00206.x

Knoll, A.H., 1994. Proterozoic and Early Cambrian protists: evidence for accelerating evolutionary tempo. Proc. Natl. Acad. Sci. 91, 6743–6750.

Knoll, A.H., Swett, K., 1987. Micropaleontology across the Precambrian-Cambrian boundary in Spitsbergen. J. Paleontol. 61, 898–926.

Knoll, A.H., Javaux, E.J., Hewitt, D., Cohen, P., 2006. Eukaryotic organisms in Proterozoic oceans. Philos. Trans. R. Soc. B Biol. Sci. 361, 1023–1038. http://dx.doi.org/10.1098/rstb.2006.1843

Kowalski, W.R., 1983. Stratigraphy of the Upper Precambrian and lowest Cambrian strata in southern Poland. Acta Geol. Pol. 33, 183–218.

Lendzion, K., Moczydłowska, M., Żakowa, H., 1982. A new look at the Bazow Cambrian Sequence (southern Holy Cross Mts). Bull. Pol. Acad. Sci. Earth Sci. 30, 67.

Lei, Y., Servais, T., Feng, Q., He, W., 2012. The spatial (nearshore–offshore) distribution of latest Permian phytoplankton from the Yangtze Block, South China. Palaeogeogr. Palaeoclimatol. Palaeoecol. 363–364, 151–162. http://dx.doi.org/10.1016/j.palaeo.2012.09.010

Lei, Y., Servais, T., Feng, Q., 2013. The diversity of the Permian phytoplankton. Rev. Palaeobot. Palynol. 198, 145–161.

Li, J., Servais, T., Yan, K., Su, W., 2007. Microphytoplankton diversity curves of the Chinese Ordovician. Bull. Soc. Géol. Fr. 178, 399–409. http://dx.doi.org/10.2113/gssgfbull.178.5.399

Martin, F., Dean, W.T., 1981. Middle and Upper Cambrian and Lower Ordovician acritarchs from Random Island, eastern Newfoundland, Geological Survey of Canada, Bulletin. Ottawa.

Martin, F., Dean, W.T., 1983. Late Early Cambrian and early Middle Cambrian acritarchs from Manuels River, eastern Newfoundland. Curr. Res. Part B Geol. Surv. Can. Paper 83, 353–363.

Martin, F., Dean, W.T., 1984. Middle Cambrian acritarchs from the Chamberlains Brook and Manuels River formations at Random Island, eastern Newfoundland. Curr. Res. Part A Geol. Surv. Can. Paper 84, 429–440.

Martin, F., Dean, W.T., 1988. Middle and Upper Cambrian acritarch and trilobite zonation at Manuels River and Random Island, eastern Newfoundland, Geological Survey of Canada, Bulletin. Energy, Mines and Resources Canada.

Martin, R.E., Quigg, A., Podkovyrov, V., 2008. Marine biodiversification in response to evolving phytoplankton stoichiometry. Palaeogeogr.Palaeoclimatol.Palaeoecol. 258, 277–291.

Mette, W., 1989. Acritarchs from Lower Paleozoic rocks of the western Sierra Morena, SW-Spain and biostratigraphic results. Geol. Palaeontol. 23, 1–19.

Mendelson, C.V., 1987. Acritarchs, in: Lipps, J.H. (Ed.), Fossil Prokaryotes and Protists. University of Tennessee, Knoxville, pp. 62–86.

Miller, K.G., Kominz, M.A., Browning, J.V., Wright, J.D., Mountain, G.S., Katz, M.E., Sugarman, P.J., Cramer, B.S., Christie-Blick, N., Pekar, S.F., 2005. The Phanerozoic Record of Global Sea-Level Change. Science 310, 1293–1298. http://dx.doi.org/10.1126/science.1116412

Moczydłowska, M., 1981. Lower and Middle Cambrian acritarchs from Northeastern Poland. Precambrian Res. 15, 63–74. http://dx.doi.org/10.1016/0301-9268(81)90067-X

Moczydłowska, M., 1988. New Lower Cambrian acritarchs from Poland. Rev. Palaeobot. Palynol. 54, 1–10. http://dx.doi.org/10.1016/0034-6667(88)90002-4

Moczydłowska, M., 1991. Acritarch biostratigraphy of the Lower Cambrian and the Precambrian-Cambrian boundary in southeastern Poland, Fossils and Strata. Universitetsforlaget, Oslo.

Moczydłowska, M., 1998. Cambrian acritarchs from Upper Silesia, Poland - biochronology and tectonic implications, Fossils and Strata. Scandinavian University Press, Oslo.

Moczydłowska, M., 2002. Early Cambrian phytoplankton diversification and appearance of trilobites in the Swedish Caledonides with implications for coupled evolutionary events between primary producers and consumers. Lethaia 35, 191–214. http://dx.doi.org/10.1111/j.1502-3931.2002.tb00079.x

Moczydłowska, M., 2011. The early Cambrian phytoplankton radiation: acritarch evidence from the Lükati Formation, Estonia. Palynology 35, 103–145. http://dx.doi.org/10.1080/01916122.2011.552563

Moczydłowska, M., Stockfors, M., 2004. Acritarchs from the Cambrian–Ordovician boundary interval on Kolguev Island, Arctic Russia. Palynology 28, 15–73. http://dx.doi.org/10.1080/01916122.2004.9989591

Moczydłowska, M., Vidal, G., 1986. Lower Cambrian acritarch zonation in southern Scandinavia and southeastern Poland. Geol. Fören. Stockh. Förh. 108, 201–223. http://dx.doi.org/10.1080/11035898609454685

Moczydłowska, M., Vidal, G., 1992. Phytoplankton from the Lower Cambrian Læså formation on Bornholm, Denmark: biostratigraphy and palaeoenvironmental constraints. Geol. Mag. 129, 17–40. http://dx.doi.org/10.1017/S0016756800008104

Moldowan, J.M., Talyzina, N.M., 1998. Biogeochemical evidence for dinoflagellate ancestors in the Early Cambrian. Science 281, 1168–1170. http://dx.doi.org/10.1126/science.281.5380.1168

Molyneux, S.G., Delabroye, A., Wicander, R., Servais, T., 2013. Biogeography of early to mid Palaeozoic (Cambrian–Devonian) marine phytoplankton. Geol. Soc. Lond. Mem. 38, 365–397. http://dx.doi.org/10.1144/M38.23

Mullins, G.L., Servais, T., 2008. The diversity of the Carboniferous phytoplankton. Rev. Palaeobot. Palynol. 149, 29–49. http://dx.doi.org/10.1016/j.revpalbo.2007.10.002

Na, L., Kiessling, W., 2015. Diversity partitioning during the Cambrian radiation. Proc. Natl. Acad. Sci. 112, 4702–4706. http://dx.doi.org/10.1073/pnas.1424985112

Paalits, I., 1992. Upper Cambrian acritarchs from boring core M-72 of North Estonia. Proc. Est. Acad. Sci., Geology 41, 29–37.

Palacios, T., 2010. Middle–Upper Cambrian acritarchs from the Oville and Barrios Formations, Cantabrian Mountains, northern Spain, in: Abstracts. Presented at the CIMP 2010 General Meeting, Warsaw, pp. 50–53.

Palacios, T., Jensen, S., Barr, S.M., White, C.E., 2009. Acritarchs from the MacLean Brook Formation, southeastern Cape Breton Island, Nova Scotia, Canada: New data on Middle Cambrian–Lower Furongian acritarch zonation. Palaeogeogr. Palaeoclimatol. Palaeoecol. 273, 123–141. http://dx.doi.org/10.1016/j.palaeo.2008.12.006

Palacios, T., Vidal, G., 1992. Lower Cambrian acritarchs from northern Spain: the Precambrian-Cambrian boundary and biostratigraphic implications. Geol. Mag. 129, 421–436. http://dx.doi.org/10.1017/S0016756800019518

Parsons, M.G., Anderson, M.M., 2000. Acritarch microfloral succession from the Late Cambrian and Ordovician (early Tremadoc) of Random Island, eastern Newfoundland, and its comparison to coeval microfloras, particularly those of the East European Platform, AASP Contributions Series. American Association of Stratigraphic Palynologists Foundation, Dallas, Texas.

Peng, S., Babcock, L.E., Cooper, R.A., 2012. The Cambrian Period. in: Gradstein, F.M., Ogg, J.G., Schmitz, M.D., Ogg, G.M. (Eds.), The Geologic Time Scale 2012, Vol. 2, 437–488. Elsevier, Amsterdam.

Põldvere, A., Paalits, I., 1998. Middle and Upper Cambrian, in: Männik, P. (Ed.), Tartu (453) Drillcore, Estonian Geological Sections. Geological Survey of Estonia, Tallinn, pp. 10–11.

Press, W.H., Teukolsky, S.A., Vetterling, W.T., Flannery, B.P., 1992. Numerical recipes in C: the art of scientific computing, 2nd ed. Cambridge University Press.

Raevskaya, E., Golubkova, E., 2006. Biostratigraphical implication of Middle–Upper Cambrian acritarchs from Severnaya Zemlya (high Arctic of Russia). Rev. Palaeobot. Palynol. 139, 53–69. http://dx.doi.org/10.1016/j.revpalbo.2005.07.010

R Core Team, 2013. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria [WWW Document]. URL http://www.r-project.org/. Accessed: 01/09/2014.

Ribecai, C.B., Bagnoli, G., Mazzarini, F., Musumeci, G., 2005. Paleontological evidence for Late Cambrian in the Arburese area, SW Sardinia, in: Steemans, P., Javaux, E. (Eds.), Pre-Cambrian to Palaeozoic Palaeopalynology and Palaeobotany, Carnets de Géologie / Notebooks on Geology. Brest, pp. 45–50.

Saltzman, M.R., Young, S.A., Kump, L.R., Gill, B.C., Lyons, T.W., Runnegar, B., 2011. Pulse of atmospheric oxygen during the late Cambrian. Proc. Natl. Acad. Sci. 108, 3876–3881. http://dx.doi.org/10.1073/pnas.1011836108

Sarjeant, W.A.S., Stancliffe, R.P.W., 1994. The *Micrhystridium* and *Veryhachium* complexes (Acritarcha: Acanthomorphitae and Polygonomorphitae): A taxonomic reconsideration. Micropaleontology 40, 1. http://dx.doi.org/10.2307/1485800

Scotese, C.R., 2009. Late Proterozoic plate tectonics and palaeogeography: a tale of two supercontinents, Rodinia and Pannotia. Geol. Soc. Lond. Spec. Publ. 326, 67–83. http://dx.doi.org/10.1144/SP326.4

Sepkoski, J.J., 1976. Species Diversity in the Phanerozoic: Species-Area Effects. Paleobiology 2, 298–303.

Sepkoski, J.J., 1997. Biodiversity: Past, Present, and Future. J. Paleontol. 71, 533–539.

Servais, T., Eiserhardt, K.H., 1995. A discussion and proposals concerning the lower Paleozoic “galeate” acritarch plexus. Palynology 19, 191–210. http://dx.doi.org/10.1080/01916122.1995.9989460

Servais, T., Lehnert, O., Li, J., Mullins, G.L., Munnecke, A., Nützel, A., Vecoli, M., 2008. The Ordovician Biodiversification: revolution in the oceanic trophic chain. Lethaia 41, 99–109. http://dx.doi.org/10.1111/j.1502-3931.2008.00115.x

Servais, T., Li, J., Stricanne, L., Vecoli, M., Wicander, R., 2004a. Acritarchs, in: Webby, B.D., Paris, F., Droser, M.L., Percival, I.G. (Eds.), The Great Ordovician Biodiversification Event. Columbia University Press, New York, pp. 348–360.

Servais, T., Stricanne, L., Montenari, M., Pross, J., 2004b. Population dynamics of galeate acritarchs at the Cambrian–Ordovician transition in the Algerian Sahara. Palaeontology 47, 395–414. http://dx.doi.org/10.1016/10.1111/j.0031-0239.2004.00367.x

Servais, T., Owen, A.W., Harper, D.A.T., Kröger, B., Munnecke, A., 2010. The Great Ordovician Biodiversification Event (GOBE): the palaeoecological dimension. Palaeogeogr. Palaeoclimatol. Palaeoecol. 294, 99–119. http://dx.doi.org/10.1016/j.palaeo.2010.05.031

Strother, P.K., 2008. A speculative review of factors controlling the evolution of phytoplankton during Paleozoic time. Rev. Micropaléontologie 51, 9–21. http://dx.doi.org/10.1016/j.revmic.2007.01.007

Strother, P.K., Al-Hajri, S., Traverse, A., 1996. New evidence for land plants from the lower Middle Ordovician of Saudi Arabia. Geology 24, 55–58. http://dx.doi.org/10.1130/0091-7613(1996)024<0055:NEFLPF>2.3.CO;2

Szczepanik, Z., 2000. The Cambrian of the western part of the Pomeranian Caledonides foreland, Peribaltic Syneclise: microfloral evidence. Geol. Q. 44, 261–273.

Talyzina, N.M., Moldowan, J.M., Johannisson, A., Fago, F.J., 2000. Affinities of Early Cambrian acritarchs studied by using microscopy, fluorescence flow cytometry and biomarkers. Rev. Palaeobot. Palynol. 108, 37–53. http://dx.doi.org/10.1016/S0034-6667(99)00032-9

Tappan, H., Loeblich Jr., A.R., 1972. Fluctuating rates of protistan evolution, diversification and extinction, in: 24th International Geological Congress, Section 7. pp. 205–213.

Tappan, H., Loeblich Jr., A.R., 1973. Evolution of the oceanic plankton. Earth-Sci. Rev. 9, 207–240. http://dx.doi.org/10.1016/0012-8252(73)90092-5

Torsvik, T.H., 2009. BugPlates: Linking Biogeography and Palaeogeography [WWW Document]. URL http://www.geodynamics.no/bugs/SoftwareManual.pdf. Accessed: 01/09/2014.

Torsvik, T.H., Cocks, L.R.M., 2013. New global palaeogeographical reconstructions for the Early Palaeozoic and their generation. Geol. Soc. Lond. Mem. 38, 5–24. http://dx.doi.org/10.1144/M38.2

Uutela, A., 2008. Distribution of Cambrian, Ordovician and lowermost Silurian acritarchs, in: Põldvere, A. (Ed.), Männamaa (F-367) Drill Core, Estonian Geological Sections. Geological Survey of Estonia, Tallinn, pp. 18–23.

Vanguestaine, M., 1986. Progrès récents de la stratigraphie par Acritarches du Cambro-Ordovicien d'Ardenne, d'Irlande, d'Angleterre, du Pays de Galles et de Terre-Neuve orientale. Ann. Soc. Géol. Nord 105, 65–76.

Vanguestaine, M., Van Looy, J., 1983. Acritarches du Cambrien Moyen de la vallée de Tacheddirt (Haut-Atlas, Maroc) dans le cadre d'une nouvelle zonation du Cambrien. Ann. Soc. Géol. Belg. 106, 69–85.

Van Waveren, I.M., 1992. Morphology of probable planktonic crustacean eggs from the Holocene of the Banda Sea (Indonesia), in: Head, M.J., Wrenn, J.H. (Eds.), Neogene and Quarternary Dinoflagellate Cysts. American Association of Stratigraphic Palynologists Foundation, Dallas, Texas, pp. 89–120.

Van Waveren, I.M., Marcus, N.H., 1993. Morphology of recent copepod egg envelopes from Turkey Point, Gulf of Mexico, and their implications for acritarch affinity. Spec. Pap. Palaeontol. 48, 111–124.

Vecoli, M., 1996. Stratigraphic significance of acritarchs in Cambro-Ordovician boundary strata, Hassi-Rmel area, Algerian Sahara. Boll. Della Soc. Paleontol. Ital. 35, 3–58.

Vecoli, M., Le Hérissé, A., 2004. Biostratigraphy, taxonomic diversity and patterns of morphological evolution of Ordovician acritarchs (organic-walled microphytoplankton) from the northern Gondwana margin in relation to palaeoclimatic and palaeogeographic changes. Earth-Sci. Rev. 67, 267–311. http://dx.doi.org/10.1016/j.earscirev.2004.03.002

Vecoli, M., Playford, G., 1997. Stratigraphically significant acritarchs in uppermost Cambrian to basal Ordovician strata of northwestern Algeria. Grana 36, 17–28.

Vecoli, M., Tongiorgi, M., Abdesselam-Roughi, F.-F., Benzarti, R., Massa, D., 1999. Palynostratigraphy of upper Cambrian-upper Ordovician intracratonic clastic sequences, North Africa. Boll. Della Soc. Paleontol. Ital. 38, 331–342.

Vidal, G., 1981. Lower Cambrian acritarch stratigraphy in Scandinavia. Geol. Fören. Stockh. Förh. 103, 183–192. http://dx.doi.org/10.1080/11035898109454517

Vidal, G., Knoll, A.H., 1982. Radiations and extinctions of plankton in the late Proterozoic and early Cambrian. Nature 297, 57–60. http://dx.doi.org/10.1038/297057a0

Vidal, G., Moczydłowska, M., 1996. Vendian-Lower Cambrian acritarch biostratigraphy of the central Caledonian fold belt in Scandinavia and the palaeogeography of the Iapetus-Tornquist seaway. Nor. Geol. Tidsskr. 76, 147–168.

Vidal, G., Moczydłowska-Vidal, M., 1997. Biodiversity, speciation, and extinction trends of Proterozoic and Cambrian phytoplankton. Paleobiology 23, 230–246.

Vidal, G., Moczydłowska, M., Rudavskaya, V.R., 1995. Constraints on the early Cambrian radiation and correlation of the Tommotian and Nemakit-Daldynian regional stages of eastern Siberia. J. Geol. Soc. 152, 499–510. http://dx.doi.org/10.1144/gsjgs.152.3.0499

Volkova, N.A., 1990. Akritarkhi srednego i verkhnego kembriya vostochno-evropejskoj platformy [Middle and Upper Cambrian acritarchs in the East-European Platform], Trudy. Nauka, Moscow.

Volkova, N.A., 1993. Akritarkhi pogranichnikh otlozhenij kembriya i ordovika priglintovoj polosy estonii (skvazhina M-56) [Acritarchs from the Cambrian–Ordovician boundary beds (boring core M-56) of the Estonian near-clint area]. Proc. Est. Acad. Sci. Geol. 42, 15–22.

Volkova, N.A., 1995. Acritarchs of the Cambrian–Ordovician boundary deposits of the Baltic phytoplankton province. Strat. Geol. Korreljatsiya 3, 362–374.

Wang Fuxing, Chen Qiao, 1987. Spiniferous acritarchs from the lowest Cambrian, Emei, Sichuan, southwestern China. Rev. Palaeobot. Palynol. 52, 161–177. http://dx.doi.org/10.1016/0034-6667(87)90052-2

Webby, B.D., Paris, F., Droser, M.L., Percival, I.G. (Eds.), 2004. The Great Ordovician Biodiversification Event, Critical Moments and Perspectives in Earth History and Paleobiology. Columbia University Press, New York.

Welsch, M., 1986. Die Acritarchen der höheren Digermul-Gruppe, Mittelkambrium bis Tremadoc, Ost-Finnmark, Nord-Norwegen. Palaeontogr. Abt. B 201, 1–109.

Yang Ruidong, Yin Leiming, 2001. Acritarch assemblages from the Early-middle Cambrian Kaili formation of east Guizhou Province and biostratigraphic implication. Acta Micropalaeontol. Sin. 18, 55–69.

Yin, C., 1990. Microfossils from the Zhongyicun Member of Yuhuchun Formation (Lower Cambrian) in Jinning, Yunnan Province, China. Prof. Pap. Stratigr. Palaeontol. 23, 131–140.

Yin Leiming, 1987. New data of microfossils from Precambrian–Cambrian cherts in Ningqiang, southern Shaanxi. Acta Palaeontol. Sin. 26, 187–195.

Yin, L., Zhao, Y., Yang, R., Peng, J., 2010. Acritarchs from the Early-Middle Cambrian Kaili Formation in the Wuliu-Zengjianya section, east Guizhou Province, China. Acta Palaeontol. Sin. 49, 164–173.

Yin, F., Xue, X., 2002. Early Cambrian palaeobiogeography of acritarch. J. Northwest Univ. Nat. Sci. Ed. 32, 177–180.

Young, T., Martin, F., Dean, W.T., Rushton, A.W.A., 1994. Cambrian stratigraphy of St Tudwal's Peninsula, Gwynedd, northwest Wales. Geol. Mag. 131, 335–360. http://dx.doi.org/10.1017/S0016756800011109

Zang, W.L., 1992. Sinian and Early Cambrian floras and biostratigraphy on the South China Platform. Palaeontogr. Abt. B 224, 75–119.

Zhuravlev, A.Y., 2001. Biotic diversity and structure during the Neoproterozoic-Ordovician transition, in: Zhuravlev, A.Y., Riding, R. (Eds.), The Ecology of the Cambrian Radiation. Columbia University Press, New York, pp. 173–199.

Żylińska, A., Szczepanik, Z., 2009. Trilobite and acritarch assemblages from the Lower-Middle Cambrian boundary interval in the Holy Cross Mountains (Poland). Acta Geol. Pol. 59, 413–458.

Fig. 1. Cambrian stratigraphic scheme and stratigraphic ranges of source studies used for diversity analyses.

Chronostratigraphy according to Peng et al. (2012). *Ac.* = *Acadoparadoxides*. *Ag.* = *Agnostus*. *Pb.* = *Parabolina*. For complete references of source studies see supplementary information S2.

Fig. 2. Palaeogeographical reconstruction for the mid Cambrian Period (510 Ma) with study areas marked.

Base map produced with BugPlates (Torsvik, 2009). 1 Nova Scotia, Canada (Palacios et al., 2009); 2 Eastern Newfoundland, Canada (Martin and Dean, 1981; Martin and Dean, 1983; Martin and Dean, 1984; Martin and Dean, 1988; Parsons and Anderson, 2000); 3 County Wexford, Ireland (Brück and Vanguestaine, 2004); 4 Wales (Young et al., 1994); 5 Belgium (Vanguestaine, 1986); 6 Sardinia, Italy (Ribecai et al., 2005); 7 Sierra Morena, Spain (Mette, 1989); 8 Cantabrian Mountains, Spain (Palacios and Vidal, 1992; Albani et al., 2006; Palacios, 2010); 9 N Algeria (Vecoli, 1996; Vecoli and Playford, 1997; Vecoli et al., 1999); 10 Ghadames Basin, Libya/Tunisia (Albani et al., 1991); 11 Barrandian area, Czech Republic (Fatka et al., 2004); 12 Upper Silesia (Bruno-Silesia), Poland (Jachowicz, 1994; Buła and Jachowicz, 1996; Moczydłowska, 1998; Jachowicz-Zdanowska, 2013); 13 Holy Cross Mountains (Małopolska High), Poland (Jagielska, 1965; Lendzion et al., 1982; Kowalski, 1983; Żylińska and Szczepanik, 2009); 14 Central Alborz Mountain Range, Iran (Ghavidel-syooki, 2006); 15 Zagros Basin, Iran (Ghavidel-syooki and Vecoli, 2008); 16 South Australia (Jago et al., 2006); 17 baltic Poland (Moczydłowska, 1981, 1988, 1991; Moczydłowska and Vidal, 1986; Jankauskas and Lendzion, 1992; Szczepanik, 2000); 18 Bornholm, Denmark and Skåne, Sweden (Vidal, 1981; Moczydłowska and Vidal, 1992); 19 Lithuania (Jankauskas, 1972); 20 Östergötland and Öland, SE Sweden (Vidal, 1981; Di Milia et al., 1989; Eklund, 1990); 21 SW Sweden and SE Norway (Vidal, 1981; Vidal and Moczydłowska, 1996); 22 Belarus (Jankauskas and Lendzion, 1992); 23 Estonia (Paalits, 1992; Põldvere and Paalits, 1998; Uutela, 2008); 24 Swedish Caledonides, Sweden (Moczydłowska, 2002; Vidal and

Moczydłowska, 1996); 25 Moscow Syneclise, Russia (Volkova, 1990; Volkova, 1995); 26 Leningrad Oblast, Russia (Volkova, 1993); 27 Digermul Peninsula, Norway (Welsch, 1986); 28 Kolguev Island, Russia (Moczydłowska and Stockfors, 2004); 29 Severnaya Zemlya, Russia – Kara (Raevskaya and Golubkova, 2006); 30 NE Siberia (Vidal et al., 1995); 31 Jilin, China (Chen et al., 1985); 32 Hubei, China (Ding et al., 1992; Zang, 1992); 33 Guizhou, China (Yang and Yin, 2001; Yin et al., 2010); 34 Yunnan, China (Yin, 1990; Zang, 1992); 35 Sichuan, China (Wang and Chen, 1987); 36 Shaanxi, China (Yin, 1987); 37 Grainger County, Tennessee, USA (Clendening and Wood, 1981); 38 East Svalbard, Norway (Knoll and Swett, 1987); 39 Mackenzie Mountains, Canada (Baudet et al., 1989)

Fig. 3. Classes of taxa (in regards to ranges) present in a stratigraphic interval.

After Foote (2000).

Fig. 4. Global and regional taxonomic diversity curves of Cambrian acritarchs based on stages.

A, global species diversity. B, global genus diversity. C, Baltica species diversity (no data available for the Drumian). D, Gondwana species diversity (no data available for the Fortunian, Stages 2-3).

Fig. 5. Taxonomic diversity based on biozones.

A, global species diversity. B, global genus diversity. C, Baltica species diversity (no data available for the *Parabolina spinulosa* zone). D, Gondwana species diversity (no data available for the *Trichophycus pedum* zone, Stage 2, the *Schmidtiellus mickwitzi* and *Leptoplastus* zones).

F**ig. 6. Taxonomic changes of global species and genus diversity.**

A, B, species. C, D, genera. A, C, raw data. B, D, rates of taxonomic changes per stage duration [My].

Fig. 7. Poly-cohort analyses.

A, cohort survivorship. B, cohort prenascence.

Fig. 8. Comparison of global species and genus diversities with the distribution of studies and a previously published diversity curve.

Fig. 9. Correlation of taxonomic (global species per stage) and monographic (number of references per stage) diversity.

Fig. 10. Comparison of global sampled-in-bin genus diversity of acritarchs and marine invertebrates.

Values for invertebrates taken from the supporting information of Na and Kiessling (2015).

Fig. 11. Correlation of global sampled-in-bin genus diversity of acritarchs and marine invertebrates.

Values for invertebrates taken from the supporting information of Na and Kiessling (2015). A, scatterplot of acritarch vs. marine invertebrate diversity. B, Spearman's r_s calculated with a moving window for successive intervals, each comprising eight stages; values above 0.75 or below -0.75 (dashed lines) indicate strong correlation. The middle square indicates strong and significant correlation (r_s = 0.88, p = 0.004) for the middle set of eight stages, from Stage 2 to the Jiangshanian Stage (9).

Supplementary Material

Table S1. Database of Cambrian acritarch occurrences.

Table S2. List of source references, including bibliography, countries and palaeogeographical units corresponding to study areas.

Table S3. List of acritarch genera and species reported from the Cambrian System, with marked known synynomies and homonymies, including references.

Table S4. Global species range charts based on stages, blue = presence reported; green = presence inferred; white = absence.

Table S5. Global species range charts based on biozones, blue = presence reported; green = presence inferred; white = absence.

Table S6. Baltica species range charts based on stages, blue = presence reported; green = presence inferred; white = absence.

Table S7. Baltica species range charts based on biozones, blue = presence reported; green = presence inferred; white = absence.

Table S8. Gondwana species range charts based on stages, blue = presence reported; green = presence inferred; white = absence.

Table S9. Gondwana species range charts based on biozones, blue = presence reported; green = presence inferred; white = absence.

Table S10. Global genus range chart based on stages; blue = presence reported; green = presence inferred; white = absence.

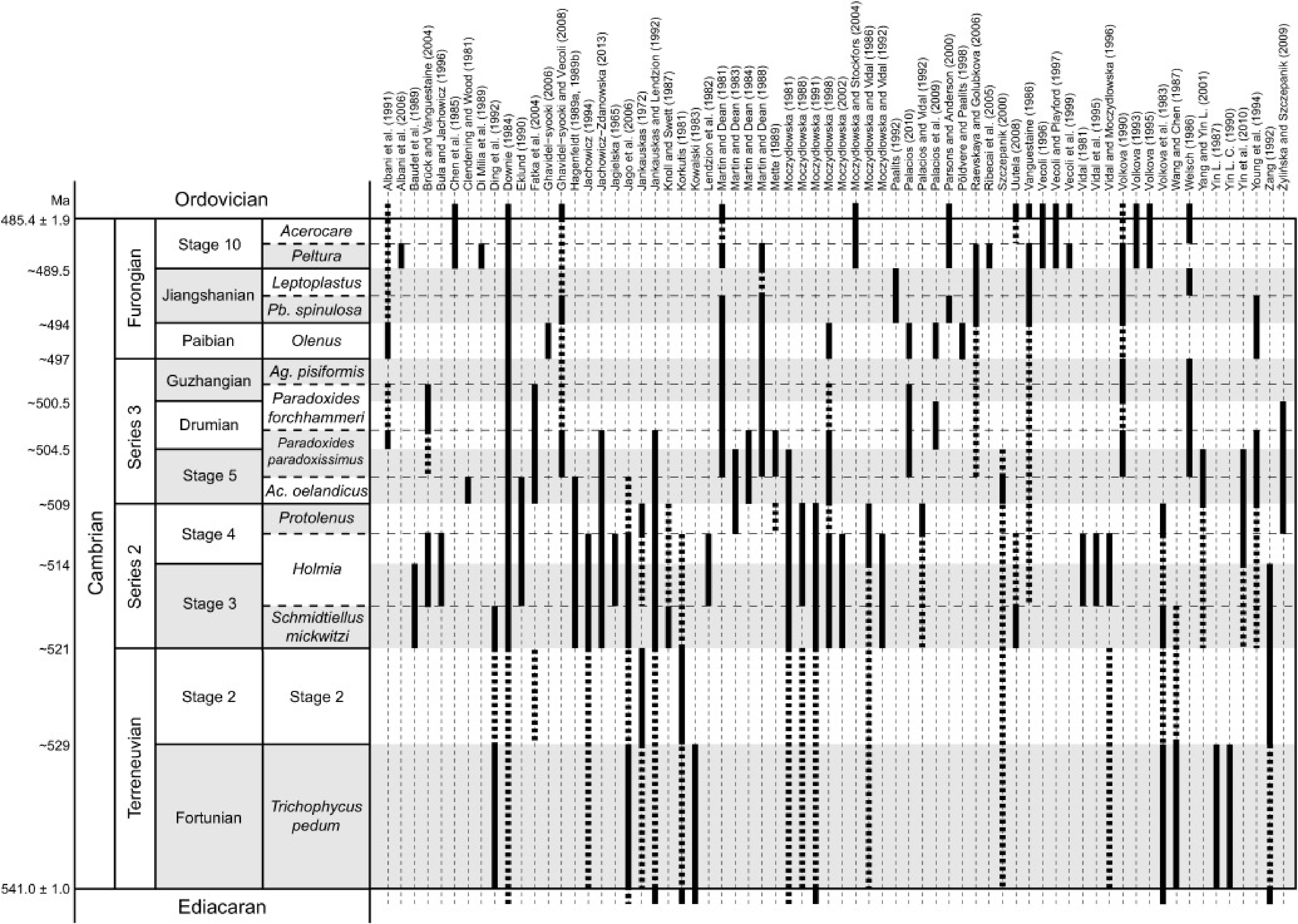
Table S11. Global genus range chart based on biozones; blue = presence reported; green = presence inferred; white = absence.

Table S12. Values of diversity indices based on stages.

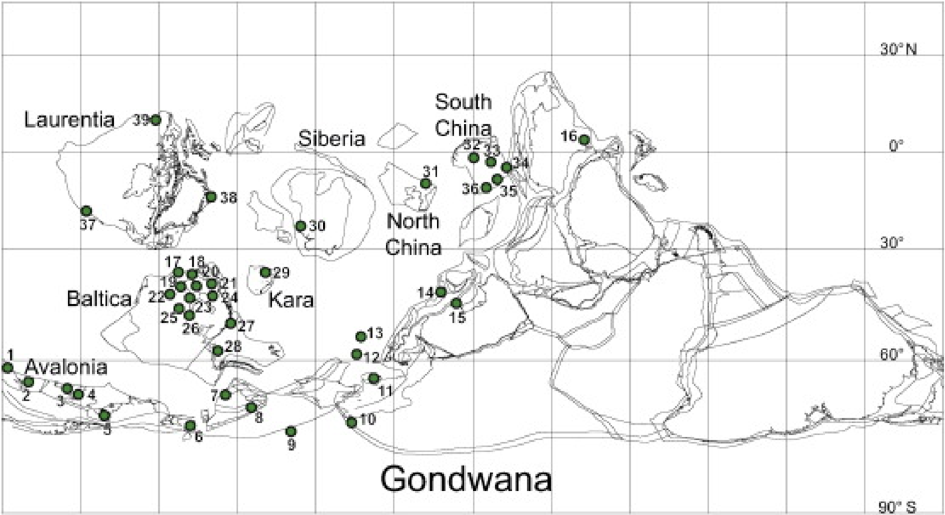
Table S13. Values of diversity indices based on biozones.

Table S14. Spearman's rs and probability value p for correlations between acritarch diversity indices and the number of studies per stage, and between global sampled-in-bin genus diversities of acritarchs and marine invertebrates (values for marine invertebrates were taken from the supporting information of Na and Kiessling, 2015).

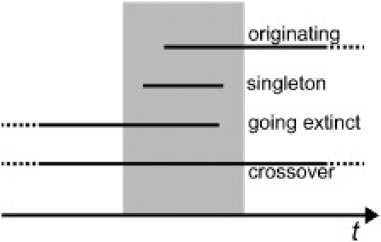
Table S15. Comparison of regional species diversities based on biozones; Baltica and Gondwana: this study, sampled-in-bin diversity; Upper Silesia: Moczydłowska (1998), total? diversity.

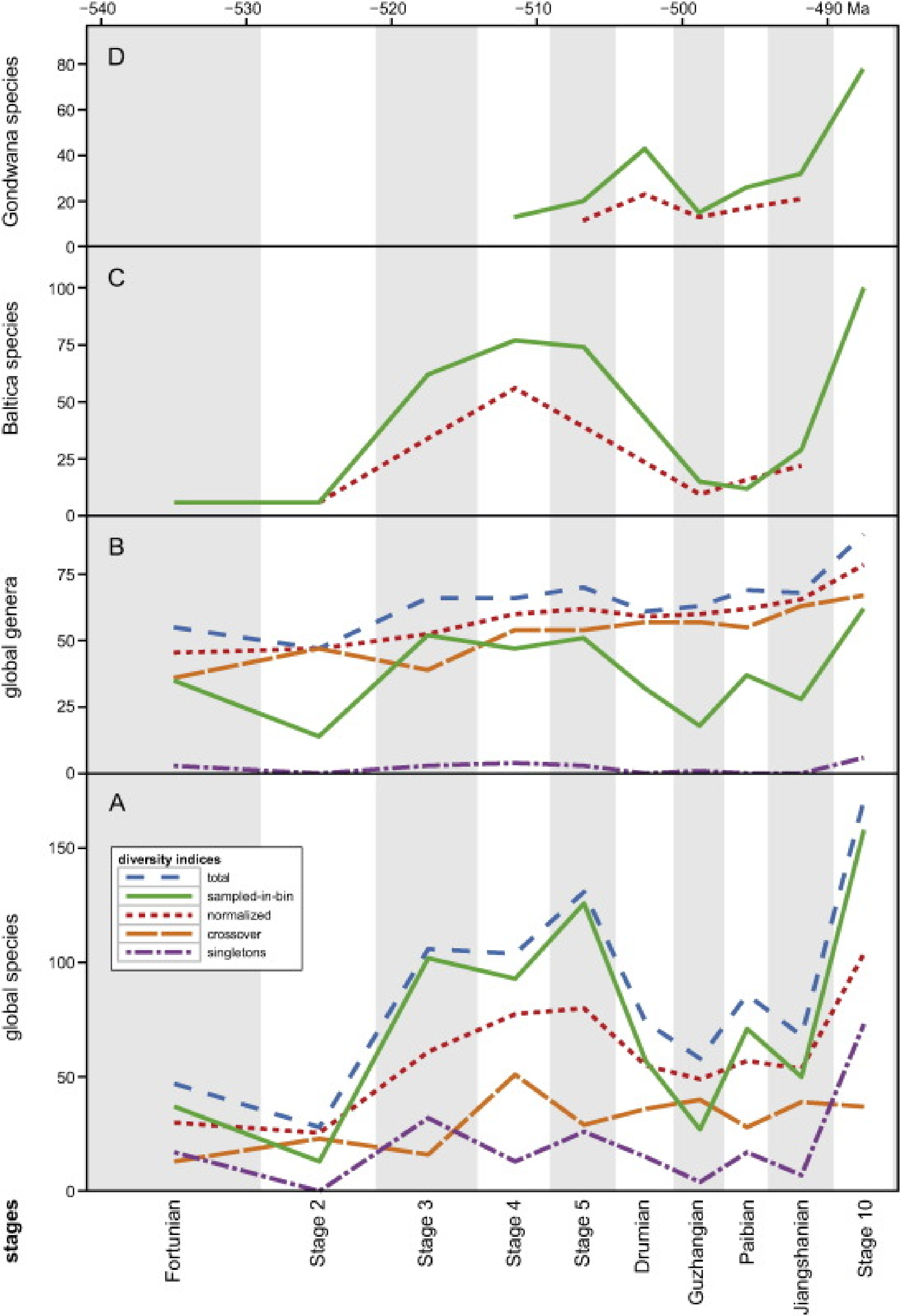


Ma
485.4 ± 1.9
~489.5
~494
~497
~500.5
~504.5
~509
~514
~521
~529
541.0 ± 1.0
Ordovician
Cambrian
Ediacaran
Furongian
Series 3
Series 2
Terreneuvian
Stage 10
Jiangshanian
Paibian
Guzhangian
Drumian
Stage 5
Stage 4
Stage 3
Stage 2
Fortunian
Acerocare
Peltura
Leptoplastus
Pb. spinulosa
Olenus
Ag. pisiformis
Paradoxides forchhammeri
Paradoxides paradoxissimus
Ac. oelandicus
Protolenus
Holmia
Schmidtiellus mickwitzi
Stage 2
Trichophycus pedum
Albani et al. (1991)
Albani et al. (2006)
Baudet et al. (1989)
Brück and Vanguestaine (2004)
Bula and Jachowicz (1996)
Chen et al. (1985)
Clendening and Wood (1981)
Di Milia et al. (1989)
Ding et al. (1992)
Downie (1984)
Eklund (1990)
Fatka et al. (2004)
Ghavidel-syooki (2006)
Ghavidel-syooki and Vecoli (2008)
Hagenfeldt (1989a, 1989b)
Jachowicz (1994)
Jachowicz-Zdanowska (2013)
Jagielska (1965)
Jago et al. (2006)
Jankauskas (1972)
Jankauskas and Lendzion (1992)
Knoll and Swett (1987)
Korkutis (1981)
Kowalski (1983)
Lendzion et al. (1982)
Martin and Dean (1981)
Martin and Dean (1983)
Martin and Dean (1984)
Martin and Dean (1988)
Mette (1989)
Moczydłowska (1981)
Moczydłowska (1988)
Moczydłowska (1991)
Moczydłowska (1998)
Moczydłowska (2002)
Moczydłowska and Stockfors (2004)
Moczydłowska and Vidal (1986)
Moczydłowska and Vidal (1992)
Paalits (1992)
Palacios (2010)
Palacios and Vidal (1992)
Palacios et al. (2009)
Parsons and Anderson (2000)
Põldvere and Paalits (1998)
Raevskaya and Golubkova (2006)
Ribecai et al. (2005)
Szczepanik (2000)
Uutela (2008)
Vanguestaine (1986)
Vecoli (1996)
Vecoli and Playford (1997)
Vecoli et al. (1999)
Vidal (1981)
Vidal et al. (1995)
Vidal and Moczydłowska (1996)
Volkova (1990)
Volkova (1993)
Volkova (1995)
Volkova et al. (1983)
Wang and Chen (1987)
Welsch (1986)
Yang and Yin L. (2001)
Yin L. (1987)
Yin L. C. (1990)
Yin et al. (2010)
Young et al. (1994)
Zang (1992)
Żylińska and Szczepanik (2009)

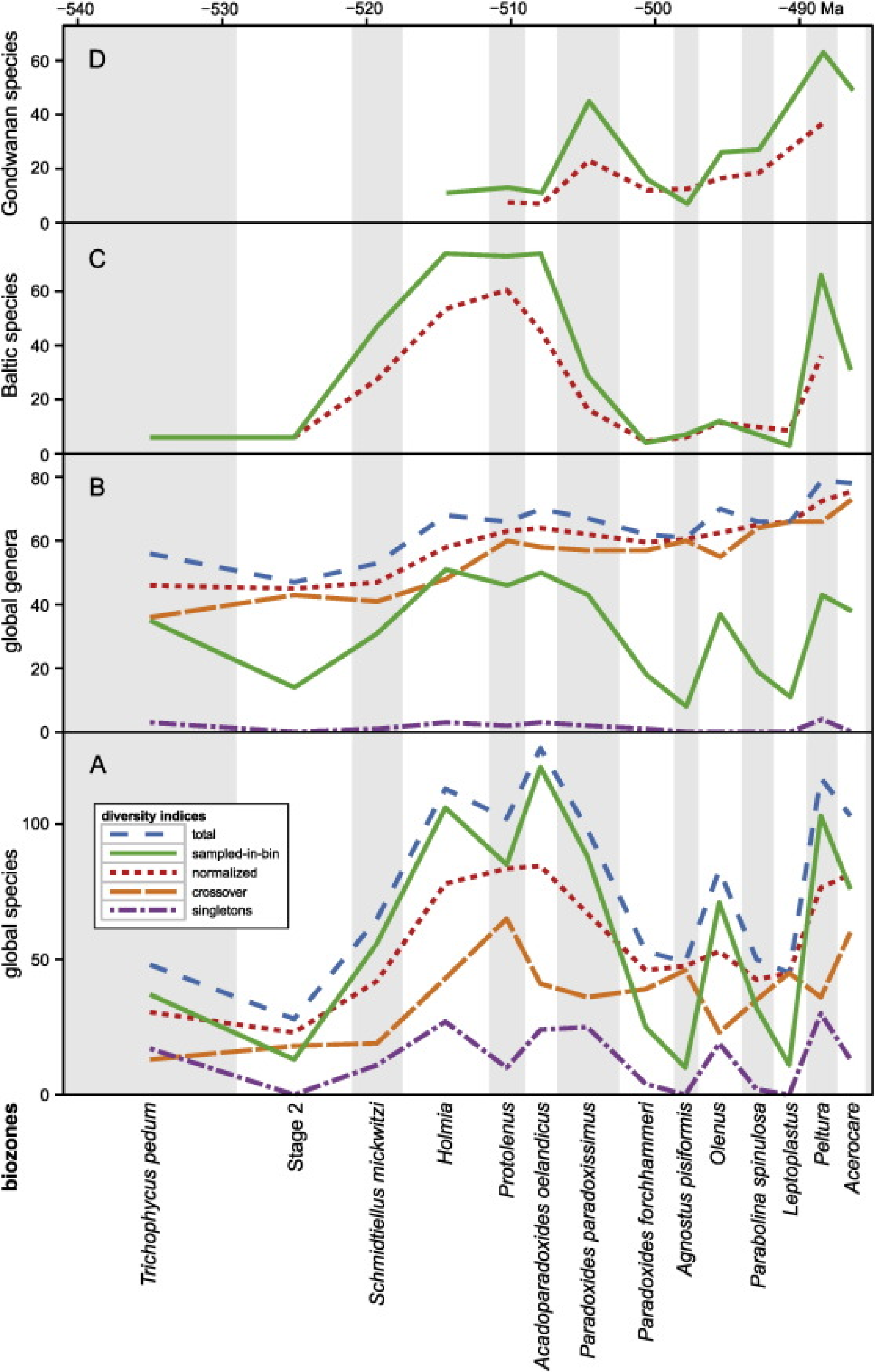


30° N
0°
30°
60°
90° S
Laurentia
Siberia
South China
North China
Baltica
Kara
Avalonia
Gondwana
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39

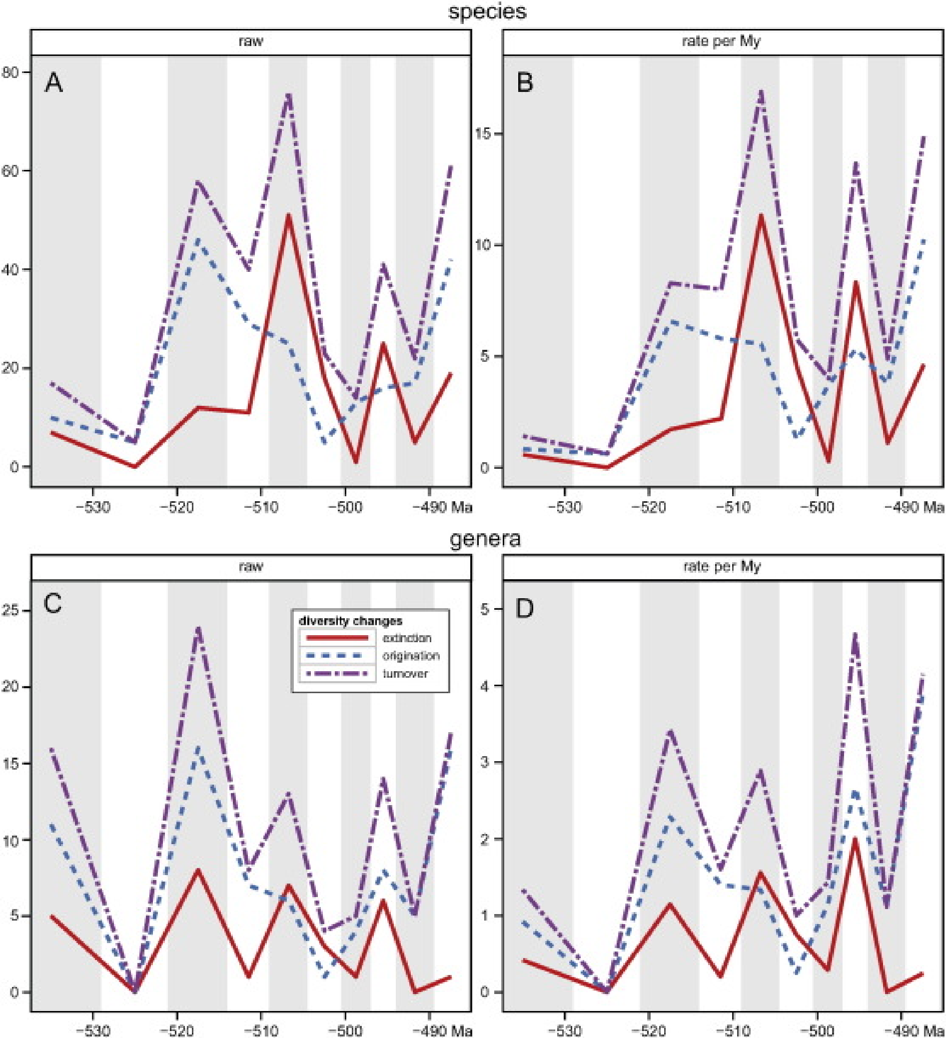

originating
singleton
going extinct
crossover
t



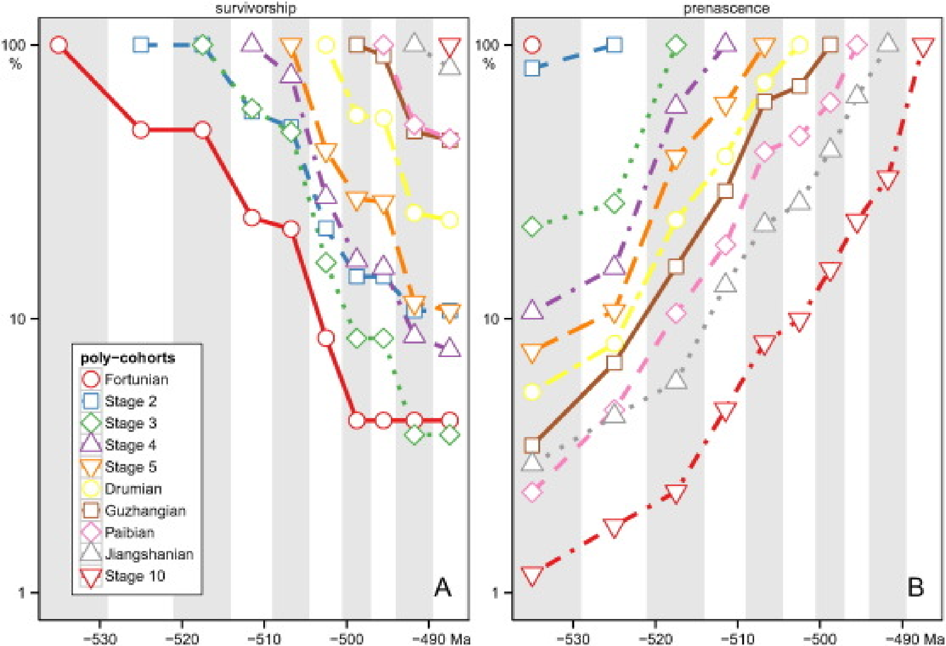
-540
-530
-520
-510
-500
-490 Ma
D
Gondwana species
C
Baltica species
B
global genera
A
global species
diversity indices
total
sampled-in-bin
normalized
crossover
singletons
stages
Fortunian
Stage 2
Stage 3
Stage 4
Stage 5
Drumian
Guzhangian
Paibian
Jiangshanian
Stage 10



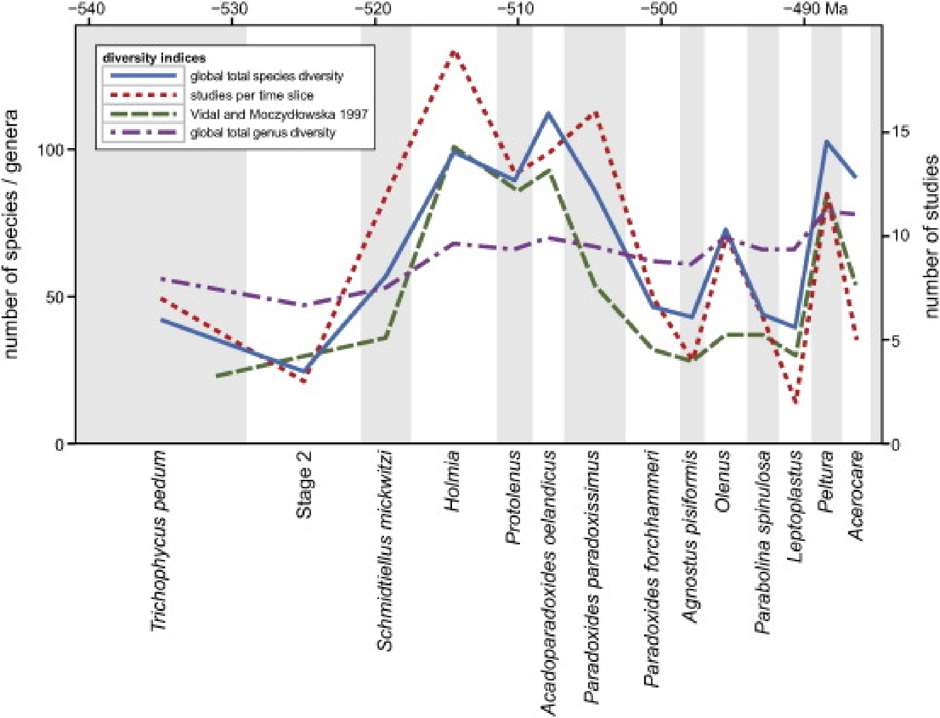
−540
−530
−520
−510
−500
−490 Ma
D
Gondwanan species
C
Baltic species
B
global genera
A
global species
diversity indices
total
sampled-in-bin
normalized
crossover
singletons
biozones
Trichophycus pedum
Stage 2
Schmidtiellus mickwitzi
Holmia
Protolenus
Acadoparadoxides oelandicus
Paradoxides paradoxissimus
Paradoxides forchhammeri
Agnostus pisiformis
Olenus
Parabolina spinulosa
Leptoplastus
Peltura
Acerocare



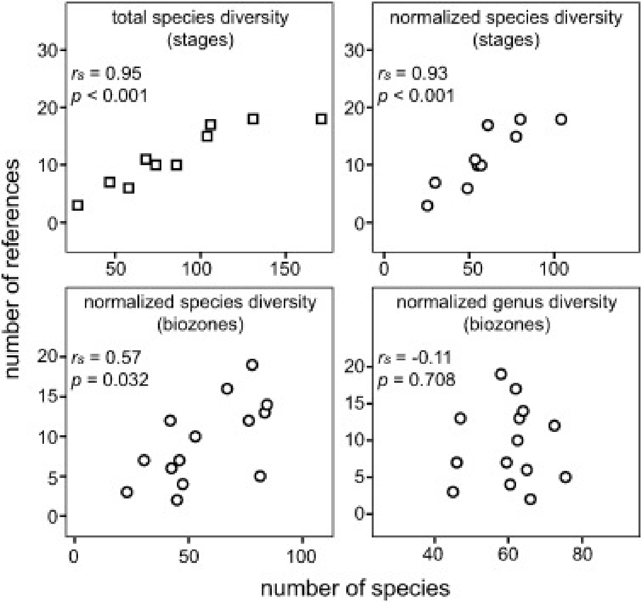
species
raw
rate per My
A
B
genera
C
D
diversity changes
extinction
origination
turnover
Ma

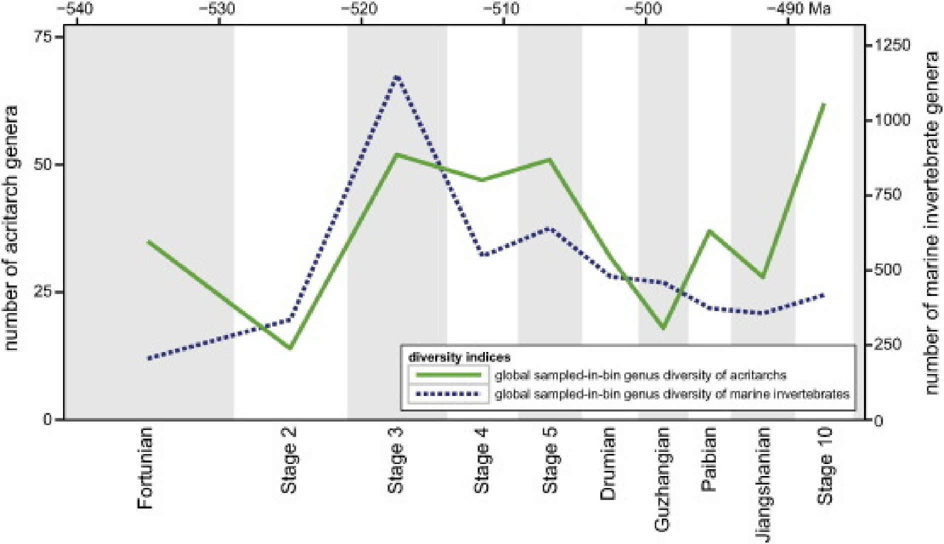


survivorship
prenascence
100
%
10
1
poly-cohorts
Fortunian
Stage 2
Stage 3
Stage 4
Stage 5
Drumian
Guzhangian
Paibian
Jiangshanian
Stage 10
A
B
-530
-520
-510
-500
-490 Ma



−540
−530
−520
−510
−500
−490 Ma
diversity indices
global total species diversity
studies per time slice
Vidal and Moczydlowska 1997
global total genus diversity
number of species / genera
number of studies
0
50
100
5
10
15
Trichophycus pedum
Stage 2
Schmidtiellus mickwitzi
Holmia
Protolenus
Acadoparadoxides oelandicus
Paradoxides paradoxissimus
Paradoxides forchhammeri
Agnostus pisiformis
Olenus
Parabolina spinulosa
Leptoplastus
Peltura
Acerocare


total species diversity (stages)
rs = 0.95
p < 0.001
normalized species diversity (stages)
rs = 0.93
p < 0.001
normalized species diversity (biozones)
rs = 0.57
p = 0.032
normalized genus diversity (biozones)
rs = -0.11
p = 0.708
number of references
number of species



−540
−530
−520
−510
−500
−490 Ma
number of acritarch genera
75
50
25
0
number of marine invertebrate genera
1250
1000
750
500
250
0
diversity indices
global sampled-in-bin genus diversity of acritarchs
global sampled-in-bin genus diversity of marine invertebrates
Fortunian
Stage 2
Stage 3
Stage 4
Stage 5
Drumian
Guzhangian
Paibian
Jiangshanian
Stage 10

List of literary sources for the Cambrian acritarch database

[country/countries – palaeocontinent(s)]
* not included in the diversity analyses

1. Albani R, Massa D, Tongiorgi M (1991) Palynostratigraphy (Acritarchs) of some Cambrian beds from the Rhadames (Ghadamis) basin (Western Libya—southern Tunisia). Boll Della Soc Paleontol Ital 30: 255–280.

   [Libya, Tunisia – Africa/Gondwana]

2. Albani R, Bagnoli G, Bernárdez E, Gutíerrez-Marco JC, Ribecai C (2006) Late Cambrian acritarchs from the "Túnel Ordovícico del Fabar", Cantabrian Zone, N Spain. Rev Palaeobot Palynol 139: 41–52. doi:10.1016/j.revpalbo.2005.07.005.

   [Spain – Iberia/Gondwana]

3. Aráoz L, Milagro-Vergel M del (2006) Palinología de la transición cambro-ordovícica en Quebrada de Moya, Cordillera Oriental, Argentina. Rev Bras Paleontol 9: 1–8.

   [Argentina – South America/Gondwana]*

4. Bagnoli G, Stouge S, Tongiorgi M (1988) Acritarchs and conodonts from the Cambro-Ordovician Furuhäll (Köpingsklint) section (Öland, Sweden). Riv Ital Paleontol E Stratigr 94: 163–248.

   [Sweden – Baltica]*

5. Baudelot S, Géry B (1979) Découverte d'Acritarches du Cambrien supérieur et du Trémadoc dans le massif ancien de Grande Kabylie (Algérie). Comptes Rendus Académie Sci Paris 288: 1513–1516.

   [Algeria – Africa/Gondwana]*

6. Baudet D, Aitken JD, Vanguestaine M (1989) Palynology of uppermost Proterozoic and lowermost Cambrian formations, central Mackenzie Mountains, northwestern Canada. Can J Earth Sci 26: 129–148. doi:10.1139/e89-011.

   [Canada – Laurentia]

7. Brück PM, Vanguestaine M (2004) Acritarchs from the Lower Palaeozoic succession on the south County Wexford coast, Ireland: new age constraints for the Cullenstown Formation and the Cahore and Ribband Groups. Geol J 39: 199–224.

   [Ireland – Avalonia/Gondwana]

8. Buła Z, Jachowicz M (1996) The Lower Paleozoic sediments in the Upper Silesian Block. Geol Q 40: 299–336.

   [Poland – Bruno-Silesia]

9. Chen J, Qian Y, Lin Y, Zhang J, Wang Z, et al. (1985) Study on Cambrian-Ordovician Boundary Strata and Its Biota in Dayagcha, Hunjiang, Jilin, China: Contribution to the Calgary Cambrian-Ordovician-Boundary Meeting. China Prospect Publishing House. 177 p.

   [China – North China]

10. Clendening JA, Wood GD (1981) *Thymadora*, a new acritarch genus from the middle Cambrian Rogersville shale of Tennessee, U.S.A. Palynology 5: 153–158. doi:10.1080/01916122.1981.9989223.

[USA – Laurentia]

11. Cramer FH, Díez M del CR (1972) Acritarchs from the upper Middle Cambrian Oville Formation of León, northwestern Spain. Rev Esp Micropaleontol: 39–50.

[Spain – Iberia/Gondwana]*

12. Dean WT, Martin F (1982) The sequence of trilobite faunas and acritarch microfloras at the Cambrian-Ordovician boundary, Wilcox Pass, Alberta, Canada. In: Basset MG, Dean WT, editors. The Cambrian-Ordovician Boundary: Sections, Fossil Distribution, and Correlations. National Museum of Wales, Geological Series. Cardiff. pp. 131–140.

[Canada – Laurentia]*

13. Dean WT, Martin F, Monod O, Günay Y, Kozlu H, et al. (1997) Precambrian? and Cambrian stratigraphy of the Penbeğli-Tut inlier, southeastern Turkey. Geol Mag 134: 37–53.

[Turkey – Arabia/Gondwana]*

14. Di Milia A (1991) Upper Cambrian acritarchs from the Solanas Sandstone Formation, central Sardinia, Italy. Boll Della Soc Paleontol Ital 30: 127–152.

[Italy – Sardinia/Gondwana]*

15. Di Milia A, Ribecai C, Tongiorgi M (1989) Late Cambrian acritarchs from the *Peltura scarabaeoides* Trilobite Zone at Degerhamn (Öland, Sweden). Palaeontogr Ital 76: 1–56.

[Sweden – Baltica]*

16. Di Milia A, Tongiorgi M, Albani R (1993) Acritarch findings in Early Paleozoic, low-grade metasediments of Sardinia (Italy): a review. Rev Esp Paleontol 8: 170–176.

[Italy – Sardinia/Gondwana]*

17. Ding L, Li Y, Chen H (1992) Discovery of *Micrhystridium regulare* from Sinian–Cambrian boundary strata in Yichang, Hubei, and its stratigraphic significance. Acta Micropalaeontologica Sin 9: 303–309.

[China – South China]

18. Dong L, Xiao S, Shen B, Zhou C, Li G, et al. (2009) Basal Cambrian Microfossils from the Yangtze Gorges Area (South China) and the Aksu Area (Tarim Block, Northwestern China). J Paleontol 83: 30–44. doi:10.1666/07-147R.1.

[China – Tarim, South China]*

19. Downie C (1982) Lower Cambrian acritarchs from Scotland, Norway, Greenland and Canada. Trans R Soc Edinb 72: 257–285. doi:10.1017/S0263593300010051.

[Canada – Laurentia; Greenland/Denmark – Greenland/Laurentia; Scotland – N Britain/Laurentia; Canada – Avalonia/Gondwana; Norway – Baltica]*

20. Downie C (1984) Acritarchs in British stratigraphy. Geol Soc London Spec Rep 17: 1–26.

[UK, Ireland – Gondwana, Laurentia]

21. Eklund C (1990) Lower Cambrian acritarch stratigraphy of the Bårstad 2 core, Östergötland, Sweden. Geol Fören Stockh Förh 112: 19–44. doi:10.1080/11035899009453157.

[Sweden – Baltica]

22. Fatka O, Kordule V, Szabad M (2004) Stratigraphical distribution of Cambrian fossils in the Příbram-Jince Basin (Barrandian area, Czech Republic). Senckenberg Lethaea 84: 367–381. doi:10.1007/BF03043477.

[Czech Republic – 'Perunica'/Gondwana]

23. Ghavidel-syooki M (1990) The encountered acritarchs and chitinozoans from Mila, Ilebeck and Zard Kuh Formation in Tang-e-Ilebek at Zard Kuh region and their correlation with Palaeozoic sequence at Chal-i-Sheh area. Proceedings of Symposium on Diapirism with special reference to Iran. Geological Survey of Iran, Vol. 1. pp. 141–218.

[Iran – Arabia/Gondwana]*

24. Ghavidel-syooki M (1996) Palynostratigraphy and Palaeobiogeography of the Lower Palaeozoic sequence in the Northeastern Alborz Range (Kopet–Dagh Region) of Iran. Proceedings of the IX international palynological congress Houston, Texas, USA. pp. 17–35.

[Iran – Arabia/Gondwana]

25. Ghavidel-syooki M (2006) Palynostratigraphy and Palaeogeography of Cambrian strata (Zaigun, Lalun, Mila and Ilebyek Formations) from the High Zagros Mountain Ranges, southern Iran. Abstract of the International Palaeontology Congress, Beijing China. Beijing. pp. 80–81.

[Iran – Alborz/Gondwana]

26. Ghavidel-syooki M, Vecoli M (2008) Palynostratigraphy of Middle Cambrian to lowermost Ordovician stratal sequences in the High Zagros Mountains, southern Iran: Regional stratigraphic implications, and palaeobiogeographic significance. Rev Palaeobot Palynol 150: 97–114.

[Iran – Arabia/Gondwana]

27. Hagenfeldt SE (1989) Lower Cambrian acritarchs from the Baltic Depression and south-central Sweden, taxonomy and biostratigraphy. Stockh Contrib Geol 41: 1–176.

[Sweden – Baltica]

28. Hagenfeldt SE (1989) Middle Cambrian acritarchs from the Baltic Depression and south-central Sweden, taxonomy and biostratigraphy. Stockh Contrib Geol 41: 177–250.

[Sweden – Baltica]

29. Jachowicz M (1994) Occurrence of the microfossils belonging to Acritarcha in the older Palaeozoic of the NW border of the Upper Silesia Coal Basin (SW Poland). Prz Geol 42: 631–637.

[Poland – Bruno-Silesia]

30. Jachowicz-Zdanowska M (2013) Cambrian phytoplankton of the Brunovistulicum–taxonomy and biostratigraphy. Pol Geol Inst Spec Pap 28: 1–150.

[Poland, Czech Republic – Bruno-Silesia]

31. Jagielska L (1965) Nowe dane o mikroflorze eokambru i najniższego kambru antyklinorium klimontowskiego [New data on the Eocambrian and lowermost Cambrian microflora from the Klimontów Anticlinorium]. Kwart Geol 9: 499–509.

[Poland – Małopolska]

32. Jago JB, Zang W, Sun X, Brock GA, Paterson JR, et al. (2006) A review of the Cambrian biostratigraphy of South Australia. Palaeoworld 15: 406–423. doi:10.1016/j.palwor.2006.10.014.

[Australia – W Australia/Gondwana]

33. Jankauskas T (1972) Biostratigrafiya nizhnego kembriya Litvy (po akritarkham) [Stratigraphical subdivision of the Lower Cambrian of Lithuania (using acritarchs)]. Akad Nauk SSSR Dokl Earth Sci Sect 205: 1186–1189.

[Belarus, Lithuania, Poland – Baltica]

34. Jankauskas T, Lendzion K (1992) Lower and Middle Cambrian acritarch-based biozonation of the Baltic Syneclise and adjacent areas (East European Platform). Przegląd Geol 40: 519–525.

[Lithuania, Poland, Belarus – Baltica]

35. Keegan JB, Rasul SM, Shaheen Y (1990) Palynostratigraphy of the lower Palaeozoic, Cambrian to Silurian, sediments of the Hashemite Kingdom of Jordan. Rev Palaeobot Palynol 66: 167–180. doi:10.1016/0034-6667(90)90037-J.

[Jordan – Arabia/Gondwana]*

36. Knoll AH, Swett K (1987) Micropaleontology across the Precambrian-Cambrian boundary in Spitsbergen. J Paleontol 61: 898–926.

[Norway – E Svalbard/Laurentia]

37. Korkutis V (1981) Late Precambrian and Early Cambrian in the East European platform. Precambrian Res 15: 75–94. doi:10.1016/0301-9268(81)90068-1.

[Baltica, Bruno-Silesia]

38. Kowalski WR (1983) Stratigraphy of the Upper Precambrian and lowest Cambrian strata in southern Poland. Acta Geol Pol 33: 183–218.

[Poland – Małopolska]

39. Lendzion K, Moczydłowska M, Żakowa H (1982) A new look at the Bazow Cambrian Sequence (southern Holy Cross Mts). Bull Pol Acad Sci Earth Sci 30: 67.

[Poland – Małopolska]

40. Martin F (1992) Uppermost Cambrian and lower Ordovician acritarchs and lower Ordovician chitinozoans from Wilcox Pass, Alberta. Geol Surv Canada Bull 420: 1–57.

[Canada – Laurentia]*

41. Martin F, Dean WT (1981) Middle and Upper Cambrian and Lower Ordovician acritarchs from Random Island, eastern Newfoundland. Geol Surv Canada Bull 343: 1-43.

[Canada – Avalonia/Gondwana]

42. Martin F, Dean WT (1983) Late Early Cambrian and early Middle Cambrian acritarchs from Manuels River, eastern Newfoundland. Curr Res Part B Geol Surv Can Paper 83: 353–363.

[Canada – Avalonia/Gondwana]

43. Martin F, Dean WT (1984) Middle Cambrian acritarchs from the Chamberlains Brook and Manuels River formations at Random Island, eastern Newfoundland. Curr Res Part Geol Surv Can Paper 84: 429–440.

[Canada – Avalonia/Gondwana]

44. Martin F, Dean WT (1988) Middle and Upper Cambrian acritarch and trilobite zonation at Manuels River and Random Island, eastern Newfoundland. Energy, Mines and Resources Canada. 91 p.

[Canada – Avalonia/Gondwana]

45. Mette W (1989) Acritarchs from Lower Paleozoic rocks of the western Sierra Morena, SW-Spain and biostratigraphic results. Geol Palaeontol 23: 1–19.

[Spain – Iberia/Gondwana]

46. Moczydłowska M (1981) Lower and Middle Cambrian acritarchs from Northeastern Poland. Precambrian Res 15: 63–74. doi:10.1016/0301-9268(81)90067-X.

[Poland – Baltica]

47. Moczydłowska M (1988) New Lower Cambrian acritarchs from Poland. Rev Palaeobot Palynol 54: 1–10. doi:10.1016/0034-6667(88)90002-4.

[Poland – Baltica]

48. Moczydłowska M (1991) Acritarch biostratigraphy of the Lower Cambrian and the Precambrian-Cambrian boundary in southeastern Poland. Oslo: Universitetsforlaget. 127 p.

[Poland – Baltica]

49. Moczydłowska M (1998) Cambrian acritarchs from Upper Silesia, Poland - biochronology and tectonic implications. Oslo: Scandinavian University Press. 121 p.

[Poland – Bruno-Silesia]

50. Moczydłowska M (2002) Early Cambrian phytoplankton diversification and appearance of trilobites in the Swedish Caledonides with implications for coupled evolutionary events between primary producers and consumers. Lethaia 35: 191–214. doi:10.1111/j.1502-3931.2002.tb00079.x.

[Sweden – Baltica]

51. Moczydłowska M, Vidal G (1986) Lower Cambrian acritarch zonation in southern Scandinavia and southeastern Poland. Geol Fören Stockh Förh 108: 201–223. doi:10.1080/11035898609454685.

[Denmark, Norway, Poland, Sweden – Baltica; incl. data from Greenland/Denmark – Greenland/Laurentia]

52. Moczydłowska M, Vidal G (1992) Phytoplankton from the Lower Cambrian Læså formation on Bornholm, Denmark: biostratigraphy and palaeoenvironmental constraints. Geol Mag

129: 17–40. doi:10.1017/S0016756800008104.

[Denmark – Baltica]

53. Moczydłowska M, Crimes TP (1995) Late Cambrian acritarchs and their age constraints on an Ediacaran-type fauna from the Booley Bay Formation, Co. Wexford, Eire. Geol J 30: 111–128. doi:10.1002/gj.3350300203.

[Ireland – Avalonia/Gondwana]*

54. Moczydłowska M, Stockfors M (2004) Acritarchs from the Cambrian–Ordovician boundary interval on Kolguev Island, Arctic Russia. Palynology 28: 15–73.

[Russia – Baltica]

55. Molyneux S, Osterloff P, Penney R, Spaak P (2006) Biostratigraphy of the Lower Palaeozoic Haima Supergroup, Oman: its application in sequence stratigraphy and hydrocarbon exploration. GeoArabia - Middle East Pet Geosci 11: 17–48.

[Oman – Arabia/Gondwana]*

56. Paalits I (1992) Upper Cambrian acritarchs from boring core M-72 of North Estonia. Proc Est Acad Sci 41: 29–37.

[Estonia – Baltica]

57. Paalits I (2005) Distribution of Furongian (Upper Cambrian) organic-walled microfossils. In: Põldvere A, editor. Mehikoorma (421) Drill Core. Estonian Geological Sections. Tallinn: Geological Survey of Estonia. pp. 30–31.

[Estonia – Baltica]*

58. Paalits I (2007) Distribution of Furongian (Upper Cambrian) organic-walled microfossils. In: Põldvere A, editor. Tsiistre (327) Drill Core. Estonian Geological Sections. Tallinn: Geological Survey of Estonia. pp. 9–10.

[Estonia – Baltica]*

59. Palacios T (2010) Middle–Upper Cambrian acritarchs from the Oville and Barrios Formations, Cantabrian Mountains, northern Spain. Abstracts. Warsaw. pp. 50–53.

[Spain – Iberia/Gondwana]

60. Palacios T, Vidal G (1992) Lower Cambrian acritarchs from northern Spain: the Precambrian-Cambrian boundary and biostratigraphic implications. Geol Mag 129: 421–436. doi:10.1017/S0016756800019518.

[Spain – Iberia/Gondwana]

61. Palacios T, Jensen S, Barr SM, White CE (2009) Acritarchs from the MacLean Brook Formation, southeastern Cape Breton Island, Nova Scotia, Canada: New data on Middle Cambrian–Lower Furongian acritarch zonation. Palaeogeogr Palaeoclimatol Palaeoecol 273: 123–141. doi:10.1016/j.palaeo.2008.12.006.

[Canada – Avalonia/Gondwana]

62. Palmer SE, Burden E, Waldron JWF (2001) Stratigraphy of the Curling Group (Cambrian), Humber Arm Allochthon, Bay of Islands. Curr Res Rep 2001-1: 105–112.

[Canada – Laurentia]*

63. Parsons MG, Anderson MM (2000) Acritarch microfloral succession from the Late Cambrian and Ordovician (early Tremadoc) of Random Island, eastern Newfoundland, and its comparison to coeval microfloras, particularly those of the East European Platform. Dallas, Texas: American Association of Stratigraphic Palynologists Foundation. 138 p.

[Canada – Avalonia/Gondwana]

64. Põldvere A, Paalits I (1998) Middle and Upper Cambrian. In: Männik P, editor. Tartu (453) Drillcore. Estonian Geological Sections. Tallinn: Geological Survey of Estonia. pp. 10–11. [+ Appendix 9: Paalits I (1998) Acritarchs in Upper Cambrian strata. p. 44.]

[Estonia – Baltica]

65. Pykhova NG (1967) Microfossils of Lower Cambrian and Precambrian deposits in eastern Siberia. Rev Palaeobot Palynol 5: 31–38. doi:10.1016/0034-6667(67)90206-0.

[Russia – Siberia]*

66. Raevskaya E, Golubkova E (2006) Biostratigraphical implication of Middle–Upper Cambrian acritarchs from Severnaya Zemlya (high Arctic of Russia). Rev Palaeobot Palynol 139: 53–69. doi:10.1016/j.revpalbo.2005.07.010.

[Russia – Kara]

67. Ribecai CB, Bagnoli G, Mazzarini F, Musumeci G (2005) Paleontological evidence for Late Cambrian in the Arburese area, SW Sardinia. In: Steemans P, Javaux E, editors. Pre-Cambrian to Palaeozoic Palaeopalynology and Palaeobotany. Carnets de Géologie / Notebooks on Geology. Brest, Vol. 2. pp. 45–50.

[Italy – Sardinia/Gondwana]

68. Steiner M, Fatka O (1996) Lower Cambrian tubular micro-to macrofossils from the Paseky Shale of the Barrandian area (Czech Republic). Paläontol Z 70: 275–299.

[Czech Republic – ‘Perunica’/Gondwana]*

69. Strother PK (2008) A new Cambrian acritarch from the Nolichucky Shale, eastern Tennessee, U.S.A. Palynology 32: 205–212. doi:10.1080/01916122.2008.9989658.

[USA – Laurentia]*

70. Sun S (1999) Cambrian microflora in Yunxi, Hubei and its stratigraphic significance. Geol Rev 45: 291–294.

[China – South China]*

71. Szczepanik Z (2000) The Cambrian of the western part of the Pomeranian Caledonides foreland, Peribaltic Syneclise: microfloral evidence. Geol Q 44: 261–273.

[Poland – Baltica]

72. Tiwari M (1999) Organic-walled microfossils from the Chert–phosphorite Member, Tal Formation, Precambrian–Cambrian Boundary, India. Precambrian Res 97: 99–113. doi:10.1016/S0301-9268(99)00023-6.

[India – India/Gondwana]*

73. Uutela A (2008) Distribution of Cambrian, Ordovician and lowermost Silurian acritarchs. In: Põldvere A, editor. Männamaa (F-367) Drill Core. Estonian Geological Sections. Tallinn: Geological Survey of Estonia. pp. 18–23.

[Estonia – Baltica]

74. Vanguestaine M (1986) Progrès récents de la stratigraphie par Acritarches du Cambro-Ordovicien d'Ardenne, d'Irlande, d'Angleterre, du Pays de Galles et de Terre-Neuve orientale. Ann Société Géologique Nord 105: 65–76.

[Belgium – Avalonia/Gondwana]

75. Vanguestaine M, Van Looy J (1983) Acritarches du Cambrien Moyen de la vallée de Tacheddirt (Haut-Atlas, Maroc) dans le cadre d'une nouvelle zonation du Cambrien. Ann Société Géologique Belg 106: 69–85.

[Morocco – Africa/Gondwana]*

76. Vanguestaine M, Brück PM, Maziane-Serraj N, Higgs KT (2002) Cambrian palynology of the Bray Group in County Wicklow and South County Dublin, Ireland. Rev Palaeobot Palynol 120: 53–72. doi:10.1016/S0034-6667(01)00150-6.

[Ireland – Avalonia/Gondwana]*

77. Vecoli M (1996) Stratigraphic significance of acritarchs in Cambro-Ordovician boundary strata, Hassi-Rmel area, Algerian Sahara. Boll Della Soc Paleontol Ital 35: 3–58.

[Algeria –Africa/Gondwana]

78. Vecoli M, Playford G (1997) Stratigraphically significant acritarchs in uppermost Cambrian to basal Ordovician strata of northwestern Algeria. Grana 36: 17–28.

[Algeria –Africa/Gondwana]

79. Vecoli M, Tongiorgi M, Abdesselam-Roughi F-F, Benzarti R, Massa D (1999) Palynostratigraphy of upper Cambrian-upper Ordovician intracratonic clastic sequences, North Africa. Boll Della Soc Paleontol Ital 38: 331–342.

[Tunisia, Algeria – Africa/Gondwana]

80. Vecoli M, Videt B, Paris F (2008) First biostratigraphic (palynological) dating of Middle and Late Cambrian strata in the subsurface of northwestern Algeria, North Africa: Implications for regional stratigraphy. Rev Palaeobot Palynol 149: 57–62. doi:10.1016/j.revpalbo.2007.10.004.

[Algeria – Africa/Gondwana]

81. Vecoli M, Dieni I, Sassi F, Servais T (2008) Cambrian Acritarchs from the Col di Foglia (Agordo) southalpine metamorphic basement, Italian Eastern Alps: the oldest biostratigraphic record in the alps. Rendiconti Lincei 19: 45–55. doi:10.1007/s12210-008-0003-y.

[Italy – ?]

82. Vidal G (1981) Lower Cambrian acritarch stratigraphy in Scandinavia. Geol Fören Stockh Förh 103: 183–192. doi:10.1080/11035898109454517.

[Sweden, Denmark, Norway – Baltica]

83. Vidal G, Moczydłowska M (1996) Vendian Lower Cambrian acritarch biostratigraphy of the central Caledonian fold belt in Scandinavia and the palaeogeography of the Iapetus-Tornquist seaway. Nor Geol Tidsskr 76: 147–168.

[Denmark, Sweden, Norway – Baltica]

84. Vidal G, Peel JS (1993) Acritarchs from the Lower Cambrian Buen Formation in North Greenland. Geological Survey of Greenland. 35 p.

[Greenland/Denmark – Greenland/Laurentia]*

85. Vidal G, Moczydłowska M, Rudavskaya VR (1995) Constraints on the early Cambrian radiation and correlation of the Tommotian and Nemakit-Daldynian regional stages of eastern Siberia. J Geol Soc 152: 499–510. doi:10.1144/gsjgs.152.3.0499.

[Russia – Siberia]

86. Volkova NA (1980) Akritarki srednego i verkhnego kembriya Moskovskoy sineklizy [Acritarchs of the Middle and Upper Cambrian in the Moscow Syneclise]. Izv Akad Nauk SSSR 12: 49–57.

[Russia – Baltica]*

87. Volkova NA (1984) *Elenia*, a new genus of acritarchs from the Cambrian-Ordovician deposits of the Russian platform. J Micropalaeontology 3: 7–10. doi:10.1144/jm.3.2.7.

[Russia – Baltica]*

88. Volkova NA (1990) Akritarkhi srednego i verkhnego kembriya vostochno-evropejskoj platformy [Middle and Upper Cambrian acritarchs in the East-European Platform]. Moscow: Nauka. 116 p.

[Russia – Baltica]

89. Volkova NA (1993) Akritarkhi pogranichnikh otlozhenij kembriya I ordovika priglintovoj polosy estonii (skvazhina M-56) [Acritarchs from the Cambrian–Ordovician boundary beds (boring M-56) of the Estonian near-clint area]. Proc Est Acad Sci Geol 42: 15–22.

[Estonia – Baltica]

90. Volkova NA (1995) Acritarchs of the Cambrian–Ordovician boundary deposits of the Baltic phytoplankton province. Strat Geol Korreljatsiya 3: 362–374.

[Estonia – Baltica]

91. Volkova NA, Kirjanov VV, Piskun LV, Paškevičienė LT, Jankauskas TV (1983) Plant microfossils. Up Precambrian Cambr Palaeontol East-Eur Platf: 7–46.

[Belarus, Estonia, Latvia, Lithuania, Poland, Russia, Ukraine – Baltica]

92. Wang F, Chen Q (1987) Spiniferous acritarchs from the lowest Cambrian, Emei, Sichuan, southwestern China. Rev Palaeobot Palynol 52: 161–177. doi:10.1016/0034-6667(87)90052-2.

[China – South China]

93. Welsch M (1986) Die Acritarchen der höheren Digermul-Gruppe, Mittelkambrium bis Tremadoc, Ost-Finnmark, Nord-Norwegen. Palaeontographica B 201: 1–109.

[Norway – Baltica]

94. Wood GD, Clendening JA (1982) Acritarchs from the lower Cambrian Murray Shale, Chilhowee group, of Tennessee, U.S.A. Palynology 6: 255–265. doi:10.1080/01916122.1982.9989244.

[USA – Laurentia]*

95. Yang R, Yin L (2001) Acritarch assemblages from the Early-middle Cambrian Kaili formation of east Guizhou Province and biostratigraphic implication. Acta Micropalaeontologica Sin 18: 55–69.

[China – South China]

96. Yao J, Xiao S, Yin L, Li G, Yuan X (2005) Basal Cambrian microfossils from the Yurtus and Xishanblaq formations (Tarim, North-West China): systematic revision and biostratigraphic correlation of *Micrhystridium*-like acritarchs. Palaeontology 48: 687–708. doi:10.1111/j.1475-4983.2005.00484.x.

[China – Tarim, South China]*

97. Yin C (1990) Microfossils from the Zhongyicun Member of Yuhuchun Formation (Lower Cambrian) in Jinning, Yunnan Province, China. Prof Pap Stratigr Palaeontol 23: 131–140.

[China – South China]

98. Yin C, Gao L (1996) The early evolution of the acanthomorphic acritarchs in China and their biostratigraphical implication. Acta Geol Sin - Engl Ed 9: 193–206. doi:10.1111/j.1755-6724.1996.mp9002007.x.

[China – South China]*

99. Yin L (1987) New data of microfossils from Precambrian–Cambrian cherts in Ningqiang, southern Shaanxi. Acta Palaeontol Sin 26: 187–195.

[China – South China]

100. Yin L, Zhao Y, Yang R, Peng J (2010) Acritarchs from the Early-Middle Cambrian Kaili Formation in the Wuliu-Zengjianya section, east Guizhou Province, China. Acta Palaeontol Sin 49: 164–173.

[China – South China]

101. Young T, Martin F, Dean WT, Rushton AWA (1994) Cambrian stratigraphy of St Tudwal's Peninsula, Gwynedd, northwest Wales. Geol Mag 131: 335–360. doi:10.1017/S0016756800011109.

[UK – Avalonia/Gondwana]

102. Zang W (1992) Sinian and Early Cambrian floras and biostratigraphy on the South China Platform. Palaeontographica B 224: 75–119.

[China – South China]

103. Żylińska A, Szczepanik Z (2009) Trilobite and acritarch assemblages from the Lower-Middle Cambrian boundary interval in the Holy Cross Mountains (Poland). Acta Geol Pol 59: 413–458.

[Poland –Małopolska]

Comments on systematic palaeontology

Among the so-called acritarchs reported from the Cambrian, the genera *Chuaria* Walcott 1899, *Cymatiosphaera* Wetzel 1933 *ex* Deflandre 1954, *Dictyotidium* Eisenack 1955, *Leiopsophosphaera* Naumova 1961 *ex* Naumova 1968, *Polyedryxium* Deunff 1954, *Pterospermella* Eisenack 1972, and *Tasmanites* Newton 1875 are now considered to be (likely) prasinophytes (e.g. Guy-Ohlson 1996, Traverse 2007). At least a part of the rather featureless sphaeromorphs, especially *Leiosphaeridia* Eisenack 1958 and *Protoleiosphaeridium* Timofeev 1959 *ex* Timofeev 1960, might also belong to this group (comp. e.g. Guy-Ohlson 1996, Strother 1996). *Huroniospora* Barghoorn in Barghoorn & Tyler 1965 and *Myxococcoides* Schopf 1968 have been identified as cyanobacteria (Chroococcales; e.g. Shukla et al. 2006, Schopf 1968). *Caryosphaeroides* Schopf 1968 was described as a chlorococcoid (Chlorophyceae) green alga (Schopf 1968). According to Butterfield (2005), *Germinosphaera* Mikhailova 1986 (considered by him to be a synonym of *Tappania* Yin 1997) belongs to the fungi. *Ceratophyton* Kiryanov in Volkova et al. 1979 has been established to comprise animal remains (Fatka & Konzalová 1995). Wang and Luo (1982) reported the artificial production of structures resembling *Trematosphaeridium* Timofeev 1959 and *Polyporata* Pykhova 1966, among others. They suggested that these genera might – at least in part – represent pseudofossils. Baudet et al. (1989) tentatively identified ?*Hemisphaerium* Hemer & Nygreen 1967 from the lower Cambrian Sekwi Formation of the Canadian Mackenzie Mountains. According to Grenfell (1995), *Hemisphaerium* is a probable synonym of *Brazilea* Tiwari & Navale 1967, which he classified as a zygnematacean spore. From the Sinian (Late Proterozoic-?lower Cambrian) of northern China, Timofeev (1966) described *Pulvinomorpha* Timofeev 1966, considered by Grenfell (1995) as a possible synonym of *Tetraporina* Naumova 1939, another zygnematacean spore. This tentative interpretation would make *Brazilea (Hemisphaerium)* and *Tetraporina (Pulvinomorpha)* the oldest recorded zygnemataceans by far, with a gap in the record ranging up to the Carboniferous (Grenfell 1995). The genus *Pseudozonosphaeridium* Andreeva 1966 and the species *P. fengxiangense* Zhong Guofang 1978 in particular have been reported from the Proterozoic and the Silurian, but not the Cambrian (Fensome et al. 1990). The existence of *Veryhachium* Deunff 1954 in the Cambrian was rejected by Raevskaya and Servais (2009), but several species reported from the Cambrian have been assigned to this genus and are currently not formally transferred to other genera. Moczydłowska (1991) proposed the transfer of Cambrian forms assigned to *Micrhystridium* Deflandre 1937 (which has received numerous emendations) to the new genera *Asteridium* Moczydłowska 1991 and *Heliosphaeridium* Moczydłowska 1991. Not all concerned species have been transferred so far and not all authors have followed the proposal (e.g. Sarjeant & Stancliffe 1994).

List of acritarch genera and species reported from the Cambrian

names in “ ” have been found to be invalid

« → » indicates current name

“Abacum” Fombella 1978
→ *Virgatasporites* Combaz 1967 [acc. to Fensome et al. 1990]
type species: *“Abacum normale”* Fombella 1978
→ *Virgatasporites normalis* (Fombella 1978) Fensome et al. 1990

“Abacum normale” Fombella 1978
→ *Virgatasporites normalis* (Fombella 1978) Fensome et al. 1990

Acanthodiacrodium Timofeev 1958 emend. Deflandre & Deflandre-Rigaud 1962 restrict. Moczydłowska & Stockfors 2004
type species: *Acanthodiacrodium dentiferum* Timofeev 1958

“Acanthodiacrodium achrasii” (Martin 1972) Martin & Dean 1988
→ *Actinotodissus achrasii* (Martin 1972) Yin L. 1986

Acanthodiacrodium anceps Timofeev 1959b

Acanthodiacrodium angustum (Downie 1958) Combaz 1967

Acanthodiacrodium complanatum (Deunff 1961a) Vavrdová 1965

Acanthodiacrodium enodum Timofeev 1959b

Acanthodiacrodium golubii Fensome et al. 1990

Acanthodiacrodium cf. *ignoratum* (Deunff 1961a) Downie & Sarjeant 1965

Acanthodiacrodium lanatum Timofeev 1959b ex Downie & Sarjeant 1965

Acanthodiacrodium petrovii Timofeev 1959b

“Acanthodiacrodium polymorphum” Timofeev 1959b
→ *Actinotodissus polimorphus* (Timofeev 1959b) Moczydłowska & Stockfors 2004

“Acanthodiacrodium secundarium” Timofeev 1959b
→ *Actinotodissus secundarius* (Timofeev 1959b) Moczydłowska & Stockfors 2004

Acanthodiacrodium sinuosum Rasul 1979

Acanthodiacrodium snookense Parsons & Anderson 2000

Acanthodiacrodium cf. *spinum* Rasul 1979

“Acanthodiacrodium spinutisum” Timofeev 1959b

→ *Actinotodissus spinutisus* (Timofeev 1959b) Moczydłowska & Stockfors 2004

“*Acanthodiacrodium timofeevii*” Golub & Volkova in Volkova & Golub 1985
→ *Acanthodiacrodium golubii* Fensome et al. 1990

Acanthodiacrodium tricorne (Timofeev 1959b ex Downie & Sarjeant 1965) Martin 1969

“*Acanthodiacrodium tuberatum*” (Downie 1958) Martin 1972
→ *Goniosphaeridium tuberatum* (Downie 1958) Welsch 1986

“*Acanthodiacrodium ubuii*” Martin 1969
→ *Actinotodissus ubuii* (Martin 1969) Fensome et al. 1990

“*Acanthodiacrodium uniforme*” Burmann 1968
[**senior homonym:** *Acanthodiacrodium uniforme* Timofeev 1959b, acc. to Fensome et al. 1990]
→ *Actinotodissus burmanniae* (Fensome et al. 1990) Moczydłowska & Stockfors 2004 [Moczydłowska & Stockfors 2004 gave authorship of this combination as “(Burmann 1968) Fensome et al. 1990 »]
→ {*pro parte* in Chen J. et al. 1985} *Actinotodissus achrasii* (Martin 1972) Yin L. 1986 [acc. to Martin & Dean 1988]
→ {*pro parte* in Chen J. et al. 1985} *Dasydiacrodium obsonum* Martin in Martin & Dean 1988 [acc. to Moczydłowska & Stockfors 2004]

Acanthodiacrodium sp. A Parsons & Anderson 2000

Acanthodiacrodium sp. B Parsons & Anderson 2000

Acanthodiacrodium sp. I Yin L. in Chen J. et al. 1985

Acrum Fombella 1977
type species: *Acrum novum* Fombella 1977

?*Acrum araxisii* Di Milia 1991

Acrum cylindriferum Downie 1982

Acrum radiale Fombella 1977

Actinotodissus Loeblich & Tappan 1978
type species: *Actinotodissus longitaleosus* Loeblich & Tappan 1978

Actinotodissus achrasii (Martin 1972) Yin L. 1986

Actinotodissus formosus (Górka 1967) Moczydłowska & Stockfors 2004

Actinotodissus polimorphus (Timofeev 1959b) emend. Moczydłowska & Stockfors 2004

Actinotodissus secundarius (Timofeev 1959b) Moczydłowska & Stockfors 2004

Actinotodissus spinutisus (Timofeev 1959b) Moczydłowska & Stockfors 2004

Actinotodissus ubuii (Martin 1969) Fensome et al. 1990

Actinotodissus sp. A Martin 1992

Adara Fombella 1977 emend. Martin in Martin & Dean 1981
type species: *Adara mutatina* Fombella 1977

Adara alea Martin in Martin & Dean 1981
→ {in Albani et al. 1991} *Multiplicisphaeridium ?ancliforme* Fombella 1978 [acc. to Jachowicz-Zdanowska 2013]
→ {in Buła & Jachowicz 1996; Moczydłowska 1998} *Turrisphaeridium semireticulatum* (Timofeev 1959b) Jachowicz-Zdanowska 2013 [acc. to Jachowicz-Zdanowska 2013]

"*Adara denticulata*" Tongiorgi in Bagnoli et al. 1988
→ *Adara alea* Martin in Martin & Dean 1981 [acc. to Vanguestaine & Brück 2008]

Adara matutina Fombella 1977

"*Adara undulata*" Moczydłowska 1998
→ *Adara alea* Martin in Martin & Dean 1981 [acc. to Vanguestaine & Brück 2008]

Adara sp. A Baudet et al. 1989

Alliumella Fanderflit in Umnova & Fanderflit 1971
type species: *Alliumella baltica* Fanderflit in Umnova & Fanderflit 1971

Alliumella baltica Fanderflit in Umnova & Fanderflit 1971

Alliumella n. sp. Vanguestaine 1986

Ammonidium Lister 1970 emend. Sarjeant & Vavrdová 1997
type species: *Ammonidium microcladum* (Downie 1963) Lister 1970 emend. Sarjeant & Vavrdová 1997

Ammonidium bellulum (Moczydłowska 1998) Sarjeant & Stancliffe 2000

Ammonidium notatum (Volkova 1969) Jachowicz-Zdanowska 2013

Ammonidium oligum (Jankauskas in Jankauskas & Posti 1976) Jachowicz-Zdanowska 2013

Annulum Fombella 1978
type species: *Annulum difuminatum* Fombella 1978

“Annulum squamaceum” (Volkova 1968) emend. Martin in Martin & Dean 1983
→ *Granomarginata squamacea* Volkova 1968

Aranidium Jankauskas 1975
type species: *Aranidium izhoricum* Jankauskas 1975

Aranidium granulatum Welsch 1986

Aranidium izhoricum Jankauskas 1975

Aranidium aff. *pycnacanthum* Jankauskas 1975

Aranidium sparsum Volkova in Volkova et al. 1979

Arbusculidium Deunff 1968a emend. Welsch 1986
type species: *Arbusculidium destombesii* Deunff 1968a

?Arbusculidium adminiculum Di Milia et al. 1989

Arbusculidium destombesii Deunff 1968a

Arbusculidium cf. *mamillosum* Welsch 1986

Arbusculidium ornatum (Combaz 1967) Fensome et al. 1990

Arbusculidium perlongum Di Milia et al. 1989

Arbusculidium polypus Di Milia et al. 1989

“Arbusculidium rommelaerei” Martin in Martin & Dean 1981
→ *Ladogella rommelaerei* (Martin in Martin & Dean 1981) Di Milia et al. 1989

Arbusculidium sp. 1 Volkova 1990

Archaeodiscina Naumova 1961 emend. Volkova 1968
type species: *Archaeodiscina granulata* Naumova 1961

Archaeodiscina bicostata Volkova in Volkova et al. 1979

Archaeodiscina umbonulata Volkova 1968

Archaeodiscina multipunctata Jachowicz-Zdanowska 2013

Archaeodiscina sp. A Baudet et al. 1989

?Archaeodiscina sp. B Baudet et al. 1989

Archaeosacculina Pykhova 1967
[**junior homonym:** *"Archaeosacculina"* Naumova 1968]
type species: *Archaeosacculina torosa* Pykhova 1967

"Archaeosacculina atava" Pykhova 1966
[not validly published acc. to Fensome et al. 1990]

Aryballomorpha Martin and Yin L. 1988
type species: *Aryballomorpha grootaertii* (Martin 1984) emend. Martin and Yin L. 1988

Aryballomorpha albertana Martin 1992

Asperatopsophosphaera Shepeleva 1963 emend Kowalski 1983
type species: *Asperatopsophosphaera bavlensis* Shepeleva 1963 emend. Kowalski 1983

Asperatopsophosphaera bavlensis Shepeleva 1963

"Asperatopsophosphaera partialis" Shepeleva 1963
→ *Asperatopsophosphaera bavlensis* Shepeleva 1963 [acc. to Kowalski 1983]

Asperatopsophosphaera rugosa Ding
[cited without complete reference in Ding et al. 1992]

Asperatopsophosphaera umishanensis Xing & Liu 1973

Asteridium Moczydłowska 1991
type species: *Asteridium lanatum* (Volkova 1969) Moczydłowska 1991

Asteridium cerinum (Volkova 1968) Moczydłowska 1991

Asteridium lanatum (Volkova 1969) Moczydłowska 1991

Asteridium ordense (Downie 1982) emend. Vidal & Peel 1993

Asteridium pallidum (Volkova 1968) Moczydłowska 1991

Asteridium pilare Moczydłowska 1998

Asteridium solidum Moczydłowska 1998

Asteridium spinosum (Volkova 1969) Moczydłowska 1991

Asteridium tornatum (Volkova 1968) Moczydłowska 1991

Asteriscus Kowalski 1983
type species: *Asteriscus irregularis* Kowalski 1983

Asteriscus irregularis Kowalski 1983

Auritusphaera Strother 2008
type species: *Auritusphaera bifurcata* Strother 2008

Auritusphaera bifurcata Strother 2008

Baltisphaeridium Eisenack 1958c ex Eisenack 1959a emend. Staplin et al. 1965 emend. Eisenack 1969 emend. Eiserhardt 1989
type species: *Baltisphaeridium longispinosum* (Eisenack 1931 ex Wetzel 1933) Eisenack 1959a

Baltisphaeridium acerosum Jankauskas & Posti 1976

"Baltisphaeridium brachyspinosum" Kiryanov 1974
→ *Ichnosphaera delicata* Jachowicz-Zdanowska 2013

"Baltisphaeridium capillatum" (Naumova 1950) Umnova 1975
[**senior homonym:** *Baltisphaeridium capillatum* Jardiné et al. 1974]

"Baltisphaeridium cerinum" Volkova 1968
→ *Globosphaeridium cerinum* (Volkova 1968) Moczydłowska 1991

"Baltisphaeridium ciliosum" Volkova 1969
→ *Skiagia ciliosa* (Volkova 1969) Downie 1982

Baltisphaeridium citrinum (Downie 1963) Stockmans & Willière 1974

"Baltisphaeridium compressum" Volkova 1968
→ *Skiagia compressa* (Volkova 1968) Downie 1982

Baltisphaeridium crinitum Martin in Dean & Martin 1978

Baltisphaeridium dictium Wang & Chen Q. 1987

"Baltisphaeridium dubium" Volkova 1968
→ *"Lophosphaeridium dubium"* (Volkova 1968) Moczydłowska 1991]

Baltisphaeridium ellipticum Wang et Chen
[cited without complete reference in Wang & Chen Q. 1987]

Baltisphaeridium emeiense Wang et Chen
[cited without complete reference in Wang & Chen Q. 1987]

Baltisphaeridium favosum Xing 1962

"Baltisphaeridium implicatum" Fridriksone 1971
→ *Solisphaeridium implicatum* (Fridriksone 1971) Moczydłowska 1998

"Baltisphaeridium insigne" (Fridriksone 1971) Volkova 1974
→ *Skiagia insignis* (Fridriksone 1971) Downie 1982

Baltisphaeridium jiulaodongense Wang & Chen Q. 1987

Baltisphaeridium jilinense Fensome et al. 1990

"Baltisphaeridium latviense" Volkova 1974
→ *Comasphaeridium latviense* (Volkova 1974) Hagenfeldt 1989a

Baltisphaeridium longispinosum (Eisenack 1931 ex Wetzel 1933) Eisenack 1959a

"Baltisphaeridium orbiculare" Volkova 1968
→ *Skiagia orbicularis* (Volkova 1968) Downie 1982

"Baltisphaeridium ornatum" Volkova 1968
→ *Skiagia ornata* (Volkova 1968) Downie 1982

"Baltisphaeridium papillosum" (Timofeev 1959) ex Volkova 1968
→ *Filisphaeridium papillosum* (Timofeev 1959 ex Volkova 1968) Hu Yunxu 1986

"Baltisphaeridium pilosiusculum" Jankauskas in Volkova et al. 1979
→ *Skiagia pilosiuscula* (Jankauskas in Volkova et al. 1979) Jachowicz-Zdanowska 2013

"Baltisphaeridium primarium" Jankauskas in Volkova et al. 1979
→ *Goniosphaeridium primarium* (Jankauskas in Volkova et al. 1979) Downie 1982

Baltisphaeridium pseudofaveolatum Fridriksone 1971

Baltisphaeridium cf. *psilatum* Kjellström 1971a

"Baltisphaeridium pungens" Timofeev 1959b ex Martin 1969
→ *Polygonium pungens* (Timofeev 1959b ex Martin 1969) Albani 1989

Baltisphaeridium reticulum Wang & Chen Q. 1987

"Baltisphaeridium robustum" Yin L. in Chen J. et al. 1985
→ *Baltisphaeridium jilinense* Fensome et al. 1990

Baltisphaeridium simplex Deunff 1961a
[**junior homonym:** *"Baltisphaeridium simplex"* Stockmans & Willière 1962]

Baltisphaeridium solidum Xing 1962

"Baltisphaeridium stipaticum" Hagenfeldt 1989a
→ *Ichnosphaera stipaticum* (Hagenfeldt 1989a) Jachowicz-Zdanowska 2013

"?Baltisphaeridium strigosum" Jankauskas in Jankauskas & Posti 1976
→ *Comasphaeridium strigosum* (Jankauskas in Jankauskas & Posti 1976) Downie 1982

Baltisphaeridium tuberculatum Fridriksone 1971

"Baltisphaeridium varium" Volkova 1969
→ *Eklundia varia* (Volkova 1969) Jachowicz-Zdanowska 2013

Baltisphaeridium sp. 1 Volkova 1980

Baltisphaeridium sp. 1 Volkova et al. 1983

Baltisphaeridium sp. 1 Volkova et al. 1983

Baltisphaeridium sp. 2 Volkova 1980

Baltisphaeridium sp. 2 Volkova et al. 1983
→ *Goniosphaeridium volkovae* Hagenfeldt 1989a [acc. to Jachowicz-Zdanowska 2013]

Bavlinella Shepeleva 1962
[acc. to Muir 1977 "[...] objects like *Bavlinella* are not fossils. They are organic residua from framboids."]
type species: *Bavlinella faveolata* Shepeleva 1962

Bavlinella faveolata Shepeleva 1962

"Bothroligtriletes" Timofeev 1958
[not validly published acc. to Fensome et al. 1990]
variant: *"Bothroligotriletum"*
no type species

"Bothroligotriletes exasperatus" Timofeev 1959b

Brevitrichoides Jankauskas 1980
type species: *Brevitrichoides bashkirius* Jankauskas 1980

Brevitrichoides crassus (Xing & Liu 1978) Zang 1992

Brochos
[cited without reference for the genus in Volkova 1995]
type species: ?

Brochos eisenackii Vanderflit et Mikhailova
[cited without complete reference in Volkova 1995]

Bubomorpha Yin L. in Chen J. et al. 1985
type species: *Bubomorpha hunjiangensis* Yin L. in Chen J. et al. 1985

Bubomorpha balangensis Yin L. et al. 2010

Bubomorpha hunjiangensis Yin L. in Chen J. et al. 1985

Buchinia Volkova 1990
type species: *Buchinia variabilis* Volkova 1990

Buchinia variabilis Volkova 1990

Buedingiisphaeridium Schaarschmidt 1963 emend. Lister 1970 emend. Sarjeant & Stancliffe 1994
type species: *Buedingiisphaeridium permicum* Schaarschmidt 1963

Buedingiisphaeridium tremadocum Rasul 1979

Caldariola Molyneux in Molyneux & Rushton 1988
type species: *Caldariola glabra* (Martin 1972) Molyneux in Molyneux & Rushton 1988

Caldariola glabra (Martin 1972) Molyneux in Molyneux & Rushton 1988

Calyxiella Golub & Volkova in Volkova & Golub 1985
type species: *Calyxiella izhoriensis* Golub & Volkova in Volkova & Golub 1985

Calyxiella izhoriensis Golub & Volkova in Volkova & Golub 1985

Caryosphaeroides Schopf 1968
[Chlorococcales]
type species: *Caryosphaeroides pristina* Schopf 1968

Caryosphaeroides pristina Schopf 1968

Celtiberium Fombella 1977 emend. Sarjeant & Stancliffe 2000 type species: *Celtiberium geminum* Fombella 1977

Celtiberium cf. *clarum* Fombella 1978
→ {in Vanguestaine & Van Looy 1983} *Turrisphaeridium semireticulatum* (Timofeev 1959b) Jachowicz-Zdanowska 2013

Celtiberium dedalinum Fombella 1978

Celtiberium geminum Fombella 1977

Celtiberium cf. *geminum* Fombella 1977
→ {in Vanguestaine & Van Looy 1983} *Turrisphaeridium semireticulatum* (Timofeev 1959b) Jachowicz-Zdanowska 2013

?Celtiberium papillatum Moczydłowska 1998

Celtiberium robustum Hagenfeldt 1989b

Celtiberium n. sp. A Palacios 2010

Celtiberium sp. A Downie 1982

Celtiberium sp. B Downie 1982

Celtiberium sp. B Knoll & Swett 1987

Celtiberium sp. indet. B Jago et al. 2006

Ceratophyton Kiryanov in Volkova et al. 1979
[SCF]
type species: *C. vernicosum* Kiryanov in Volkova et al. 1979

Chuaria Walcott 1899 emend. Vidal & Ford 1985
type species: *Chuaria circularis* Walcott 1899 emend. Vidal & Ford 1985

Chuaria circularis Walcott 1899 emend. Vidal & Ford 1985

Comasphaeridium Staplin et al. 1965 emend. Sarjeant & Stancliffe 1994
type species: *Comasphaeridium cometes* (Valensi 1949) Staplin et al. 1965

Comasphaeridium agglutinatum Moczydłowska 1988

Comasphaeridium annulare (Wang 1985) Yao et al. 2005

"Comasphaeridium brachyspinosum" (Kiryanov 1974) Moczydłowska & Vidal 1988
→ *Ichnosphaera delicata* Jachowicz-Zdanowska 2013

"Comasphaeridium caesariatum" Wood & Clendening 1982

[**senior homonym:** *Comasphaeridium caesariatum* Wicander 1974]
→ *Comasphaeridium woodii* Fensome et al. 1990

?Comasphaeridium densispinosum Vidal in Vidal & Peel 1993

"Comasphaeridium filiforme" Fombella 1979
[nomen nudum, acc. to Fensome et al. 1990]

Comasphaeridium formosum Moczydłowska 1988

Comasphaeridium francinae Jachowicz-Zdanowska 2013

Comasphaeridium gogense (Downie 1982) Sarjeant & Stancliffe 1994

Comasphaeridium latviense (Volkova 1974) Hagenfeldt 1989a

Comasphaeridium longispinosum Hagenfeldt 1989b
[**junior homonym:** *"Comasphaeridium longispinosum"* Vidal in Vidal & Peel 1993]

"Comasphaeridium longispinosum" Vidal in Vidal & Peel 1993
[**senior homonym:** *Comasphaeridium longispinosum* Hagenfeldt 1989b]

Comasphaeridium mackenzianum Baudet et al. 1989

Comasphaeridium molliculum Moczydłowska & Vidal 1988

"Comasphaeridium piliferum" Fombella 1979
[nomen nudum, acc. to Fensome et al. 1990]
→ *Parmasphaeridium implicatum* (Fridriksone 1971) Jachowicz-Zdanowska 2013

Comasphaeridium silesiense Moczydłowska 1998

Comasphaeridium soniae Jachowicz-Zdanowska 2013

Comasphaeridium spinosum Jachowicz-Zdanowska 2013

Comasphaeridium strigosum (Jankauskas in Jankauskas & Posti 1976) Downie 1982
→ {in Szczepanik 2000} *Comasphaeridium silesiense* Moczydłowska 1998 [acc. to Jachowicz-Zdanowska 2013]

Comasphaeridium velvetum Moczydłowska 1988

Comasphaeridium vozmedianum Fombella 1978 ex Jachowicz-Zdanowska 2013

Comasphaeridium woodii Fensome et al. 1990

Comasphaeridium n. sp. 3 Moczydłowska & Vidal 1986

Comasphaeridium n. sp. 4 Moczydłowska & Vidal 1986

Comasphaeridium n. sp. A Palacios 2010
→ *Comasphaeridium francinae* Jachowicz-Zdanowska 2013

Comasphaeridium n. sp. Vidal 1981

Comasphaeridium sp. 2 Moczydłowska & Vidal 1986

Comasphaeridium sp. A Downie 1982

Comasphaeridium sp. A Palacios et al. 2009

Comasphaeridium sp. B Palacios et al. 2009

Comasphaeridium sp. indet. A Jago et al. 2006

Corollasphaeridium Martin in Dean & Martin 1982 emend. Yin L. 1986
type species: *Corollasphaeridium wilcoxianum* Martin in Dean & Martin 1982

Corollasphaeridium wilcoxianum Martin in Dean & Martin 1982

Corrugasphaera Fensome et al. 1990
type species: *Corrugasphaera terranovana* (Martin in Martin & Dean 1988) Fensome et al. 1990

Corrugasphaera terranovana (Martin in Martin & Dean 1988) Fensome et al. 1990

Coryphidium Vavrdová 1972
type species: *Coryphidium bohemicum*Vavrdová 1972

Coryphidium sichuanense Wang & Chen Q. 1987

Cristallinium Vanguestaine 1978
type species: *Cristallinium cambriense* (Slavíková 1968) Vanguestaine 1978

Cristallinium aciculatum Tongiorgi in Bagnoli et al. 1988

Cristallinium baculatum Volkova 1990

Cristallinium cambriense (Slavíková 1968) Vanguestaine 1978

Cristallinium compactum Jachowicz-Zdanowska 2013

?Cristallinium delicatum Yin L. in Chen J. et al. 1985

Cristallinium dubium Volkova 1990

Cristallinium locale Volkova 1990

"Cristallinium ovillense" (Cramer & Díez 1972) Fensome et al. 1990
→ *Cristallinium cambriense* (Slavíková 1968) Vanguestaine 1978 [acc. to Moczydłowska 1998]

"Cristallinium ovillense" (Cramer & Díez 1972) Martin in Martin & Dean 1981
→ *Retisphaeridium ovillense* (Cramer & Díez 1972) Vanguestaine 2002

Cristallinium pilosum Golub & Volkova in Volkova & Golub 1985

Cristallinium cf. randomense Martin in Martin & Dean 1981 emend. Martin in Martin & Dean 1988

Cymatiogalea Deunff 1961a emend. Deunff 1964
type species: *Cymatiogalea margaritata* Deunff 1961a

Cymatiogalea aspergillum Martin in Martin & Dean 1988

Cymatiogalea bellicosa Deunff 1961a

Cymatiogalea bouvardii Martin 1972
→ {in Martin & Dean 1981} *Stelliferidium* sp. A Parsons & Anderson 2000

“*Cymatiogalea columellifera*” (Deunff 1961a) Eisenack et al. 1973
→ *Cymatiogalea cuvillieri* (Deunff 1961a) Deunff 1964 [acc. to Rasul 1974]

Cymatiogalea cristata (Downie 1958) Rauscher 1973

Cymatiogalea cuvillieri (Deunff 1961a) Deunff 1964

“*Cymatiogalea cylindrata*” Rasul 1974
→ *Stelliferidium cylindratum* (Rasul 1974) Elaouad-Debbaj 1988

Cymatiogalea dentalea Paalits 1992b

Cymatiogalea fascicularis Yin L. in Chen J. et al. 1985

Cymatiogalea fimbriata Volkova 1990

Cymatiogalea geometrica Di Milia et al. 1989

Cymatiogalea gorkae Rauscher 1973

Cymatiogalea hunjiangensis Yin L. in Chen J. et al. 1985 emend Yin L. 1986

Cymatiogalea membranispina Deunff 1961a

?Cymatiogalea membranula Martin in Dean & Martin 1978

Cymatiogalea multarea (Deunff 1961a) Eisenack et al. 1973

Cymatiogalea parvivela Di Milia 1991

Cymatiogalea regularis Yin L. in Chen J. et al. 1985 emend. Yin L. 1986

Cymatiogalea velifera (Downie 1958) Martin 1969

Cymatiogalea virgulta Martin in Martin & Dean 1988

Cymatiogalea wironica Paalits 1992b

Cymatiogalea sp. 1 Paalits 1992b

Cymatiogalea sp. 2 Paalits 1992b

Cymatiogalea sp. 3 Paalits 1992b

Cymatiosphaera Wetzel 1933 ex Deflandre 1954
type species: *Cymatiosphaera radiata* Wetzel 1933

Cymatiosphaera baarstadi Eklund 1990

"Cymatiosphaera capsulara" Jankauskas in Jankauskas & Posti 1976
→ *Retisphaeridium capsulatum* (Jankauskas in Jankauskas & Posti 1976) Vanguestaine in Brück & Vanguestaine 2005

Cymatiosphaera crameri Slavíková 1968

Cymatiosphaera cristata Jankauskas 1976

"Cymatiosphaera favosa" Jankauskas 1976
→ *Cristallinium cambriense* (Slavíková 1968) Vanguestaine 1978

Cymatiosphaera gotlandica Hagenfeldt 1989a

"Cymatiosphaera luminosa" Fombella 1978
→ *Duplisphaera luminosa* (Fombella 1978) Moczydłowska 1998

"?Cymatiosphaera membranacea" Kiryanov 1974
→ *Fimbriaglomerella membranacea* Kiryanov 1974 ex Moczydłowska & Vidal 1988

"Cymatiosphaera minuta" Jankauskas in Volkova et al. 1979
→ *Fimbriaglomerella minuta* (Jankauskas in Volkova et al. 1979) Moczydłowska & Vidal 1988

Cymatiosphaera cf. *mirabilis* Deunff 1959

Cymatiosphaera cf. *nebulosa* (Deunff 1954b) Deflandre 1954

"Cymatiosphaera nerisica" Jankauskas 1976
→ *Cristallinium cambriense* (Slavíková 1968) Vanguestaine 1978 [acc. to Welsch 1986]

"Cymatiosphaera ovillensis" Cramer & Díez 1972
→ *Cristallinium cambriense* (Slavíková 1968) Vanguestaine 1978

Cymatiosphaera aff. *pavimenta* (Deflandre 1945) Deflandre 1954

"Cymatiosphaera postii" Jankauskas in Volkova et al. 1979
→ *Retisphaeridium postae* (Jankauskas in Volkova et al. 1979) Vanguestaine in Brück & Vanguestaine 2004

"Cymatiosphaera pusilla" Moczydłowska 1998
→ *Retisphaeridium pusillum* (Moczydłowska 1998) Vanguestaine in Brück & Vanguestaine 2005

Cymatiosphaera sp. 1 Hagenfeldt 1989b

Cymatiosphaera sp. 1 Volkova et al. 1979

Cymatiosphaera sp. 2 Hagenfeldt 1989a

Cymatiosphaera sp. A Moczydłowska & Stockfors 2004

Cymatiosphaera sp. A Moczydłowska 1998

Cymatiosphaera sp. A Vanguestaine 1978
[dated 1977 in Baudet et al. 1989]

Cymatiosphaera sp. A Vanguestaine 1986

Dactylofusa Brito & Santos 1965 emend Combaz et al. 1967 emend Cramer 1970
type species: *Dactylofusa maranhensis* Brito & Santos 1965

"*Dactylofusa simplex*" Combaz 1967
→ *Leiofusa simplex* (Combaz 1967) Martin 1975

"*Dactylofusa squama*" (Deunff 1961a) Rauscher 1973
→ *Poikilofusa squama* (Deunff 1961a) Martin 1973

Dasydiacrodium Timofeev 1959b ex Deflandre & Deflandre-Rigaud 1962 emend. Moczydłowska & Stockfors 2004
type species: *Dasydiacrodium eichwaldii* Timofeev 1959b

Dasydiacrodium cf. *angulare* Timofeev 1959b ex Downie & Sarjeant 1965

"*Dasydiacrodium caudatum*" Vanguestaine 1973b
→ *Ninadiacrodium caudatum* (Vanguestaine 1973b) Raevskaya & Servais 2009

Dasydiacrodium obsonum Martin in Martin & Dean 1988

Dasydiacrodium palmatilobum Timofeev 1959b ex Downie & Sarjeant 1965

?Dasydiacrodium setuensis Paalits 1992a

"*Dasydiacrodium tricorne*" Timofeev 1959b ex Downie & Sarjeant 1965
→ *Acanthodiacrodium tricorne* (Timofeev 1959b ex Downie & Sarjeant 1965) Martin 1969

Dasydiacrodium tumidum (Deunff 1961a) Tongiorgi in Bagnoli et al. 1988

Dasydiacrodium veryhachioides Di Milia et al. 1989

Dasydiacrodium sp. A Moczydłowska & Stockfors 2004

Dasydiacrodium sp. B Moczydłowska & Stockfors 2004

Deunffia Downie 1960 emend. Thusu 1973
type species: *Deunffia monospinosa* (Deunff 1951) Downie 1960

"*Deunffia dentifera*" Volkova 1969
→ *Volkovia dentifera* (Volkova 1969) Downie 1982

"Dichasphaira" Vanguestaine 1973a
[not validly published, acc. to Fensome et al. 1990]
type species: ?

“Dichasphaira vorax” Vanguestaine 1973a
[not validly published, acc. to Fensome et al. 1990]

Dichotisphaera Turner 1984
type species: *Dichotisphaera* caradocensis Turner 1984

Dichotisphaera gregalis (Hagenfeldt 1989a) Vanguestaine 1991

Dicrodiacrodium Burmann 1968
type species: *Dicrodiacrodium ancoriforme* Burmann 1968

Dicrodiacrodium ramusculosum (Combaz 1967) Volkova 1990

Dictyotidium Eisenack 1955 emend. Staplin 1961
type species: *Dictyotidium dictyotum* (Eisenack 1938a) Eisenack 1955

Dictyotidium birvetense Paškevičienė in Volkova et al. 1979

“Dictyotidium cambriense” Slavíková 1968
→ *Cristallinium cambriense* (Slavíková 1968) Vanguestaine 1978

Dictyotidium hasletianum Vanguestaine 1974

“Dictyotidium microreticulatum” Hagenfeldt 1989b
[**senior homonym:** *Dictyotidium microreticulatum* Jiabo 1978 (= Song et al. 1978)]

Dictyotidium perforatum Vidal in Vidal & Peel 1993

Dictyotidium priscum Kiryanov & Volkova in Volkova et al. 1979

Dictyotidium sp. 1 Hagenfeldt 1989b

Dictyotidium sp. 1 Volkova 1980

Dictyotidium sp. 1 Volkova et al. 1979

Dominopolia Kiryanov 1974
type species: *Dominopolia longispinosa* Kiryanov 1974

Dominopolia lata Kiryanov 1974

Dominopolia longispinosa Kiryanov 1974

Duplisphaera Moczydłowska 1998
type species: *Duplisphaera luminosa* (Fombella 1978) Moczydłowska 1998

Duplisphaera luminosa (Fombella 1978) Moczydłowska 1998

Eklundia Jachowicz-Zdanowska 2013
type species: *Eklundia campanula* (Eklund 1990) Jachowicz-Zdanowska 2013

Eklundia campanula (Eklund 1990) Jachowicz-Zdanowska 2013

Eklundia florentinata Jachowicz-Zdanowska 2013

Eklundia pusilla Jachowicz-Zdanowska 2013

Eklundia varia (Volkova 1969) Jachowicz-Zdanowska 2013

Elektoriskos Loeblich 1970
type species: *Elektoriskos aurora* Loeblich 1970

"Elektoriskos cerinus" (Volkova 1968) Vanguestaine 1978
→ *Globosphaeridium cerinum* (Volkova 1968) Moczydłowska 1991

"Elektoriskos flexuosus" Eklund 1990
→ *Ichnosphaera flexuosa* (Eklund 1990) Jachowicz-Zdanowska 2013
→ {in Brück & Vanguestaine 2004} *Ichnosphaera robusta* Jachowicz-Zdanowska 2013

Elektoriskos sp. A Vidal & Peel 1993

Elenia Volkova 1984
type species: *Elenia armillata* Fanderflit in Umnova & Fanderflit 1971 ex Volkova 1984

Elenia armillata Fanderflit in Umnova & Fanderflit 1971 ex Volkova 1984

Eliasum Fombella 1977
type species: *Eliasum llaniscum* Fombella 1977

Eliasum asturicum Fombella 1977

Eliasum hutchinsonii Martin in Martin & Dean 1984

Eliasum jennessii Martin in Martin & Dean 1984

Eliasum llaniscum Fombella 1977

"Eliasum microgranulatum" Hagenfeldt 1989b
→ *Eliasum llaniscum* Fombella 1977 [acc. to Vanguestaine & Brück 2008]

Eliasum pisciforme Fombella 1977

Eliasum pisiformis
[cited without reference in Palacios 2008, 2010; presumably a misspelling of *Eliasum pisciforme* Fombella 1977]

Eliasum n. sp. A Palacios 2010

Eliasum sp. 1 Volkova 1990

Eliasum sp. A Żylińska & Szczepanik 2009

Eomicrhystridium Deflandre 1968
type species: *Eomicrhystridium barghoornii* Deflandre 1968

Estiastra Eisenack 1959a emend. Sarjeant & Stancliffe 1994
type species: *Estiastra magna* Eisenack 1959a

Estiastra minima Volkova 1969

"Eupoikilofusa" Cramer 1970
→ *Dactylofusa* Brito & Santos 1965 [acc. to Fensome et al. 1990]
type species: *"Eupoikilofusa striatifera"* (Cramer 1964a) Cramer 1970
→ *Dactylofusa striatifera* (Cramer 1964a) Fensome et al. 1990

"Eupoikilofusa squama" (Deunff 1961a) Eisenack et al. 1979
→ *Poikilofusa squama* (Deunff 1961a) Martin 1973

Evittia Brito 1967a emend. Lister 1970
type species: *Evittia sommeri* Brito 1967a

Evittia irregulare Downie 1982

Filisphaeridium Staplin et al. 1965 emend. Sarjeant & Stancliffe 1994 (emend. rejected by Mullins 2001)
type species: *Filisphaeridium setasessitante* (Jansonius 1962) Staplin et al. 1965

Filisphaeridium hirtum (Timofeev 1959b ex Umnova 1975) Sarjeant & Stancliffe 1994

Filisphaeridium papillosum (Timofeev 1959b ex Volkova 1968) Hu Yunxu 1986

Filisphaeridium sp. A Jago et al. 2006

Fimbriaglomerella Loeblich & Drugg 1968
type species: *Fimbriaglomerella divisa* Loeblich & Drugg 1968

Fimbriaglomerella gothlandica
[cited without reference in Jago et al. 2006]

Fimbriaglomerella membranacea Kiryanov 1974 ex Moczydłowska & Vidal 1988

Fimbriaglomerella minuta (Jankauskas in Volkova et al. 1979) Moczydłowska & Vidal 1988

Germinosphaera Mikhailova 1986
[fungi]
type species: *Germinosphaera bispinosa* Mikhailova 1986

Globosphaeridium Moczydłowska 1991
type species: *Globosphaeridium cerinum* (Volkova 1968) Moczydłowska 1991

Globosphaeridium arenulum Jachowicz-Zdanowska 2013

Globosphaeridium cerinum (Volkova 1968) Moczydłowska 1991

Globus Vidal *in* Moczydłowska & Vidal 1988
type species: *Globus gossipinus* Vidal *in* Moczydłowska & Vidal 1988

Globus gossipinus Vidal *in* Moczydłowska & Vidal 1988

Gloeocapsomorpha Zalessky 1917 emend. Foster et al. 1989
[incertae sedis]
type species: *Gloeocapsomorpha prisca* Zalessky 1917

Goniomorpha Yin L. 1986
type species: *Goniomorpha rara* Yin L. 1986

Goniosphaeridium Eisenack 1969 emend. Kjellström 1971a emend. Turner 1984
type species: *Goniosphaeridium polygonale* (Eisenack 1931 ex Eisenack 1938a) Eisenack 1969

"*Goniosphaeridium* aff. *akrochordum*" (Rasul 1979) Dean & Martin 1982
[misspelled as "*akrochodermum*" in Dean & Martin 1982 and Martin 1992]
→ {in Dean & Martin 1982; *pro parte* in Martin 1992} *Polygonium martinae* Moczydłowska & Crimes 1995 [acc. to Moczydłowska & Stockfors 2004]
→ {*pro parte* in Martin 1992} *Solisphaeridium akrochordum* (Rasul 1979) Moczydłowska & Stockfors 2004

Goniosphaeridium canningia (Combaz & Peniguel 1972) Playford & Martin 1984

"*Goniosphaeridium* aff. *dentatum*" (Timofeev 1959b ex Konzalová-Mazancová 1969) Rauscher 1973
→ *Polygonium pungens* (Timofeev 1959b ex Martin 1969) Albani 1989 [acc. to Moczydłowska & Stockfors 2004]

"*Goniosphaeridium implicatum*" (Fridriksone 1971) Downie 1982
→ *Parmasphaeridium implicatum* (Fridriksone 1971) Jachowicz-Zdanowska 2013

Goniosphaeridium primarium (Jankauskas in Volkova et al. 1979) Downie 1982

Goniosphaeridium rasulii Welsch 1986

"*Goniosphaeridium regulare*" Yin L. in Chen J. et al. 1985
→ *Stellechinatum uncinatum* (Downie 1958) Molyneux 1987 [acc. to Yin L. 1986]

Goniosphaeridium tener Timofeev 1959b ex Elaouad-Debbaj 1988

Goniosphaeridium tuberatum (Downie 1958) Welsch 1986
[comb. not validly published in Wolf 1980]

"*Goniosphaeridium uncinatum*" (Downie 1958) Kjellström 1971b
→ *Stellechinatum uncinatum* (Downie 1958) Molyneux 1987

"*Goniosphaeridium varium*" (Volkova 1969) Downie 1982
→ *Eklundia varia* (Volkova 1969) Jachowicz-Zdanowska 2013

Goniosphaeridium volkovae Hagenfeldt 1989a

Goniosphaeridium sp. A Downie 1982

Goniosphaeridium sp. A Vidal & Peel 1993

Goniosphaeridium sp. B Downie 1982

Gorgonisphaeridium Staplin et al. 1965 emend. Kiryanov 1978
type species: *Gorgonisphaeridium winslowiae* Staplin et al. 1965

?Gorgonisphaeridium sp. A Wood & Clendening 1982

?Gorgonisphaeridium sp. B Wood & Clendening 1982

?Gorgonisphaeridium sp. C Wood & Clendening 1982

?Gorgonisphaeridium sp. D Wood & Clendening 1982

?Gorgonisphaeridium sp. E Wood & Clendening 1982

?Gorgonisphaeridium sp. F Wood & Clendening 1982

Granomarginata Naumova 1961
type species: *Granomarginata prima* Naumova 1961

Granomarginata parva Jachowicz-Zdanowska 2013

Granomarginata prima Naumova 1961

Granomarginata squamacea Volkova 1968

Granomarginata vulgaris Naumova 1968

Granularia Kowalski 1983
type species: *Granularia saccoformis* Kowalski 1983

Granularia saccoformis Kowalski 1983

Heliosphaeridium Moczydłowska 1991
type species: *Heliosphaeridium dissimilare* (Volkova 1969) Moczydłowska 1991

Heliosphaeridium ampliatum (Wang 1985) Yao et al. 2005

"Heliosphaeridium bellulum" Moczydłowska 1998

→ *Ammonidium bellulum* (Moczydłowska 1998) Sarjeant & Stancliffe 2000

Heliosphaeridium coniferum (Downie 1982) Moczydłowska 1991

Heliosphaeridium dissimilare (Volkova 1969) Moczydłowska 1991

Heliosphaeridium exile Moczydłowska 1998

Heliosphaeridium lanceolatum (Vanguestaine 1974) Moczydłowska 1998

"?Heliosphaeridium llynense" Martin in Young et al. 1994
→ *Multiplicisphaeridium llynense* (Martin in Young et al. 1994) Jachowicz-Zdanowska 2013

Heliosphaeridium longum (Moczydłowska 1988) Moczydłowska 1998

Heliosphaeridium lubomlense (Kiryanov 1974) Moczydłowska 1991

Heliosphaeridium nodosum Moczydłowska 1998

"Heliosphaeridium notatum" (Volkova 1969) Moczydłowska 1991
→ *Ammonidium notatum* (Volkova 1969) Jachowicz-Zdanowska 2013

Heliosphaeridium obscurum (Volkova 1969) Moczydłowska 1991

"Heliosphaeridium oligum" (Jankauskas in Jankauskas & Posti 1976) Moczydłowska 1998
→ *Ammonidium oligum* (Jankauskas in Jankauskas & Posti 1976) Jachowicz-Zdanowska 2013

Heliosphaeridium radzynicum (Volkova in Volkova et al. 1979) Moczydłowska 1991

Heliosphaeridium serridentatum Moczydłowska 1998

Heliosphaeridium n. sp. B Moczydłowska & Crimes 1995

Hemisphaerium Hemer & Nygreen 1967
→ *Brazilea* Tiwari & Navale 1967 [acc. to Grenfell 1995; Zygnemataceae]
type species: *Hemisphaerium inornatum* Hemer & Nygreen 1967

Hubeisphaera Xing & Liu 1978
type species: *Hubeisphaera radiata* Xing & Liu 1978

Hubeisphaera radiata Xing & Liu 1978

Huroniospora Barghoon in Barghoorn & Tyler 1965
type species: *Huroniospora microreticulata* Barghoorn in Barghoorn & Tyler 1965

Huroniospora microreticulata Barghoorn in Barghoorn & Tyler 1965

Ichnosphaera Jachowicz-Zdanowska 2013
type species: *Ichnosphaera flexuosa* (Eklund 1990) Jachowicz-Zdanowska 2013

Ichnosphaera aranea Jachowicz-Zdanowska 2013

Ichnosphaera delicata Jachowicz-Zdanowska 2013

Ichnosphaera flexuosa (Eklund 1990) Jachowicz-Zdanowska 2013

Ichnosphaera robusta Jachowicz-Zdanowska 2013

Ichnosphaera stipatica (Hagenfeldt 1989a) Jachowicz-Zdanowska 2013

Impluviculus Loeblich & Tappan 1969 emend. Martin 1975
type species: *Impluviculus milonii* (Deunff 1968b) Loeblich & Tappan 1969

?Impluviculus bibulbulus Parsons & Anderson 2000

Impluviculus cleae (Martin 1972) Martin 1975

Impluviculus lenticularis Martin 1975

Impluviculus milonii (Deunff 1968b) Loeblich & Tappan 1969

Impluviculus multiangularis (Umnova in Umnova & Fanderflit 1971) Volkova 1990

Impluviculus stellaris Martin 1975

Impluviculus villosiusculus Volkova 1990

Impluviculus sp. A Martin & Dean 1988

?Impluviculus sp. A Parsons & Anderson 2000

Izhoria Golub & Volkova in Volkova & Golub 1985
type species: *Izhoria angulata* Golub & Volkova in Volkova & Golub 1985

Izhoria angulata Golub & Volkova in Volkova & Golub 1985

“Kildinella” Shepeleva & Timofeev 1963 ex Timofeev 1966
→ *Leiosphaeridia* Eisenack 1958a [acc. to Volkova 1968 and Lindgren 1982]
type species: “*Kildinella hyperboreica*” Timofeev 1966
→ *Leiosphaeridia hyperboreica* (Timofeev 1966) Fensome et al. 1990

“Kildinosphaera” Vidal in Vidal & Siedlecka 1983
→ *Valeria* Jankauskas 1982 [acc. to Fensome et al. 1990]

type species: “*Kildinosphaera chagrinata*” Vidal in Vidal & Siedlecka 1983
→ *Valeria sinica* (Timofeev 1966) Fensome et al. 1990

“*Kildinosphaera chagrinata*” Vidal in Vidal & Siedlecka 1983
→ *Valeria sinica* (Timofeev 1966) Fensome et al. 1990

“*Kildinosphaera granulata*” Vidal in Vidal & Siedlecka 1983
→ *Megasacculina atava* Naumova 1961

Ladogella Golub & Volkova in Volkova & Golub 1985
type species: *Ladogella rotundiformis* Golub & Volkova in Volkova & Golub 1985

?Ladogella aries Di Milia et al. 1989

Ladogella filifera Di Milia et al. 1989

?Ladogella intermedia Parsons & Anderson 2000

Ladogella rommelaerei (Martin in Martin & Dean 1981) Di Milia et al. 1989

Ladogella rotundiformis Golub & Volkova in Volkova & Golub 1985

Ladogella saharica Vecoli & Playford 1997

Ladogella volkovae Di Milia et al. 1989

Ladogella sp. A Parsons & Anderson 2000

Lechistania Jachowicz-Zdanowska 2013
type species: *Lechistania magna* Jachowicz-Zdanowska 2013

Lechistania magna Jachowicz-Zdanowska 2013

Leiofusa Eisenack 1938a emend. Eisenack 1965a emend. Combaz et al. 1967 emend. Cramer 1970
type species: *Leiofusa fusiformis* Eisenack 1934 ex Eisenack 1938a

Leiofusa cf. *bicornuta* Xing & Liu 1973

Leiofusa cf. *gravida* Pittau 1985

“*Leiofusa pristina*” Potter in Baudelot & Géry 1979
[nomen nudum, acc. to Fensome et al. 1990; Baudelot & Géry 1979 gave authorship as “Potter 1974”, refering to an unpublished thesis]

Leiofusa simplex (Combaz 1967) Martin 1975

“*Leiofusa squama*” Deunff 1961a
→ *Poikilofusa squama* (Deunff 1961a) Martin 1973

Leiofusa stoumonensis Vanguestaine 1973b

“Leioligotriletes” Timofeev 1958
[not validly published acc. to Fensome et al. 1990]
variant: *“Leioligotriletum”*
type species: “*Leioligotriletes crassus*” (Naumova 1949) Timofeev 1958 [not validly published, acc. to Fensome et al. 1990]

“*Leioligotriletes crassus*” (Naumova 1949) Timofeev 1958
[not validly published, acc. to Fensome et al. 1990]

Leiomarginata Naumova 1961
type species: *Leiomarginata simplex* Naumova 1961

Leiomarginata simplex Naumova 1961

“Leiominuscula” Naumova 1961
→ *Leiosphaeridia* Eisenack 1958a [acc. to Cramer & Díez 1979]
type species: “*Leiominuscula minuta*” Naumova 1961
→ *Leiosphaeridia riphiana* Fensome et al. 1990

“*Leiominuscula minuta*” Naumova 1961
→ *Leiosphaeridia riphiana* Fensome et al. 1990

“Leiopsophosphaera” Naumova 1961 ex Naumova 1968
→ *Leiosphaeridia* Eisenack 1958a [acc. to Volkova 1968 and Lindgren 1982]
type species: “*Leiopsophosphaera convexiplicata*” Naumova 1968

“*Leiopsophosphaera indefinita*” Pichova
[cited as “*Leiopsophosphaera indefinitus* Pichova” without complete reference in Pykhova 1967]

“*Leiopsophosphaera infriata*” Shepeleva
[cited without complete reference in Ding et al. 1992]
[possible homonym: “*Leiopsophosphaera infriata* (Andr.) Sin et Liu (comb. nov.)” in Xing &

Liu 1978, wherein the basionym was not properly referenced; Fensome et al. 1990 also reported citations of *“Leiopsophosphaera infriata”* without complete references and authorship given as: “(Andreeva)” in Xing et al. 1979; “(Timofeev)” in Xing & Liu 1980]

“Leiopsophosphaera pseudozonalis” Wang et Chen
[cited without complete reference in Wang & Chen Q. 1987]

“Leiopsophosphaera rotunda” Pykhova 1967
[not validly published, acc. to Fensome et al. 1990]

“Leiopsophosphaera solida” (Liu et Sin) Xing & Liu 1978
[the basionym was not properly referenced in Xing & Liu 1978, most likely *Protoleiosphaeridium solidum* Liu & Xing in Xing & Liu 1973]

Leiosphaeridia Eisenack 1958a emend. Downie & Sarjeant 1963 emend. Turner 1984
type species: *Leiosphaeridia baltica* Eisenack 1958a

Leiosphaeridia annulata Yin L. in Chen J. et al. 1985

Leiosphaeridia asperata (Naumova 1950) Lindgren 1982

“Leiosphaeridia atava” (Naumova 1961) Cramer & Díez 1979
→ *Megasacculina atava* Naumova 1961

Leiosphaeridia bicrura Jankauskas in Jankauskas & Posti 1976

Leiosphaeridia cerebriformis Volkova 1969

Leiosphaeridia crassa (Naumova 1949) Jankauskas in Jankauskas et al. 1989
[**junior homonym:** *“Leiosphaeridia crassa”* (Pykhova 1973) Fensome et al. 1990]

Leiosphaeridia dehisca Paškevičienė in Volkova et al. 1979

“Leiosphaeridia densa” (Timofeev 1966) Pyatiletov 1978
[**junior homonym:** *Leiosphaeridia densa* (Maithy 1975) Nautiyal 1983]
→ *Protoleiosphaeridium laccatum* (Timofeev 1966) Fensome et al. 1990 [acc. to Vidal 1974]

Leiosphaeridia desmosa Yin L. in Chen J. et al. 1985

“Leiosphaeridia fragile” Downie 1982
→ *Saharidia fragilis* (Downie 1958) Combaz 1967

Leiosphaeridia fumiana Vanguestaine 1974

“Leiosphaeridia gregalis” Hagenfeldt 1989a
→ *Dichotisphaera gregalis* (Hagenfeldt 1989a) Vanguestaine 1991

Leiosphaeridia macrostomata Yin L. in Chen J. et al. 1985

Leiosphaeridia minutissima (Naumova 1949) Jankauskas in Jankauskas et al. 1989

“Leiosphaeridia papillata” (Staplin 1961) Downie & Sarjeant 1965
→ *Lophosphaeridium papillatum* (Staplin 1961) Martin 1969

Leiosphaeridia pylomifera Paškevičienė in Volkova et al. 1979

Leiosphaeridia subgranulata Kiryanov 1974

Leiosphaeridia tenuissima Eisenack 1958b

Leiosphaeridia ternata (Timofeev 1966) Mikhailova & Jankauskas in Jankauskas et al. 1989

Leiosphaeridia tubulosa Eisenack 1963

Leiosphaeridia sp. 1 Cramer & Díez 1972

Leiosphaeridia sp. 1 Eklund 1990

Leiosphaeridia sp. 1 Moczydłowska & Vidal 1986

Leiosphaeridia sp. 1 Volkova et al. 1979

Leiosphaeridia sp. 2 Moczydłowska & Vidal 1986

Leiosphaeridia sp. A Parsons & Anderson 2000

Leiovalia Eisenack 1965a ex Górka 1969
type species: *Leiovalia ovalis* (Eisenack 1938a) Górka 1969

Leiovalia tenera Kiryanov 1974

Liepaina Jankauskas and Volkova in Volkova et al. 1979
type species: *Liepaina plana* Jankauskas and Volkova in Volkova et al. 1979

Liepaina plana Jankauskas and Volkova in Volkova et al. 1979

Liepaina rigida Eklund 1990

?Liepaina n. sp. Vidal 1981
→ *Turrisphaeridium semireticulatum* (Timofeev 1959b) Jachowicz-Zdanowska 2013

Lophodiacrodium Timofeev 1958 emend. Deflandre & Deflandre-Rigaud 1962
type species: *Lophodiacrodium obtusum* Timofeev 1958

Lophodiacrodium valdaicum (Timofeev 1959b) Downie & Sarjeant 1965

“Lopholigotriletum” Timofeev 1959b
[not validly published, acc. to Fensome et al. 1990]
no type species

“Lopholigotriletum spathaeforme” Timofeev 1959b
→ *Lophosphaeridium spathaeforme* Timofeev 1959b ex Hu Yunxu 1986

Lophominuscula Naumova 1961
type species: *Lophominuscula prima* Naumova 1961

Lophominuscula acietata Sun in Sun & Zhai 1989
[complete reference only available in Chinese]

Lophominuscula crassa Xing & Liu 1978

Lophominuscula prima Naumova 1961

Lophopsophosphaera Naumova
[cited without complete reference in Pykhova 1967; most likely a misspelling of *Leiopsophosphaera* Naumova 1961]
type species: ?

Lophosphaeridium Timofeev 1959b ex Downie 1963 emend. Lister 1970
type species: *Lophosphaeridium rarum* Timofeev 1959b ex Downie 1963

Lophosphaeridium acietatum Xing & Liu 1978

Lophosphaeridium bacilliferum Vanguestaine 1974

Lophosphaeridium bottnicum Hagenfeldt 1989b

“Lophosphaeridium citrinum” Downie 1963
→ *Baltisphaeridium citrinum* (Downie 1963) Stockmans & Willière 1974

“Lophosphaeridium dubium” (Volkova 1968) Moczydłowska 1991
[**senior hymonym:** *Lophosphaeridium dubium* Jankauskas & Vaitekunene 1972, acc. to Molyneux et al. 1996]

Lophosphaeridium kryptoradiatum Vanguestaine 1974

Lophosphaeridium latviense (Volkova 1974) Moczydłowska 1998

Lophosphaeridium orbiculatum Xing 1962

Lophosphaeridium papillatum (Staplin 1961) Martin 1969

Lophosphaeridium spathaeforme Timofeev 1959b ex Hu Yunxu 1986

Lophosphaeridium tentativum Volkova 1968

Lophosphaeridium truncatum Volkova 1969

Lophosphaeridium tynnii Hagenfeldt 1989b

Lophosphaeridium variabile Volkova 1974

Lophosphaeridium yichangense Xing & Liu 1978

Lophosphaeridium sp. A Potter 1974

Lusatia Burmann 1970 emend. Sarjeant & Vavrdová 1997
type species: *Lusatia dendroidea* Burmann 1970 emend. Albani et al. 2007

Lusatia dendroidea Burmann 1970 emend. Albani et al. 2007

"Lusatia triangularis" (Umnova 1975) Volkova 1990
→ *Lusatia dendroidea* Burmann 1970 emend. Albani et al. 2007

Macroptycha Timofeev 1973a ex Timofeev et al. 1976
type species: *Macroptycha uniplicata* Timofeev in Timofeev et al. 1976

Macroptycha uniplicata Timofeev in Timofeev et al. 1976

Margominuscula Naumova 1961
type species: *Margominuscula rugosa* Naumova 1961

Margominuscula rugosa Naumova 1961

Medousapalla Wood & Clendening 1982
type species: *Medousapalla choanoklosma* Wood & Clendening 1982

Medousapalla choanoklosma Wood & Clendening 1982

Megasacculina Naumova 1961
type species: *Megasacculina atava* Naumova 1961

Megasacculina atava Naumova 1961

Micrhystridium Deflandre 1937 emend. Staplin 1961 emend. Downie & Sarjeant 1963 emend. Staplin et al. 1965 emend. Sarjeant 1967 emend. Lister 1970 emend. Sarjeant & Stancliffe 1994
type species: *Micrhystridium inconspicuum* (Deflandre 1935) Deflandre 1937

Micrhystridium ampliatum Wang 1985
[**junior homonym:** *"Micrhystridium ampliatum"* Wicander & Playford 1985, acc. to Fensome et al. 1990]
→ *Heliosphaeridium ampliatum* (Wang 1985) Yao et al. 2005

Micrhystridium breviacanthum Slavíková 1968

Micrhystridium brevicornum Jankauskas 1976
→ {in Welsch 1986} *Heliosphaeridium serridentatum* Moczydłowska 1998

Micrhystridium cerinum
[cited without reference in Yang & Yin L. 2001]

Micrhystridium confusum (Jankauskas 1975) Fensome et al. 1990
[acc. to Fensome et al. 1990, this combination was not validly published in Pozaryski et al. 1981]

"Micrhystridium coniferum" Downie 1982
→ *Heliosphaeridium coniferum* (Downie 1982) Moczydłowska 1991

Micrhystridium cf. *coronatum* Stockmans & Willière 1963

"Micrhystridium dissimilare" Volkova 1969
→ *Heliosphaeridium dissimilare* (Volkova 1969) Moczydłowska 1991

Micrhystridium dubium
[cited without reference in Yang & Yin L. 2001]

Micrhystridium echinulatum Luo & Wang in Wang & Luo 1984

Micrhystridium ellaense Downie 1982

"Micrhystridium ellipticum" Downie 1982
→ *Heliosphaeridium obscurum* (Volkova 1969) Moczydłowska 1991

Micrhystridium flexispinosum Downie 1982

"Micrhystridium gogense" Downie 1982
→ *Comasphaeridium gogense* (Downie 1982) Sarjeant & Stancliffe 1994

Micrhystridium guizhouense Fensome et al. 1990

Micrhystridium henryi Paris & Deunff 1970

"Micrhystridium lanatum" Volkova 1969
→ *Asteridium lanatum* (Volkova 1969) Moczydłowska 1991

"Micrhystridium lanceolatum" Vanguestaine 1974
[**junior homonym:** *"Micrhystridium lanceolatum"* Yin L. 1985, acc. to Palacios & Vidal 1992]
→ *Heliosphaeridium lanceolatum* (Vanguestaine 1974) Moczydłowska 1998

"Micrhystridium lanceolatum" Yin L. 1985
[**senior homonym:** *"Micrhystridium lanceolatum"* Vanguestaine 1974, **now** *Asteridium lanceolatum* (Vanguestaine 1974) Moczydłowska 1998, acc. to Palacios & Vidal 1992]

Micrhystridium longispiniferum Wang & Luo 1984

“Micrhystridium longum” Moczydłowska 1988
→ *Heliosphaeridium longum* (Moczydłowska 1988) Moczydłowska 1998

“Micrhystridium lubomlense” Kiryanov 1974
→ *Heliosphaeridium lubomlense* (Kiryanov 1974) Moczydłowska 1991

Micrhystridium maidingense Wang & Chen Q. 1987

Micrhystridium minimum Xing
[cited without complete reference in Yin C. & Gao 1996]

Micrhystridium minutum Downie 1982
[**junior homonym:** *“Micrhystridium minutum”* Luo & Wang in Wang & Luo 1984, acc. to Fensome et al. 1990]

“Micrhystridium minutum” Luo &Wang in Wang & Luo 1984
[**senior homonym:** *Micrhystridium minutum* Downie 1982, acc. to Fensome et al. 1990]
→ *Micrhystridium guizhouense* Fensome et al. 1990

Micrhystridium ningqiangense Xing
[cited without complete reference in Yin C. & Gao 1996]

“Micrhystridium notatum” Volkova 1968
→ *Ammonidium notatum* (Volkova 1969) Jachowicz-Zdanowska 2013

Micrhystridium obscurum Volkova 1969
→ *Heliosphaeridium obscurum* (Volkova 1969) Moczydłowska 1991

“Micrhystridium oligum” Jankauskas in Jankauskas & Posti 1976
→ *Ammonidium oligum* (Jankauskas in Jankauskas & Posti 1976) Jachowicz-Zdanowska 2013

“Micrhystridium ordense” Downie 1982
→ *Asteridium ordense* (Downie 1982) Vidal & Peel 1993

“Micrhystridium pallidum” Volkova 1968
→ *Asteridium pallidum* (Volkova 1968) Moczydłowska 1991

?Micrhystridium profusum Wicander 1974

Micrhystridium pseudozonale Wang & Chen Q. 1987

“Micrhystridium radzynicum” Volkova in Volkova et al. 1979
→ *Heliosphaeridium radzynicum* (Volkova in Volkova et al. 1979) Moczydłowska 1991

Micrhystridium regulare Yin L. 1987

Micrhystridium resistens Timofeev 1959b ex Deflandre & Deflandre-Rigaud 1965

Micrhystridium semiapertum Welsch 1986

Micrhystridium setulerum Wang et al. 1987
[cited as “in press” in Wang & Chen Q. 1987]

Micrhystridium shinetonense Downie 1958

“Micrhystridium sinuosum” Potter in Baudelot & Géry 1979
[nomen nudum, acc. to Fensome et al. 1990; Baudelot & Géry 1979 gave authorship as “Potter 1974”, refering to an unpublished thesis]

“Micrhystridium spinosum” Volkova 1969

→ *Asteridium spinosum* (Volkova 1969) Moczydłowska 1998

Micrhystridium stellatum Deflandre 1945

“*Micrhystridium tornatum*” Volkova 1968
→ *Asteridium tornatum* (Volkova 1968) Moczydłowska 1991

Micrhystridium varium
[cited without reference in Yang & Yin L. 2001]

Micrhystridium villosum Kiryanov 1974

Micrhystridium n. sp. Vidal 1981

Micrhystridium sp. 1 Cramer & Díez 1972

Micrhystridium sp. 1 Hagenfeldt 1989b

Micrhystridium sp. 1 Paalits 2005

Micrhystridium sp. 2 Hagenfeldt 1989b

Micrhystridium sp. 2 Paalits 2005

Micrhystridium sp. A Albani et al. 1991

Micrhystridium sp. A Knoll & Swett 1987

Micrhystridium sp. A Parsons & Anderson 2000

Micrhystridium sp. B Albani et al. 1991

Micrhystridium sp. B Potter 1974

Microconcentrica Naumova 1961 ex Naumova 1968
type species: *Microconcentrica atava* Naumova 1961 ex Naumova 1968

Microconcentrica atava Naumova 1961 ex Naumova 1968

Microconcentrica induplicata Liu & Xing in Xing & Liu 1973

Monocrodium Pittau 1985
type species: *Monocrodium mediterraneum* Pittau 1985

Monotrematosphaeridium Sin in Xing & Liu 1978
[authorship in Xing & Liu 1978 was given as “Sin 1962 (MS)”, presumably referencing an unpublished manuscript or Xing 1962]
type species: *Monotrematosphaeridium asperum* Xing & Liu 1978

“*Monotrematosphaeridium quadratum*” Sin 1962

[probably not validly published]

Monotrematosphaeridium simplex Wang et Chen
[cited without complete reference in Wang & Chen Q. 1987]

Multiplicisphaeridium Staplin 1961 emend. Staplin et al. 1965 emend. Eisenack 1969 emend. Lister 1970 emend. Eiserhardt 1992 emend. Sarjeant & Vavrdová 1997
type species: *Multiplicisphaeridium ramispinosum* Staplin 1961

Multiplicisphaeridium ?ancliforme Fombella 1978

"Multiplicisphaeridium campanulum" Eklund 1990
→ *Eklundia campanula* (Eklund 1990) Jachowicz-Zdanowska 2013

Multiplicisphaeridium cervinacornuum Welsch 1986

Multiplicisphaeridium chakor Vanguestaine & Van Looy 1983

Multiplicisphaeridium constipatum Eklund 1990

Multiplicisphaeridium dactilum Vidal in Moczydłowska & Vidal 1988

"Multiplicisphaeridium dendroideum" (Jankauskas 1976) Jankauskas & Kiryanov in Volkova et al. 1979
[**senior homonyms:** *Multiplicisphaeridium dendroidium* Morbey 1975; *Multiplicisphaeridium dendroideum* (Burmann 1970) Eisenack et al. 1976, acc. to Fensome et al. 1990]
→ *Multiplicisphaeridium xianum* Fombella 1977 [acc. to Moczydłowska 1998]

Multiplicisphaeridium cf. *eodigitatum* Fombella 1978

Multiplicisphaeridium cf. *eopiriferum* Fombella 1978

"?Multiplicisphaeridium cf. *furcatum"* (Deunff 1961a) Eisenack et al. 1973
→ *Stelliferidium* cf. *furcatum* (Deunff 1961a) emend. Deunff et al. 1974

Multiplicisphaeridium jaroslavicum Volkova 1990

"Multiplicisphaeridium lancarae" Cramer & Díez 1972
→ *Timofeevia lancariae* (Cramer & Díez 1972) Vanguestaine 1978

Multiplicisphaeridium llynense (Martin in Young et al. 1994) Jachowicz-Zdanowska 2013

Multiplicisphaeridium martae Cramer & Díez 1972

Multiplicisphaeridium ramosum Moczydłowska 1998

"Multiplicisphaeridium raquelinae" Cramer & Díez 1972
→ *Timofeevia raquelinae* (Cramer & Díez 1972) Cramer & Díez 1979

Multiplicisphaeridium parvum (Hagenfeldt 1989b) Moczydłowska 1998

Multiplicisphaeridium sosnowiecense Moczydłowska 1998

Multiplicisphaeridium varietatis Moczydłowska 1998

"Multiplicisphaeridium vilnense" (Jankauskas 1976) Jankauskas in Volkova et al. 1979

→ *Timofeevia lancariae* (Cramer & Díez 1972) Vanguestaine 1978

Multiplicisphaeridium waltonii Downie 1982

Multiplicisphaeridium xianum Fombella 1977

Multiplicisphaeridium yankauskasii Fensome et al. 1990

Multiplicisphaeridium sp. 1 Volkova 1990

Myxococcoides Schopf 1968
type species: *Myxococcoides minor* Schopf 1968

Myxococcoides inornata Schopf 1968

Myxococcoides minor Schopf 1968

Myxococcoides staphylidion Lo 1980

Nanocyclopia Loeblich & Wicander 1976
type species: *Nanocyclopia aspratilis* Loeblich & Wicander 1976

Nanocyclopia sp. 1 Uutela 2008

Navifusa Combaz et al. 1967 ex Eisenack 1976
type species: *Navifusa navis* (Eisenack 1938b) Eisenack 1976

Nellia Golub & Volkova in Volkova & Golub 1985
type species: *Nellia longiuscula* Golub & Volkova in Volkova & Golub 1985

Nellia acifera (Umnova in Umnova & Fanderflit 1971) Volkova 1990

?Nellia longispinata Parsons & Anderson 2000

Nellia longiuscula Golub & Volkova in Volkova & Golub 1985

Nellia magna Volkova 1990

Nellia sukatschevii (Timofeev 1959b) Volkova 1990

Neoveryhachium Cramer 1970
type species: *Neoveryhachium carminae* (Cramer 1964b) Cramer 1970

Ninadiacrodium Raevskaya & Servais 2009
type species: *Ninadiacrodium dumontii* (Vanguestaine 1973b) Raevskaya & Servais 2009

Ninadiacrodium caudatum (Vanguestaine 1973b) Raevskaya & Servais 2009

Ninadiacrodium dumontii (Vanguestaine 1973b) Raevskaya & Servais 2009

Nodosus Hagenfeldt 1989b
type species: *Nodosus irregulare* Hagenfeldt 1989b

Nodosus irregulare Hagenfeldt 1989b

Nucellosphaeridium Timofeev 1966
type species: *Nucellosphaeridium deunffii* Timofeev 1966

Nucellosphaeridium sp. A Martin & Dean 1983

"Ocridoligotriletes" Timofeev 1958
variant: *"Ocridoligotriletum"*
→ *Trachytriletes* Naumova 1939 ex Naumova 1949 [acc. to Fensome et al. 1990]
type species: *O. kryshtofovichii* (Naumova 1949) Timofeev 1958 [comb. illegitimate acc. to Fensome et al. 1990]
→ *Trachytriletes kryshtofovichii* Naumova 1949

"Ocridoligotriletum kryshtofovichi" (Naumova 1949) Timofeev 1958 [comb. illegitimate acc. to Fensome et al. 1990]
→ *Trachytriletes kryshtofovichii* Naumova 1949

Octaedryxium Rudavskaya 1973a
or *Octoedryxium* Rudavskaya 1973b [uncertain seniority acc. to Fensome et al. 1990]
type species: *Octaedryxium truncatum* Rudavskaya 1973a or Rudavskaya 1973b

Octaedryxium minutum Wang & Chen Q. 1987

Octaedryxium simplex Wang & Chen Q. 1987

Ooidium Timofeev 1957 emend. Norris & Sarjeant 1965
type species: *Ooidium rossicum* Timofeev 1957

?Ooidium clavigerum Parsons & Anderson 2000

"*Ooidium* aff. *revinium*" Vanguestaine 1973b
→ *Trunculumarium* aff. *revinium* (Vanguestaine 1973b) Loeblich & Tappan 1976

Ooidium rossicum Timofeev 1957

Ooidium timofeevii Loeblich 1970

Ooidium sp. A Vanguestaine 1986

?Ooidium sp. A Martin & Dean 1981

Orthosphaeridium Eisenack 1968 emend. Kjellström 1971a emend. Turner 1984
type species: *Orthosphaeridium rectangulare* (Eisenack 1963) Eisenack 1968

?Orthosphaeridium extensum Parsons & Anderson 2000
→ {*pro parte* in Parsons & Anderson 2000} *Lusatia dendroidea* Burmann 1970 emend. Albani et al. 2007

"*?Orthosphaeridium triangulare*" (Umnova 1975) Parsons & Anderson 2000
→ *Lusatia dendroidea* Burmann 1970 emend. Albani et al. 2007

Orygmatosphaeridium Timofeev 1959b
type species: *Orygmatosphaeridium ruminatum* Timofeev 1959b

Orygmatosphaeridium holtedahlii (Timofeev 1966) Fensome et al. 1990

"*Orygmatosphaeridium semireticulatum*" Andreeva 1966
→ *Orygmatosphaeridium holtedahlii* (Timofeev 1966) Fensome et al. 1990

"Ovulum" Jankauskas 1975
[not validly published, acc. to Fensome et al. 1990]
→ *Revinotesta* Vanguestaine 1974 [acc. to Cramer & Díez 1979]
type species: *Ovulum saccatum* Jankauskas 1975
→ *Revinotesta saccata* (Jankauskas 1975) ex Fensome et al. 1990

"*Ovulum lanceolatum*" Jankauskas 1975

→ *Revinotesta lanceolata* Jankauskas 1975 ex Fensome et al. 1990

“*Ovulum saccatum*” Jankauskas 1975
→ *Revinotesta saccata* Jankauskas 1975 ex Fensome et al. 1990

Paracymatiosphaera Wang 1985
type species: *Paracymatiosphaera regularis* Wang 1985

Paracymatiosphaera annularis Wang 1985

Paracymatiosphaera hunnanensis Wang 1985

Paracymatiosphaera irregularis Wang 1985

Paracymatiosphaera regularis Wang 1985

Paracymatiosphaera spinosa Yin C. in Yin C. & Liu 1988

Parmasphaeridium Jachowicz-Zdanowska 2013
type species: *Parmasphaeridium implicatum* (Fridriksone 1971) Jachowicz-Zdanowska 2013

Parmasphaeridium implicatum (Fridriksone 1971) Jachowicz-Zdanowska 2013

Parmasphaeridium robustispinosum Jachowicz-Zdanowska 2013

Peramorpha Martin in Martin & Dean 1983
type species: *Peramorpha manuelsensis* Martin in Martin & Dean 1983

Peramorpha manuelsensis Martin in Martin & Dean 1983

Petaloferidium Jacobson 1978
type species: *Petaloferidium stigii* Jacobson 1978

Petaloferidium lacrimiferum Palacios et al. 2009

Peteinosphaeridium Staplin et al. 1965
type species: *Peteinosphaeridium bergstroemii* Staplin et al. 1965

Phenacoon Vecoli & Playford 1997
type species: *Phenacoon imperfectum* Vecoli & Playford 1997

Phenacoon imperfectum Vecoli & Playford 1997

Pirea Vavrdová 1972
type species: *Pirea dubia* Vavrdová 1972

Pirea orbicularis Volkova 1990

“Plicatosphaera” Potter in Baudelot & Géry 1979
[nomen nudum, acc. to Fensome et al. 1990]
type species: “*Plicatosphaera elementaria*” Potter in Baudelot & Géry 1979 [nomen nudum acc. to Fensome et al. 1990]

“*Plicatosphaera elementaria*” Potter in Baudelot & Géry 1979
[nomen nudum, acc. to Fensome et al. 1990; Baudelot & Géry 1979 gave authorship as “Potter 1974”, refering to an unpublished thesis]

Poikilofusa Staplin et al. 1965
type species: *Poikilofusa spinata* Staplin et al. 1965

Poikilofusa chalaza Rasul 1979

Poikilofusa squama (Deunff 1961a) Martin 1972

Polyedryxium Deunff 1954a emend. Deunff 1971
type species: *Polyedryxium deflandrei* Deunff 1954a ex Deunff 1961b

“*Polyedryxium sarjeantii*” Slavíková 1968
[not validly published, acc. to Fensome et al. 1990]

Polygonium Vavrdová 1966 restrict. Le Hérissé 1989 emend. Sarjeant & Stancliffe 1994 emend. Moczydłowska & Stockfors 2004
type species: *Polygonium gracile* Vavrdová 1966

"Polygonium dentatum" (Timofeev 1959b ex Konzalová-Mazancová 1969) Albani 1989
→ *Polygonium pungens* (Timofeev 1959b ex Martin 1969) Albani 1989 [acc. to Moczydłowska & Stockfors 2004]

Polygonium gracile Vavrdová 1966 emend. Jacobson & Achab 1985 emend. Sarjeant & Stancliffe 1996

Polygonium martinae Moczydłowska & Crimes 1995

Polygonium minimum Timofeev 1959b ex Volkova 1990

Polygonium pellicidum (Timofeev 1959b ex Tynni 1975) Volkova 1990 emend. Moczydłowska & Stockfors 2004

Polygonium pungens (Timofeev 1959b ex Martin 1969) Albani 1989
[this combination was not validly published by Baudelot & Bessiere 1977, acc. to Fensome et al. 1990]

Polygonium sexradiatum (Timofeev 1959b) Volkova 1990

"Polygonium varium" (Volkova 1969) Sarjeant & Stancliffe 1994
[Sarjeant & Stancliffe 1994 tentatively assigned this species to *Polygonium*; Moczydłowska 1998 marked this as a new combination]
→ *Eklundia varia* (Volkova 1969) Jachowicz-Zdanowska 2013

Polygonium sp. A Vanguestaine 1973a

"Polyporata" Pykhova 1966
[nomen nudum, acc. to Fensome et al. 1990]
[**homonym:** *Polyporata* Xing & Liu 1973]
no type species

"Polyporata nidia" Pykhova 1966
[not validly published, acc. to Fensome et al. 1990]

"Polyporata verrucosa" Pykhova 1966
[not validly published, acc. to Fensome et al. 1990]

Priscogalea Deunff 1961a emend. Rasul 1974
type species: *Priscogalea barbara* Deunff 1961a

"Priscogalea cortinula" Deunff 1961a
→ *Stelliferidium cortinulum* (Deunff 1961a) emend. Deunff et al. 1974

"Priscogalea cuvillieri" Deunff 1961a
→ *Cymatiogalea cuvillieri* (Deunff 1961a) Deunff 1964

"Priscogalea gautieri" Martin 1972
→ *Stelliferidium gautieri* (Martin 1972) Pittau 1985

"Priscogalea multarea" Deunff 1961a
→ *Cymatiogalea multarea* (Deunff 1961a) Eisenack et al. 1973

Priscogalea primordialis Yin L. in Chen J. et al. 1985 emend. Yin L. 1986

Priscogalea promptusa Yin L. in Chen J. et al. 1985

?Priscogalea sp. A Vanguestaine 1986

Priscotheca Deunff 1961a
type species: *Priscotheca raia* Deunff 1961a

Priscotheca notata Volkova 1988

Protoarchaeosacculina Naumova 1961
type species: *Protoarchaeosacculina atava* Naumova 1961

Protoleiosphaeridium Timofeev 1959b ex Timofeev 1960
type species: *Protoleiosphaeridium conglutinatum* Timofeev 1959b ex Timofeev 1960

Protoleiosphaeridium conglutinatum Timofeev 1959b ex Timofeev 1960

Protoleiosphaeridium crassum Timofeev 1963

"Protoleiosphaeridium densum" (Timofeev 1966) Yin L. 1979
→ *Protoleiosphaeridium laccatum* (Timofeev 1966) Fensome et al. 1990

Protoleiosphaeridium laccatum (Timofeev 1966) Fensome et al. 1990

Protoleiosphaeridium minutissimum Timofeev
[cited without complete reference in Jagielska 1965]

Protoleiosphaeridium papyraceum (Timofeev 1966) Zang 1992

Protoleiosphaeridium rugulosum (Fombella 1978) Fensome et al. 1990

Protoleiosphaeridium sp. forme A Potter 1974

Protolophosphaeridium Timofeev 1963
type species: *Protolophosphaeridium faetonum* Timofeev 1963

Protolophosphaeridium crispum Timofeev
[cited without complete reference in Jagielska 1965]

Protolophosphaeridium grumosum Timofeev
[cited without complete reference in Jagielska 1965]

Protomyceterosphaeridium Timofeev 1963
type species: *Protomyceterosphaeridium marmoratum* Timofeev 1963

Protomycterosphaeridium marmoratum Timofeev 1963

"Protosphaeridium" Timofeev 1966
→ *Protoleiosphaeridium* Timofeev 1959b ex Timofeev 1960 [acc. to Loeblich & Tappan 1976]
type species: "*Protosphaeridium densum*" Timofeev 1966
→ *Protoleiosphaeridium laccatum* (Timofeev 1966) Fensome et al. 1990

"*Protosphaeridium flexuosum*" Timofeev 1966
→ *Orygmatosphaeridium holtedahlii* (Timofeev 1966) Fensome et al. 1990

Prototrachysphaeridium Timofeev 1963
type species: *Prototrachysphaeridium staplinii* Timofeev 1963

Prototrachysphaeridium nevelense Timofeev
[cited without complete reference in Jagielska 1965]

Pseudotasmanites Kiryanov 1974
type species: *Pseudotasmanites parvus* Kiryanov 1974

Pseudotasmanites parvus Kiryanov 1974

Pseudozonosphaera Xing & Liu 1973
type species: *Pseudozonosphaera verrucosa* Xing & Liu 1973

Pseudozonosphaera asperella Xing & Liu 1978
[authorship in Xing & Liu 1978 was given as "Sin et Liu (MS)", presumably referencing an unpublished manuscript]

Pseudozonosphaera sinica Xing & Liu 1973

Pseudozonosphaera verrucosa Xing & Liu 1973

Pseudozonosphaeridium Andreeva 1966
type species: *Pseudozonosphaeridium populosum* Andreeva 1966

Pseudozonosphaeridium fengxiangense Zhong Guofang 1978
[not reported from the Cambrian, but from the Proterozoic and the Silurian]

Psophosphaera Naumova 1939 ex Ishchenko 1952 emend. Potonié 1958
[gymnospermous palynomorphs]
type species: ?

Psophosphaera obscura Pykhova 1967

Pterospermella Eisenack 1972
type species: *Pterospermella aureolata* (Cookson & Eisenack 1958) Eisenack 1972

Pterospermella gigantea Jachowicz-Zdanowska 2013

Pterospermella inordinata Jachowicz-Zdanowska 2013

Pterospermella solida (Volkova 1969) Volkova in Volkova et al. 1979

Pterospermella velata Moczydłowska 1988

Pterospermella vitalis Jankauskas in Volkova et al. 1979

Pterospermella vitrea (Volkova 1974) Fensome et al. 1990

"Pterospermella wolynica" Kiryanov
[cited in Vidal 1981 as "*P. wolynica* Kiryanov", "*P.*" implicitly representing *Pterospermella* in the context, but it should be *Pterospermopsimorpha*]
→ *Pterospermopsimorpha wolynica* Kiryanov 1974

Pterospermella n. sp. 1 Moczydłowska & Vidal 1986

Pterospermella sp. A Palacios & Vidal 1992

Pterospermella sp. B Moczydłowska & Stockfors 2004

Pterospermopsimorpha Timofeev 1966
type species: *Pterospermopsimorpha pileiformis* Timofeev 1966

Pterospermopsimorpha rugulosa Jachowicz-Zdanowska 2013

Pterospermopsimorpha wolynica Kiryanov 1974

Pulvinosphaeridium Eisenack 1954a
type species: *Pulvinosphaeridium pulvinellum* Eisenack 1954a

Pulvinosphaeridium antiquum Paškevičienė 1980

Pulvinosphaeridium delicatum Yin L. in Chen J. et al. 1985

Raphesphaera Volkova 1990
type species: *Raphesphaera spinulifera* Volkova 1990

Raphesphaera obsoleta Volkova 1990

Raphesphaera spinulifera Volkova 1990
→ *Vulcanisphaera spinulifera* (Volkova 1990) Parsons & Anderson 2000

Raphesphaera striatula Volkova 1993a

"Raphesphaera turbata" (Martin in Martin & Dean 1981) Volkova 1990
→ *Vulcanisphaera turbata* Martin in Martin & Dean 1981

Retisphaeridium Staplin et al. 1965
type species: *Retisphaeridium dichamerum* Staplin et al. 1965

Retisphaeridium brayense (Gardiner & Vanguestaine 1971) Moczydłowska & Crimes 1995

Retisphaeridium capsulatum (Jankauskas in Jankauskas & Posti 1976) Vanguestaine in Brück & Vanguestaine 2005

Retisphaeridium densum Paškevičienė in Volkova et al. 1979

Retisphaeridium dichamerum Staplin et al. 1965

"Retisphaeridium howellii" Martin in Martin & Dean 1983
→ *Retisphaeridium postae* (Jankauskas in Volkova et al. 1979) Vanguestaine in Brück & Vanguestaine 2004 [acc. to Vanguestaine in Brück & Vanguestaine 2004]

Retisphaeridium lechistanium Jachowicz-Zdanowska 2013

Retisphaeridium ovillense (Cramer & Díez 1972) Vanguestaine 2002

Retisphaeridium postae (Jankauskas in Volkova et al. 1979) Vanguestaine in Brück & Vanguestaine 2004

Retisphaeridium pusillum (Moczydłowska 1998) Vanguestaine in Brück & Vanguestaine 2005

Revinotesta Vanguestaine 1974 emend. Moczydłowska 1998
type species: *Revinotesta microspinosa* Vanguestaine 1974

Revinotesta izhorica (Jankauskas 1975) Moczydłowska 1998

"Revinotesta laevigata" Vanguestaine in Baudelot & Géry 1979
[nomen nudum, acc. to Fensome et al. 1990; Baudelot & Géry 1979 gave authorship as "Vanguestaine 1973", refering to an unpublished thesis (Vanguestaine 1973a)]

Revinotesta lanceolata Jankauskas 1975 ex Fensome et al. 1990

Revinotesta microspinosa Vanguestaine 1974

Revinotesta ordensis Downie 1982

Revinotesta saccata Jankauskas 1975 ex Fensome et al. 1990

Revinotesta n. sp. Vanguestaine 1986

"Rugasphaera" Martin in Martin & Dean 1988
[**senior homonym:** *Rugasphaera* Jiabo 1978 (= Song et al. 1978), acc. to Fensome et al. 1990]
→ *Corrugasphaera* Fensome et al. 1990
type species: *"Rugasphaera terranovana"* Martin in Martin & Dean 1988
→ *Corrugasphaera terranovana* Fensome et al. 1990

"Rugasphaera terranova" Martin in Martin & Dean 1988
→ *Corrugasphaera terranovana* Fensome et al. 1990

Sagatum Vavrdová & Bek 2001
type species: *Sagatum priscum* (Kiryanov & Volkova in Volkova et al. 1979) Vavrdová & Bek 2001

Sagatum priscum (Kiryanov & Volkova in Volkova et al. 1979) Vavrdová & Bek 2001

Saharidia Combaz 1967

type species: *Saharidia downiei* Combaz 1967

Saharidia fragilis (Downie 1958) Combaz 1967

Saharidia sp. A Parsons & Anderson 2000

Schizodiacrodium Burmann 1968
type species: *Schizodiacrodium ramiferum* Burmann 1968

Schizodiacrodium armatum Volkova 1990

Schizodiacrodium brevicrinitum Golub & Volkova in Volkova & Golub 1985

Schizodiacrodium digermulense (Welsch 1986) Parsons & Anderson 2000

Schizodiacrodium fibrosum Golub & Volkova in Volkova & Golub 1985

Sinianella Yin L. 1980 emend. Zang in Zang & Walter 1992
type species: *Sinianella uniplicata* Yin L. 1980 emend. Zang in Zang & Walter 1992

Sinianella uniplicata Yin L. 1980 emend. Zang in Zang & Walter 1992

Skiagia Downie 1982 emend. Moczydłowska 1991
type species: *Skiagia scottica* Downie 1982

Skiagia brachyspinosa (Kiryanov 1974) Jachowicz-Zdanowska 2013

"Skiagia brevispinosa" Downie 1982
→ *Skiagia brachyspinosa* (Kiryanov 1974) Jachowicz-Zdanowska 2013

Skiagia ciliosa (Volkova 1969) Downie 1982

Skiagia compressa (Volkova 1968) Downie 1982

Skiagia insignis (Fridriksone 1971) Downie 1982

Skiagia orbicularis (Volkova 1968) Downie 1982

Skiagia ornata (Volkova 1968) Downie 1982

Skiagia pilosiuscula (Jankauskas in Volkova et al. 1979) Jachowicz-Zdanowska 2013

Skiagia pura Moczydłowska 1988

Skiagia scottica Downie 1982

Skiagia sp. A Knoll & Swett 1987

Solisphaeridium Staplin et al. 1965 emend. Sarjeant 1968 emend. Moczydłowska 1998
type species: *Solisphaeridium stimuliferum* (Deflandre 1938) Staplin et al. 1965 [Fensome et al. 1990 gave authorship for this comb. as "(Deflandre 1938) Pocock 1972"]

Solisphaeridium akrochordum (Rasul 1979) Moczydłowska & Stockfors 2004

"Solisphaeridium baltoscandium" Eklund 1990 emend. Moczydłowska 1998
→ *Goniosphaeridium volkovae* Hagenfeldt 1989a

Solisphaeridium bimodulentum Moczydłowska 1998

Solisphaeridium chinese Moczydłowska & Stockfors 2004

Solisphaeridium cylindratum Moczydłowska 1998

Solisphaeridium elegans Moczydłowska 1998

Solisphaeridium flexipilosum Slavíková 1968 emend. Moczydłowska 1998

"Solisphaeridium implicatum" (Fridriksone 1971) Moczydłowska 1998
→ *Parmasphaeridium implicatum* (Fridriksone 1971) Jachowicz-Zdanowska 2013

Solisphaeridium lucidum (Deunff 1959) Turner 1985

Solisphaeridium multiflexipilosum Slavíková 1968 emend. Moczydłowska 1998

Solisphaeridium sp. A Moczydłowska 1998

"Sphaerocongregus" Moorman 1974
→ *Bavlinella* Shepeleva 1962 [acc. to Vidal 1976]
type species: *"Sphaerocongregus variabilis"* Moorman 1974
→ *Bavlinella faveolata* Shepeleva 1962 [acc. to Vidal 1976]

"Sphaerocongregus variabilis" Moorman 1974
→ *Bavlinella faveolata* Shepeleva 1962 [acc. to Vidal 1976]

Spumosopsophosphaera Naumova
[cited without complete reference in Pykhova 1967]
?= *Spumososphaera* Naumova [cited without complete reference in Naumova 1968, acc. to Fensome et al. 1990]
type species: ?

Stellechinatum Turner 1984
type species: *Stellechinatum celestum* (Martin 1969) Turner 1984

Stellechinatum uncinatum (Downie 1958) Molyneux 1987

Stelliferidium Deunff et al. 1974
type species: *Stelliferidium striatulum* (Vavrdová 1966) Deunff et al. 1974

?*Stelliferidium anomalum* Di Milia et al. 1989

Stelliferidium cortinulamorphum Paalits 1995

Stelliferidium cortinulum (Deunff 1961a) emend. Deunff et al. 1974

Stelliferidium cylindratum (Rasul 1974) Elaouad-Debbaj 1988

Stelliferidium distinctum (Rasul 1974) Pittau 1985

?*Stelliferidium* cf. *furcatum* (Deunff 1961a) emend. Deunff et al. 1974

Stelliferidium gautieri (Martin 1972) Pittau 1985

Stelliferidium magnum Palacios et al. 2009

Stelliferidium pingiculum Martin in Martin & Dean 1988

Stelliferidium aff. *pseudoornatum* Pittau 1985

Stelliferidium robustum Moczydłowska 1998

Stelliferidium striatulum Vavrdová 1966) Deunff et al. 1974

Stelliferidium sp. 1 Volkova 1990

Stelliferidium sp. A Di Milia 1991

Stelliferidium sp. A Parsons & Anderson 2000

Stelliferidium sp. A Parsons & Anderson 2000

Stelliferidium sp. A Parsons & Anderson 2000

Stelliferidium sp. B Di Milia 1991

Stelliferidium sp. B Parsons & Anderson 2000

Stelliferidium sp. C Di Milia 1991

Stellinium Jardiné et al. 1972
type species: *Stellinium octoaster* (Staplin 1961) Jardiné et al. 1972

?*Stellinium* n. sp. Vidal 1981

Stictosphaeridium Timofeev 1962 ex Timofeev 1966
type species: *Stictosphaeridium sinapticuliferum* Timofeev 1966

"Stictosphaeridium brayense" Gardiner & Vanguestaine 1971
→ *Retisphaeridium brayense* (Gardiner & Vanguestaine 1971) Moczydłowska & Crimes 1995

"Stictosphaeridium implexum" Timofeev 1966
→ *Protoleiosphaeridium laccatum* (Timofeev 1966) Fensome et al. 1990

Stictosphaeridium sinapticuliferum Timofeev 1966

Striatotheca Burmann 1970
type species: *Striatotheca principalis* Burmann 1970

?Striatotheca loculifera Volkova 1990

?Striatotheca randomensis Parsons & Anderson 2000

Symplassosphaeridium Timofeev 1959b ex Timofeev 1969
type species: *Symplassosphaeridium tumidulum* Timofeev 1959b

Symplassosphaeridium cambriense Slavíková 1968 ex Fensome et al. 1990

Synsphaeridium Eisenack 1965b
[**junior homonym:** *"Synsphaeridium"* Timofeev 1966, acc. to Fensome et al. 1990]
type species: *Synsphaeridium gotlandicum* Eisenack 1965b

"Synsphaeridium conglutinatum" (Timofeev 1959b ex Timofeev 1960) Timofeev 1969
→ *Protoleiosphaeridium conglutinatum* Timofeev 1959b ex Timofeev 1960

Synsphaeridium cf. *paulum* Potter in Baudelot & Géry 1979
[nomen nudum, acc. to Fensome et al. 1990; Baudelot & Géry 1979 gave authorship as "Potter 1974", refering to an unpublished thesis]

Synsphaeridium switjasium Kiryanov 1974

Synsphaeridium sp. 1 Cramer & Díez 1972

Synsphaeridium sp. 1 Young et al. 1994

Tasmanites Newton 1875

type species: *Tasmanites punctatus* Newton 1875

Tasmanites bobrowskae Ważyńska 1967

Tasmanites convolutus Volkova & Piskun 1985
[cited without complete reference in Jankauskas & Lendzion 1992 as "*Tasmanites convolutus* Volkova et Pisk."; in Jankauskas 2002 as "*T. convoliutum*" (p. 81), "*Tasmanites convolatus*" (p. 83), "*Tasmanites convuliutus* Volkova et Piskun, 1985" (p. 110); in Vetluzhskikh et al. 2009 as "*Tasmanites convolutus* Volk. et Pisk"]

Tasmanites piritaensis Posti & Jankauskas in Jankauskas & Posti 1976

Tasmanites tenellus Volkova 1968

"*Tasmanites variabilis*" Volkova 1968
→ *Tasmanites bobrowskae* Ważyńska 1967

Tasmanites volkovae Kiryanov 1974

Tasmanites sp. A Vanguestaine 1986

Tawuia Hofmann in Hofmann & Aitken 1979
type species: *Tawuia dalensis* Hofmann Hofmann & Aitken 1979

Tectitheca Burmann 1968
type species: *Tectitheca valida* Burmann 1968

Tectitheca cf. *filigera* Burmann 1968

?Tectitheca multispinula Yin L. in Chen J. et al. 1985 emend. Yin L. 1986

Teophipolia Kiryanov in Volkova et al. 1979
type species: *Teophipolia lacerata* Kiryanov in Volkova et al. 1979

Teophipolia lacerata Kiryanov in Volkova et al. 1979

Thymadora Clendening & Wood 1981
type species: *Thymadora kerka* Clendening & Wood 1981

Thymadora kerka Clendening & Wood 1981

Timofeevia Vanguestaine 1978
type species: *Timofeevia lancariae* (Cramer & Díez 1972) Vanguestaine 1978

Timofeevia estonica Volkova 1990

Timofeevia ianischewskyi (Timofeev 1959b ex Vavrdová 1976) Volkova 1990

Timofeevia lancariae (Cramer & Díez 1972) Vanguestaine 1978

Timofeevia manata Albani et al. 1991

Timofeevia microretis Martin in Martin & Dean 1981

Timofeevia parva Hagenfeldt 1989b

Timofeevia pentagonalis (Vanguestaine 1974) Vanguestaine 1978

Timofeevia phosphoritica Vanguestaine 1978

Timofeevia raquelinae (Cramer & Díez 1972) Cramer & Díez 1979

Timofeevia tacheddirtensis Vanguestaine & Van Looy 1983

Timofeevia n. sp. A Palacios 2010

Timofeevia n. sp. B Palacios 2010

Timofeevia sp. 1 Paalits 2005

Timofeevia sp. 1 Volkova 1990

Timofeevia sp. 1 Volkova 1993b

Timofeevia sp. 1 Volkova 1995

Timofeevia sp. A Raevskaya & Golubkova 2006

Timofeevia sp. A Vanguestaine 1986

Trachydiacrodium Timofeev 1959b emend. Deflandre & Deflandre-Rigaud 1962
type species: *Trachydiacrodium productum* Timofeev 1959b

Trachydiacrodium coarctatum Timofeev 1959b

Trachyoligotriletes Timofeev 1958 ex Timofeev 1960
[**variant:** *Trachyoligotriletum*]
type species: *Trachyoligotriletes nevelensis* Timofeev 1958

Trachyoligotriletes incrassatus (Naumova 1949) Timofeev 1960

Trachyoligotriletes laminaritus Timofeev 1958 ex Timofeev 1960

Trachyoligotriletes obsuletes (Naumova 1949) Timofeev 1960

Trachyoligotriletes planus Timofeev 1958

Trachysphaeridium Timofeev 1959b ex Timofeev 1966
[**junior synonym:** *Menneria* Lopukhin 1971, acc. to Vidal 1974]
type species: *Trachysphaeridium attenuatum* Timofeev 1959b

"*Trachysphaeridium cultum*" (Andreeva 1966) Xing in Xing & Liu 1973
→ *Leiosphaeridia culta* (Andreeva 1966) Paškevičienė 1980 [acc. to Fensome et al. 1990]

Trachysphaeridium hyalinum Xing & Liu 1973

Trachysphaeridium laminaritum Timofeev 1966

Trachysphaeridium leve (Lopukhin 1971) Vidal 1974

Trachysphaeridium minor Liu & Xing in Xing & Liu 1973

Trachysphaeridium rude Xing & Liu 1978

Trachysphaeridium rugosum Xing in Xing & Liu 1973

Trachysphaeridium simplex Xing 1962

"*Trachysphaeridium stipticum*" Sin et Liu
[cited without complete reference in Ding et al. 1992, presumably referring to Xing & Liu 1973. In that publication, authorship is given as "Sin (in litt.)", apparently referring to an unpublished document. Since no type specimen was designated by Xing & Liu 1973, the species was not validly published]

Trachysphaeridium timofeevii Vidal 1976

Trachytriletes Naumova 1939
type species: *Trachytriletes kryshtofovichii* Naumova 1949

Trachytriletes kryshtofovichii Naumova 1949

Trachytriletes timofeevii Fensome et al. 1990

Trematosphaeridium Timofeev 1959b
type species: *Trematosphaeridium decoratum* Timofeev 1959b

"*Trematosphaeridium holtedahlii*" Timofeev 1966
→ *Orygmatosphaeridium holtedahlii* (Timofeev 1966) Fensome et al. 1990

Trematosphaeridium minutum Xing & Liu 1978

Trematosphaeridium simplex Wang et Chen
[cited without complete reference in Wang & Chen Q. 1987; possible homonym of "*Trematosphaeridium simplex*" Pykhova 1973, which was not validly published acc. to Fensome et al. 1990]

Trichosphaeridium Timofeev 1966
type species: *Trichosphaeridium annolovaense* Timofeev 1966

Trichosphaeridium annolovaense Timofeev 1966

Trichosphaeridium hirtum Timofeev 1959b ex Fensome et al. 1990
→ *Filisphaeridium hirtum* (Timofeev 1959b ex Umnova 1975) Sarjeant & Stancliffe 1994

Trunculumarium Loeblich & Tappan 1976
type species: *Trunculumarium revinium* (Vanguestaine 1973b) Loeblich & Tappan 1976

Trunculumarium revinium (Vanguestaine 1973b) Loeblich & Tappan 1976

Tubulosphaera Palacios in Palacios & Moczydłowska 1998
type species: *Tubulosphaera perfecta* Palacios in Palacios & Moczydłowska 1998

Tubulosphaera n. sp. A Palacios 2010

Turrisphaeridium (Timofeev 1959b) Jachowicz-Zdanowska 2013
type species: *Turrisphaeridium semireticulatum* (Timofeev 1959b) Jachowicz-Zdanowska 2013

Turrisphaeridium semireticulatum (Timofeev 1959b) Jachowicz-Zdanowska 2013

Turrisphaeridium turgidum Jachowicz-Zdanowska 2013

"Uniporata" Naumova in Pykhova 1969
[not validly published, acc. to Fensome et al. 1990]
type species: "*Uniporata typica*" Naumova in Pykhova 1969 [nomen nudum, acc. to Fensome et al. 1990]

“Uniporata nidia” Pykhova 1966
[not validly published, acc. to Fensome et al. 1990]

“Uniporata torosa” Pykhova 1966
[not validly published, acc. to Fensome et al. 1990]

Valeria Jankauskas 1982
type species: *Valeria lophostriata* (Jankauskas 1979b) Jankauskas 1982

Valeria granulata (Vidal in Vidal & Siedlecka 1983) Fensome et al. 1990

Valeria sinica (Timofeev 1966) Fensome et al. 1990

Veryhachium Deunff 1954c emend. Downie & Sarjeant 1963 emend. Turner 1984 emend. Sarjeant & Stancliffe 1994
type species: *Veryhachium trisulcum* Deunff 1951 ex Deunff 1959

“Veryhachium dumontii” Vanguestaine 1973b
→ *Ninadiacrodium dumontii* (Vanguestaine 1973b) Raevskaya & Servais 2009

Veryhachium incus Paalits 1992a

Veryhachium cf. *minutum* Downie 1958

Veryhachium mutabile Di Milia et al. 1989

“Veryhachium primaevum” Deunff 1967
[nomen nudum, acc. to Fensome et al. 1990]

Veryhachium cf. *rhomboideum* Downie 1959

“Veryhachium setuensis” Paalits 1992a
→ *?Dasydiacrodium setuensis* Paalits 1992a

“Veryhachium cf. *trapezionarion”* Loeblich 1970
→ *Veryhachium* cf. *rhomboideum* Downie 1959 [acc. to Turner 1984]

Veryhachium trisentium Zang in Gravestock et al. 2001

Veryhachium sp. A Martin in Martin & Dean 1981

Veryhachium sp. A Parsons & Anderson 2000

Virgatasporites Combaz 1967
type species: *Virgatasporites rudii* Combaz 1967

Virgatasporites normale (Fombella 1978) Fensome et al. 1990

Virgatasporites rudii Combaz 1967

Vogtlandia Burmann 1970 emend. Sarjeant & Vavrdová 1997
type species: *Vogtlandia ramificata* Burmann 1970

Vogtlandia carvinacornua (Welsch 1986) Sarjeant & Vavrdová 1997

Vogtlandia notabilis Volkova 1990

Vogtlandia petropolitana (German 1974) Volkova 1990

Vogtlandia simplex Moczydłowska 1998

Volkovia Downie 1982
type species: *Volkovia dentifera* (Volkova 1969) Downie 1982

Volkovia conifera (Jankauskas 1975) Downie 1982

Volkovia dentifera (Volkova 1969) Downie 1982

Volkovia flagellata (Jankauskas 1975) Downie 1982

Vulcanisphaera Deunff 1961a emend. Rasul 1976
type species: *Vulcanisphaera africana* Deunff 1961a

Vulcanisphaera africana Deunff 1961a

Vulcanisphaera britannica Rasul 1976

Vulcanisphaera capillata Jardiné et al. 1974

"*Vulcanisphaera cirrita*" Rasul 1976
→ *Vulcanisphaera africana* Deunff 1961a [acc. to Elaouad-Debbaj 1988]

Vulcanisphaera fermosa Fombella 1977

Vulcanisphaera frequens Górka 1967

Vulcanisphaera lanugo Martin in Martin & Dean 1988

Vulcanisphaera nebulosa Deunff 1961a

Vulcanisphaera spinulifera (Volkova 1990) Parsons & Anderson 2000

"*Vulcanisphaera tuberata*" (Downie 1958) Eisenack et al. 1973
→ *Goniosphaeridium tuberatum* (Downie 1958) Welsch 1986

Vulcanisphaera turbata Martin in Martin & Dean 1981

Vulcanisphaera sp. 1 Volkova 1980

?Vulcanisphaera sp. 1 Paalits 2005

Yurtusia Dong et al. 2009
type species: *Yurtusia uniformis* Dong et al. 2009

Yurtusia uniformis Dong et al. 2009

"Zonosphaeridium" Timofeev 1959b
→ *Tasmanites* Newton 1875 [acc. to Timofeev 1966]
no type species

"Zonosphaeridium ovillensis" Cramer & Díez 1972
→ *Retisphaeridium ovillense* (Cramer & Díez 1972) Vanguestaine 2002

Acritarch gen. et sp. nov. Martin & Dean 1984
→ *Comasphaeridium francinae* Jachowicz-Zdanowska 2013

Acritarch gen. et sp. nov. Martin & Dean 1988

Acritarch gen. et sp. nov. Young et al. 1994

Acritarch sp. 1 Hagenfeldt 1989b

Acritarch sp. Wood & Clendening 1982

Gen. et sp. ind. A Di Milia 1991

Gen. et sp. ind. B Di Milia 1991

Gen. et sp. indet. 1 Paalits 2005

Gen. et sp. indet. 2 Paalits 2005

Gen. et sp. indet. C Jago et al. 2006

Gen. et sp. indet. Żylińska & Szczepanik 2009

Genus et species ind. A Di Milia et al. 1989

Genus et species ind. B Di Milia et al. 1989

References

Albani, R., 1989, Ordovician (Arenigian) acritarchs from the Solanas sandstone formation, central Sardinia, Italy: Bollettino della Società Paleontologica Italiana, v. 28, no. 1, p. 3–37.

Albani, R., G. Bagnoli, C. Ribecai, and E. Raevskaya, 2007, Late Cambrian acritarch *Lusatia*: Taxonomy, palaeogeography, and biostratigraphic implications: Acta Palaeontologica Polonica, v. 52, no. 4, p. 809–818.

Albani, R., D. Massa, and M. Tongiorgi, 1991, Palynostratigraphy (Acritarchs) of some Cambrian beds from the Rhadames (Ghadamis) basin (Western Libya—southern Tunisia): Bollettino della Società paleontologica italiana, v. 30, no. 3, p. 255–280.

Andreeva, E. M., 1966, Opisanie iskopaemykh spor predstavitelei Bryophyta, Lycopsida, Sphenopsida, Filicinae i rastitelnykh mikrofossilii neyasnogo sistematicheskogo polzheniya—Rastitelnye mikrofossilii neyssnogo sistematicheskogo polozheniyapolozheniya. In: Part II. Morfologiya Iskopaemykh Spor, Pyltsy i Drugikh Rastitelnykh Mikrofossilii Imeyushchikh Naibolee Vazhnoe Stratigraficheskoe Znachenie, *in* Paleopalinologiya. Tom I. Metodika Paleopalinologicheskikh Issledovanii i Morfologiya Nekotorykh Iskopaemykh Spor, Pyltsy i Drugikh Rastitelnykh Mikrofossilii: Leningrad, Vsesoyuznyi Nauchno-Issledovatelskii Geologicheskii Institut (VSEGEI) Trudy, Novaya Seriya 141, p. 114–135.

Bagnoli, G., S. Stouge, and M. Tongiorgi, 1988, Acritarchs and conodonts from the Cambro-Ordovician Furuhäll (Köpingsklint) section (Öland, Sweden): Rivista Italiana di Paleontologia e Stratigrafia, v. 94, no. 2, p. 163–248.

Barghoorn, E. S., and S. A. Tyler, 1965, Microorganisms from the Gunflint Chert These structurally preserved Precambrian fossils from Ontario are the most ancient organisms known: Science, v. 147, no. 3658, p. 563–575, doi:10.1126/science.147.3658.563.

Baudelot, S., and G. Bessière, 1977, Données palynostratigraphiques ser le Paléozoïque inférieur du Massif de Mounthoumet (Hautes Corbières, Aude): Annales de la Societe Géologique de Nord, v. 97, no. 1, p. 21–25.

Baudelot, S., and B. Géry, 1979, Découverte d'Acritarches du Cambrien supérieur et du Trémadoc dans le massif ancien de Grande Kabylie (Algérie): Comptes Rendus de l' Académie des sciences Paris, v. 288, p. 1513–1516.

Baudet, D., J. D. Aitken, and M. Vanguestaine, 1989, Palynology of uppermost Proterozoic and lowermost Cambrian formations, central Mackenzie Mountains, northwestern Canada:

Canadian Journal of Earth Sciences, v. 26, no. 1, p. 129–148, doi:10.1139/e89-011.

Brito, I. M., 1967, Silurian and Devonian Acritarcha from Maranhão Basin, Brazil: Micropaleontology, v. 13, no. 4, p. 473–482.

Brito, I. M., and A. S. Santos, 1965, Contribuição ao conhecimento dos microfósseis Silurianos e Devonianos da Bacia do Maranhão: parte I; Os Netromorphitae (Leiofusidae): Divisão de Geologia e Mineralogia, Notas Preliminares e Estudos, v. 129, p. 1–29.

Brück, P. M., and M. Vanguestaine, 2004, Acritarchs from the Lower Palaeozoic succession on the south County Wexford coast, Ireland: new age constraints for the Cullenstown Formation and the Cahore and Ribband Groups: Geological Journal, v. 39, no. 2, p. 199–224.

Brück, P. M., and M. Vanguestaine, 2005, An Ordovician age for the Muggort's Bay Lower Palaeozoic inlier, County Waterford, Ireland—the southernmost exposure of the Irish Caledonides: Geological Journal, v. 40, no. 5, p. 519–544, doi:10.1002/gj.1024.

Buła, Z., and M. Jachowicz, 1996, The Lower Paleozoic sediments in the Upper Silesian Block: Geol Q, v. 40, p. 299–336.

Burmann, G., 1968, Diacrodien aus dem unteren Ordovizium: Paläontologische Abhandlungen, v. 2, no. 4, p. 635–652.

Burmann, G., 1970, Weitere organische Mikrofossilien aus dem unteren Ordovizium: Paläontologische Abhandlungen, v. 3, no. 3-4, p. 289–332.

Butterfield, N. J., 2005, Probable Proterozoic fungi: Paleobiology, v. 31, no. 1, p. 165–182.

Chen, J., Y. Qian, Y. Lin, J. Zhang, Z. Wang, L. Yin, and B.-D. Erdtmann, 1985, Study on Cambrian-Ordovician Boundary Strata and Its Biota in Dayagcha, Hunjiang, Jilin, China (Contribution to the Calgary Cambrian-Ordovician-Boundary Meeting): China Prospect Publishing House, 177 p.

Clendening, J. A., and G. D. Wood, 1981, *Thymadora*, a new acritarch genus from the middle Cambrian Rogersville shale of Tennessee, U.S.A.: Palynology, v. 5, no. 1, p. 153–158, doi:10.1080/01916122.1981.9989223.

Combaz, A., 1967, Un microbios du Trémadocien dans un sondage d'Hassi-Messaoud: Actes de la Société Linnéenne de Bordeaux, v. 104, no. 29, p. 1–26.

Combaz, A., F. W. Lange, and J. Pansart, 1967, Les "Leiofusidae" Eisenack, 1938: Review of Palaeobotany and Palynology, v. 1, no. 1–4, p. 291–307, doi:10.1016/0034-6667(67)90130-3.

Combaz, A., and G. Peniguel, 1972, Étude palynostratigraphique de l'Ordovicien dans quelques sondages du Bassin de Canning (Australie Occidentale): SNPA, Centre de Recherches de

Pau, Bulletin, v. 6, no. 1, p. 121–167.

Cookson, I. C., and A. Eisenack, 1958, Microplankton from Australian and New Guinea Upper Mesozoic sediments: Proceedings of the Royal Society of Victoria, v. 70, no. 1, p. 19–79.

Cramer, F. H., 1964a, Some acritarchs from the San Pedro Formation (Gedinnien) of the Cantabric Mountains in Spain: Bulletin de la Société belge de géologie de paléontologie et d’hydrologie, v. 73, no. 1, p. 33–38.

Cramer, F. H., 1964b, Microplankton from three Palaeozoic formations in the Province of León, NW Spain: Leidse Geologische Mededelingen, v. 30, p. 253–361.

Cramer, F. H., 1970, Distribution of selected Silurian acritarchs: An account of the palynostratigraphy and paleogeography of selected Silurian acritarch taxa: Revista Española de Micropaleontología, p. 1–203.

Cramer, F. H., and M. del C. R. Díez, 1972, Acritarchs from the upper Middle Cambrian Oville Formation of León, northwestern Spain: Revista Española de Micropaleontologia, no. Número extraordinario, XXX Aniversario E. N. Adaro, p. 39–50.

Cramer, F. H., and M. del C. R. Díez, 1979, Lower Paleozoic acritarchs [Acritarcos del Paleozoico Inferior]: Léon, Spain, Instituto de Investigaciones Palinológicas, Apartado 244, p. 17–160.

Dean, W. T., and F. Martin, 1978, Lower Ordovician acritarchs and trilobites from Bell Island, eastern Newfoundland: Geological Survey of Canada, Geological Survey of Canada, Bulletin 284, 35 p.

Dean, W. T., and F. Martin, 1982, The sequence of trilobite faunas and acritarch microfloras at the Cambrian-Ordovician boundary, Wilcox Pass, Alberta, Canada, *in* M. G. Basset, and W. T. Dean, eds., The Cambrian-Ordovician Boundary: Sections, Fossil Distribution, and Correlations: Cardiff, National Museum of Wales, Geological Series 3, p. 131–140.

Deflandre, G., 1935, Considérations biologiques sur les microorganismes d’origine planctonique conservés dans les silex de la craie: Bulletin biologique de la France et de la Belgique, v. 69, p. 213–244.

Deflandre, G., 1937, Microfossiles des silex crétacés. Deuxième partie. Flagellés *incertae sedis*. Hystrichosphaeridés. Sarcodinés. Organismes divers: Annales de Paléontologie, v. 26, p. 51–103.

Deflandre, G., 1938, Microplankton des mers jurassiques conservé dans les marnes de Villers-sur-Mer (Calvados): Étude liminaire et considérations générales. Travaux de la Station zoologique de Wimereux, v. 13, p. 147–200.

Deflandre, G., 1945, Microfossiles des calcaires siluriens de la Montagne Noire: Annales de paléontologie, v. 31, p. 41–75.

Deflandre, G., 1954, Systématique des Hystrichosphaeridés: sur l'acception du genre *Cymatiosphaera* O. Wetzel: Compte Rendu sommaire des Séances de la Société géologique de France, v. 12, p. 257–258.

Deflandre, G., 1968, Sur l'existence, des le Precambrian, d'Acritarches du type Acanthomorphitae: *Eomicrhystridium* nov. gen. Typification du genre *Palaeocryptidium* Defl. 1955: Comptes Rendus des Séances de l'Academie des Sciences, v. 266, p. 2385–2389.

Deflandre, G., and M. Deflandre-Rigaud, 1962, Nomenclature et systématique des Hystrichosphères (sens. lat.). Observations et rectifications: Review Micropaléontologie, v. 4, no. 4, p. 190–196.

Deflandre, G., and M. Deflandre-Rigaud, 1965, Fichier micropaléontologique général, Série 13. Acritarches II. Acanthomorphitae I. Genre *Micrhystridium* Deflandre sens. lat.: Archives originales, Centre de documentation, Centre national de la recherche scientifique, v. 402, p. 2176–2521.

Deunff, J., 1951, Sur la présence de microorganismes (Hystrichosphères) dans les schistes ordoviciens du Finistère: Comptes rendus hebdomadaires des séances de l'Académie des sciences, v. 233, no. 4, p. 321–323.

Deunff, J., 1954a, Sur un microplancton du Dévonien du Canada recélant des types nouveaux dHystrichosphaeridés: Compte Rendu Hebdomadaire des Séances de I'Académie des Sciences, v. 239, no. 17, p. 1064–1066.

Deunff, J., 1954b, Microorganismes planctoniques (Hystrichosphères) dans le Dévonien du Massif armoricain: Compte rendu sommaire de la Société géologique de France, v. 4, p. 239–242.

Deunff, J., 1954c, *Veryhachium*, genre nouveau d'Hystrichosphères du Primaire: Compte rendu sommaire des séances de la Société géologique de France, v. 13, p. 305–306.

Deunff, J., 1959, Microorganismes planctoniques du primaire Armoricain. I.- Ordovicien du Veryhac'h (presqu'ile de Crozon): Bulletin de la Société géologique et mineralogique de Bretagne, v. 2, no. 2, p. 1–41.

Deunff, J., 1961a, Un microplancton à Hystrichosphères dans le Trémadoc du Sahara: Revue de micropaléontologie, v. 4, no. 1, p. 37–52.

Deunff, J., 1961b, Quelques précisions concernant les Hystrichosphaeridées du Dévonien du Canada: Comptes rendus sommaire des séances de la Société Géologique de France, v. 8, p. 216–218.

Deunff, J., 1964, Systématique du microplancton fossile à Acritarches. Révision de deux genres de l'Ordovicien inférieur: Revue de micropaléontologie, v. 7, no. 2, p. 119–124.

Deunff, J., 1967, Recherches sur les microplanctons du Dévonien (Acritarches et Dinophyceae):

Bulletin de la Société géologique et mineralogique de Bretagne, p. 17–25.

Deunff, J., 1968a, *Arbusculidium*, genre nouveau d'acritarche du Trémadocien marocain: Compte rendu sommaire des séances de la Société géologique de France, v. 3, p. 101–102.

Deunff, J., 1968b, Sur une forme nouvelle d'Acritarche possédant une ouverture polaire (*Veryhachium miloni* n. sp.) et sur la présence d'une colonie de *Veryhachium* dans le Trémadocien marocain: Comptes rendus des Séances de l'Académie des Sciences, v. 267, p. 46–49.

Deunff, J., 1971, Le genre *Polyedryxium* Deunff. Revision et observations, *in* Microfossiles organiques du Paleozoique, 3. Acritarches: Paris, Commission internationale de microflore du Paléozoique, Editions du Centre national de la recherche scientifique, p. 7–49.

Deunff, J., H. Górka, and R. Rauscher, 1974, Observations nouvelles et précisions sur les acritarches a large ouverture polaire du paleozoique inférieur: Geobios, v. 7, no. 1, p. 5–18, doi:10.1016/S0016-6995(74)80016-1.

Di Milia, A., 1991, Upper Cambrian acritarchs from the Solanas Sandstone Formation, central Sardinia, Italy: Bollettino della Società Paleontologica Italiana, v. 30, no. 2, p. 127–152.

Di Milia, A., C. Ribecai, and M. Tongiorgi, 1989, Late Cambrian acritarchs from the *Peltura scarabaeoides* Trilobite Zone at Degerhamn (Öland, Sweden): Palaeontogr. Ital., v. 76, p. 1–56.

Ding, L., Y. Li, and H. Chen, 1992, Discovery of *Micrhystridium regulare* from Sinian–Cambrian boundary strata in Yichang, Hubei, and its stratigraphic significance: Acta Micropalaeontologica Sinica, v. 9, no. 3, p. 303–309.

Dong, L., S. Xiao, B. Shen, C. Zhou, G. Li, and J. Yao, 2009, Basal Cambrian Microfossils from the Yangtze Gorges Area (South China) and the Aksu Area (Tarim Block, Northwestern China): Journal of Paleontology, v. 83, no. 1, p. 30–44, doi:10.1666/07-147R.1.

Downie, C., 1958, An assemblage of microplankton from the Shineton Shales (Tremadocian): Proceedings of the Yorkshire Geological and Polytechnic Society, v. 31, p. 331–350.

Downie, C., 1959, Hystrichospheres from the Silurian Wenlock Shale of England: Palaeontology, v. 2, no. 1, p. 56–71.

Downie, C., 1960, *Deunffia* and *Domasia*, new genera of hystrichospheres: Micropaleontology, v. 6, no. 2, p. 197–202.

Downie, C., 1963, “Hystrichospheres” (Acritarchs) and Spores of the Wenlock Shales (Silurian) of Wenlock, England: Palaeontology, v. 6, no. 4, p. 625–652.

Downie, C., 1982, Lower Cambrian acritarchs from Scotland, Norway, Greenland and Canada:

Transactions of the Royal Society of Edinburgh, v. 72, no. 4, p. 257–285, doi:10.1017/S0263593300010051.

Downie, C., and W. A. S. Sarjeant, 1963, On the interpretation and status of some hystrichosphere genera: Palaeontology, v. 6, no. 1, p. 83–96.

Downie, C., and W. A. S. Sarjeant, 1965, Bibliography and index of fossil dinoflagellates and acritarchs: Geological Society of America, Memoir, v. 94, p. 1–180.

Eisenack, A., 1931, Neue Mikrofossilien des baltischen Silurs. I.: Palaeontologische Zeitschrift, v. 13, no. 1-2, p. 74–118.

Eisenack, A., 1934, Neue Mikrofossilien des baltischen Silurs. III. und neue Mikrofossilien des böhmischen Silurs. I: Paläontologische Zeitschrift, v. 16, no. 1-2, p. 52–76.

Eisenack, A., 1938a, Hystrichosphaerideen und verwandte Formen im baltischen Silur: Zeitschrift für Geschiebeforschung und Flachlandsgeologie, v. 14, no. 1, p. 1–30.

Eisenack, A., 1938b, Neue Mikrofossilien des baltischen Silurs. IV: Palaeontologische Zeitschrift, v. 19, no. 3-4, p. 217–243, doi:10.1007/BF03042242.

Eisenack, A., 1955, Chitinozoen, Hystrichosphären und andere Mikrofossilien aus dem *Beyrichia*-Kalk: Senckenbergiana Lethaea, v. 36, no. 1-2, p. 157–188.

Eisenack, A., 1958a, *Tasmanites* Newton 1875 und *Leiosphaeridia* n.g. als Gattungen der Hystrichosphaeridea: Palaeontographica Abt. A, v. 110, no. 1-3, p. 1–19.

Eisenack, A., 1958b, Mikrofossilien aus dem Ordovizium des Baltikums, 1. Markasitschicht, *Dictyonema*-Schiefer, Glaukonitsand, Glaukonitkalk: Senckenbergiana Lethaea, v. 39, no. 5-6, p. 389–405.

Eisenack, A., 1958c, Mikroplankton aus dem norddeutschen Apt nebst einigen Bemerkungen über fossile Dinoflagellaten: Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, v. 106, no. 3, p. 383–422.

Eisenack, A., 1959, Neotypen baltischer Silur-Hystrichospären und neue Arten: Palaeontographica Abt. A, v. A112, no. 5-6, p. 193–211.

Eisenack, A., 1963, Mitteilungen zur Biologie der Hystrichosphären und über neue Arten: Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, v. 118, no. 2, p. 207–216.

Eisenack, A., 1965a, Die Mikrofauna der Ostseekalke. 1. Chitinozoen, Hystrichosphären: Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, v. 123, no. 2, p. 115–148.

Eisenack, A., 1965b, Mikrofossilien aus dem Silur Gotlands. Hystrichosphären, Problematika: Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, v. 122, no. 3, p. 257–274.

Eisenack, A., 1968, Mikrofossilien eines Geschiebes der Borkholmer Stufe, baltisches Ordovizium, F2: Mitteilungen aus dem Geologischen Staatsinstitut in Hamburg, v. 37, p. 81–94.

Eisenack, A., 1969, Zur Systematik einiger paläozoischer Hystrichosphären (Acritarcha) des baltischen Gebietes: Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, v. 133, no. 3, p. 245–266.

Eisenack, A., 1972, Kritische Bemerkung zur Gattung *Pterospermopsis* (Chlorophyta, Prasinophyceae): Neues Jahrbuch für Geologie und Paläontologie, Monatshefte, v. 10, p. 596–601.

Eisenack, A., 1976, Mikrofossilien aus dem Vaginatenkalk von Hälludden, Öland: Palaeontographica, v. A154, no. 4-6, p. 181–203.

Eisenack, A., F. H. Cramer, and M. del C. R. Díez, 1973, Katalog der fossilen Dinoflagellaten, Hystrichosphären und verwandten Mikröfossilien. Band III Acritarcha 1. Teil: E. Schweizerbart’sche Verlagsbuchhandlung, Stuttgart, 1104 p.

Eisenack, A., F. H. Cramer, and M. del C. R. Díez, 1976, Katalog der fossilen Dinoflagellaten, Hystrichosphären und verwandten Mikrofossilien. Band IV Acritarcha 2. Teil: Stuttgart, E. Schweizertbart’sche Verlagsbuchhandlung, 863 p.

Eisenack, A., F. H. Cramer, and M. del C. R. Díez, 1979, Katalog der fossilen Dinoflagellaten, Hystrichosphären und verwandten Mikröfossilien. Band V Acritarcha 3. Teil: E. Schweizerbart’sche Verlagsbuchhandlung, Stuttgart, 529 p.

Eiserhardt, K. H., 1989, Baltisphären aus Gotländer Öjlemyrflint (Acritarcha, Oberordoviz, Geschiebe, Schweden): Mitteilungen aus dem Geologisch-Paläontologischen Institut der Universität Hamburg, v. 68, p. 79–129.

Eiserhardt, K.-H., 1992, Die Acritarcha des Öjlemyrflintes: Palaeontographica Abt. B, v. 226, no. 1-6, p. 1–132.

Eklund, C., 1990, Lower Cambrian acritarch stratigraphy of the Bårstad 2 core, Östergötland, Sweden: Geologiska Föreningen i Stockholm Förhandlingar, v. 112, no. 1, p. 19–44, doi:10.1080/11035899009453157.

Elaouad-Debbaj, Z., 1988, Acritarches et chitinozoaires du Trémadoc de l’Anti-Atlas central (Maroc): Revue de micropaléontologie, v. 31, no. 2, p. 85–128.

Fatka, O., and M. Konzalová, 1995, Microfossils of the Paseky Shale (Lower Cambrian, Czech Republic): Journal of the Czech Geological Society, v. 40, no. 4, p. 55–66.

Fensome, R. A., G. L. Williams, M. S. Barss, J. M. Freeman, and J. M. Hill, 1990, Acritarchs and fossil prasinophytes: an index to genera, species and infraspecific taxa: American Association of Stratigraphic Palynologists Foundation, AASP Contributions Series 25, 771 p.

Fombella, M. A., 1977, Acritarcos de Edad Cambrico Medio—Inferior de la Provincia de León, España: Revista Española de Micropaleontología, v. 9, no. 1, p. 115–124.

Fombella, M. A., 1978, Acritarcos de la Formación Oville, edad Cámbrico Medio-Tremadoc, Provincia de León, España: Palinología, v. 1, p. 245–261.

Fombella, M. A., 1979, Palinología de la Formación Oville al Norte y Sur de la Cordillera Cantabrica, España: Palinología, v. 1, p. 1–15.

Foster, C. B., J. D. Reed, and R. Wicander, 1989, *Gloeocapsomorpha prisca* Zalessky, 1917: A new study: Part I: Taxonomy, Geochemistry, and paleoecology: Geobios, v. 22, no. 6, p. 735–759, doi:10.1016/S0016-6995(89)80070-1.

Fridriksone, A. I., 1971, Akritarkhi *Baltisphaeridium* i gistrikhosfery (?) iz kembriiskikh otlozhenii Latvii [Acritarchs of the genus Baltisphaeridium and hystrichosphaerids (?) from Cambrian rocks of Latvia], *in* Paleontologiya i Stratigrafiya Pribaltiki i Belorussii: Vilnius, Lithuanian Science ResearchResearch, Geological Survey Institute, sbornik III, p. 5–22.

Gardiner, P. R. R., and M. Vanguestaine, 1971, Cambrian and Ordovician microfossils from south-east Ireland and their implications: Bull. geol. Surv. Ireland, v. 1, no. 2, p. 163–210.

German, T. N., 1974, Mikrofossilii glaukonitovykh sloev (dannye issledovaniya kerna Vologodskoi opornoi skvazhiny) [Microfossils of glauconite layers (data resulting from an investigation of a core from a borehole near Vologda)], *in* Mikrofossilii Proterozoya i Rannego Palezoya SSSR [Plant microfossils of the Proterozoic and Early Palaeozoic of the USSR]: Leningrad, Akademiya Nauk SSSR, p. 20–22.

Górka, H., 1967, Quelques nouveaux acritarches des silexites du Trémadocien supérieur de la region de Kielce (Montagne de Ste. Croix, Pologne): Cahiers de Micropaléontologie, no. 6, p. 1–8.

Górka, H., 1969, Microorganismes de l'Ordovicien de Pologne: Palaeontologia Polonica, v. 22, p. 1–102.

Gravestock, D. I. et al., 2001, The Cambrian biostratigraphy of the Stansbury Basin, South Australia: Moscow, IAPC "Nauka/Interperiodica," Transactions of the Palaeontological Institute 282, 344 p.

Grenfell, H. R., 1995, Probable fossil zygnematacean algal spore genera: Review of Palaeobotany and Palynology, v. 84, no. 3–4, p. 201–220, doi:10.1016/0034-6667(94)00134-6.

Guy-Ohlson, D., 1996, Chapter 7B. Prasinophycean algae, *in* J. Jansonius, and D. C. McGregor, eds., Palynology: Principles and Applications: Salt Lake City, American Association of Stratigraphic Palynologists Foundation. Publishers Press, p. 181–189.

Hagenfeldt, S. E., 1989a, Lower Cambrian acritarchs from the Baltic Depression and south-central Sweden, taxonomy and biostratigraphy: Stockholm contributions in geology, v. 41, p. 1–176.

Hagenfeldt, S. E., 1989b, Middle Cambrian acritarchs from the Baltic Depression and south-central Sweden, taxonomy and biostratigraphy: Stockholm contributions in geology, v. 41, p. 177–250.

Hemer, D. O., and P. W. Nygreen, 1967, Algae, acritarchs and other microfossils *incertae sedis* from the lower Carboniferous of Saudi Arabia: Micropaleontology, v. 13, no. 2, p. 183–194.

Le Hérissé, A., 1989, Acritarches et kystes d'algues Prasinophycées du Silurien de Gotland, Suède: Palaeontographia Italica, v. 76, p. 57–302.

Hofmann, H. J., and J. D. Aitken, 1979, Precambrian biota from the Little Dal Group, Mackenzie Mountains, northwestern Canada: Canadian Journal of Earth Sciences, v. 16, no. 1, p. 150–166, doi:10.1139/e79-014.

Hu, Y., 1986, Micropalaeoflora from the Early Ordovician in Gaoqiao Region of Shaanxi and its stratigraphic significance: Bulletin of Xi'an Institute of Geology and Mineral Resources, Chinese Academy of Geological Sciences, v. 14, p. 199–239.

Ishchenko, A. M., 1952, Atlas mikrospor i pyltsy srednego karbona zapadnoy chasti Donetskogo basseyna [Atlas of the microspores and pollen of the Middle Carboniferous of the western part of the Donets Basin]: Izvestia Akademiia Nauk Ukrainskoi SSR, p. 1–81.

Jachowicz-Zdanowska, M., 2013, Cambrian phytoplankton of the Brunovistulicum–taxonomy and biostratigraphy: Polish Geological Institute Special Papers, v. 28, p. 1–150.

Jacobson, S. R., and A. Achab, 1985, Acritarch biostratigraphy of the *Dicellograptus complanatus* graptolite zone from the Vaureal formation (Ashgillian), Anticosti Island, Quebec, Canada: Palynology, v. 9, no. 1, p. 165–198, doi:10.1080/01916122.1985.9989294.

Jagielska, L., 1965, Nowe dane o mikroflorze eokambru i najniższego kambru antyklinorium klimontowskiego [New data on the Eocambrian and lowermost Cambrian microflora from the Klimontów Anticlinorium]: Kwartalnik Geologiczny, v. 9, p. 499–509.

Jago, J. B., W. Zang, X. Sun, G. A. Brock, J. R. Paterson, and C. B. Skovsted, 2006, A review of the Cambrian biostratigraphy of South Australia: Palaeoworld, v. 15, no. 3–4, p. 406–423, doi:10.1016/j.palwor.2006.10.014.

Jankauskas, T. V., 1975, Novye akritarkhi nizhnego kembriya Pribaltiki [New Lower Cambrian acritarchs of the Baltic region]: Paleontologicheskii Zhurnal, v. 9, no. 1, p. 94–104.

Jankauskas, T. V., 1976, Novye vidy akritarkh iz nizhnego kembriya Pribaltiki. [New acritarch species from the Lower Cambrian of the Peribaltic.], *in* I. T. Zhuravleva, ed., Stratigrafiya i Paleontologiya Nizhnego i Srednego Kembriya SSSR: Akademiya Nauk SSSR, Sibirskoe

Otdelenie, Institut Geologii i Geofiziki, Novosibirsk, Trudy, 296, p. 187–192.

Jankauskas, T. V., 1979, Srednerifeyskaya mikrobiota yuzhnogo Urala i Bashkirskogo Priuralya [Middle Riphean microbiota from the southern Urals and the Bashkirian Urals]: Akademiya Nauk SSSR (Doklady Earth Science Sections), v. 248, no. 1, p. 190–193.

Jankauskas, T. V., 1980, Novyye vodorosli iz verkhnego rifeya Yuzhnogo Urala i Priural'ya [New algae from the Upper Riphean of the Southern Urals and the Ural forelands]: Paleontologicheskii Zhurnal, v. 4, p. 107–113.

Jankauskas, T. V., 1982, Plant microfossils from the Upper Precambrian and Cambrian of the European part of the USSR, and their stratigraphic significance, Thesis: Akademiya Nauk SSSR, 52 p.

Jankauskas, T. V., 2002, Cambrian stratigraphy of Lithuania: Vilnius, Insitute of Geology of Lithuania, Vilnius University, 256 p.

Jankauskas, T. V., N. S. Mikhailova, and T. N. Germann, 1989, Precambrian microfossils of the USSR, *in* 1-191, Nauka, Leningrad: Acad. Sci. USSR.

Jankauskas, T. V., and E. Posti, 1976, Novye vidy akritarkh kembriya Pribaltiki [New Cambrian acritarchs from the East Baltic area]: Eesti NSV Teaduste, Akadeemia Toimetised, Geologia, v. 25, no. 2, p. 145–151.

Jankauskas, T. V., and G. K. Vaitekunene, 1972, Akritarkhi iz silura Pribaltiki: Paleontologicheskii Zhurnal, v. 2, p. 113–121.

Jansonius, J., 1962, Palynology of Permian and Triassic sediments, Peace river area, western Canada: Palaeontographica Abt. B, v. 110, no. 1-4, p. 35–98.

Jardiné, S., A. Combaz, L. Magloire, G. Peniguel, and G. Vachey, 1972, Acritarches du Silurien terminal et du Dévonien du Sahara Algérien, *in* Comptes rendus, Krefeld: p. 295–311.

Jardiné, S., A. Combaz, L. Magloire, G. Peniguel, and G. Vachey, 1974, Distribution stratigraphique des acritarches dans le paléozoïque du sahara algérien: Review of Palaeobotany and Palynology, v. 18, no. 1–2, p. 99–129, doi:10.1016/0034-6667(74)90012-8.

Kiryanov, V. V., 1974, Novye akritarkhi iz kembriyskikh otlozhenii Volyni [New acritarchs from the Volynian Cambrian]: Paleontologicheskii Zhurnal, v. 8, no. 2, p. 117–129.

Kiryanov, V. V., 1978, Akritarchi silura volyno-podolii: Kiev, Naukova Dumka, 116 p.

Kjellström, G., 1971a, Ordovician microplankton (baltisphaerids) from the Grötlingbo borehole No. 1 in Gotland, Sweden: Sveriges Geologiska Undersökning, v. 655, 65, no. 1, p. 1–75.

Kjellström, G., 1971b, Middle Ordovician microplankton from the Grötlingbo borehole No. 1 in

Gotland, Sweden: Sveriges Geologiska Undersökning, v. 669, 65, no. 15, p. 1–35.

Knoll, A. H., and K. Swett, 1987, Micropaleontology across the Precambrian-Cambrian boundary in Spitsbergen: Journal of Paleontology, v. 61, no. 5, p. 898–926.

Konzalová-Mazancová, M., 1969, *Acritarcha* Evitt 1963 aus dem Unter-Ashgill Böhmens: Palaeontographica Abt. B, v. 125, no. 1-3, p. 81–92.

Kowalski, W. R., 1983, Stratigraphy of the Upper Precambrian and lowest Cambrian strata in southern Poland: Acta Geologica Polonica, v. 33, no. 4, p. 183–218.

Lindgren, S., 1982, Algal coenobia and leiospheres from the Upper Riphean of the Turukhansk region, eastern Siberia: Acta Universitatis Stockholmiensis, Stockholm Contributions in Geology, v. 38, no. 3, p. 35–45.

Lister, T. R., 1970, A monograph of the acritarchs and chitinozoa from the Wenlock and Ludlow Series of the Ludlow and Millichope areas, Shropshire: Palaeontographical Society, Palaeontographical Society, Monographs 124 (publication 528), 100 p.

Lo, S.-C. C., 1980, Microbial fossils from the lower Yudoma Suite, earliest Phanerozoic, eastern Siberia: Precambrian Research, v. 13, no. 2–3, p. 109–166, doi:10.1016/0301-9268(80)90002-9.

Loeblich Jr., A. R., 1970, Morphology, ultrastructure and distribution of Paleozoic acritarchs, *in* Proceedings of the North American Paleontological Convention, Chicago (1969): p. 705–788.

Loeblich Jr, A. R., and W. S. Drugg, 1968, New acritarchs from the Early Devonian (late Gedinnian) Haragan Formation of Oklahoma, USA: Tulane Studies in Geology, v. 6, no. 4, p. 129–137.

Loeblich Jr, A. R., and H. Tappan, 1969, Acritarch excystment and surface ultrastructure with descriptions of some Ordovician taxa: Rev. Esp. Micropaleontol, v. 1, no. 1, p. 45–57.

Loeblich Jr., A. R., and H. Tappan, 1976, Some new and revised organic-walled phytoplankton microfossil genera: Journal of Paleontology, v. 50, no. 2, p. 301–308.

Loeblich Jr., A. R., and H. Tappan, 1978, Some middle and late ordovician microphytoplankton from Central North America: Journal of Paleontology, v. 52, no. 6, p. 1233–1287.

Loeblich Jr., A. R., and E. R. Wicander, 1976, Organic-walled microplankton from the Lower Devonian (Late Gedinnian) Haragan and Bois d'Arc Formations of Oklahoma, USA: Palaeontographica Abt. B, v. 159, no. 1-3, p. 1–39.

Lopukhin, A. S., 1971, Novye mikrofossilii iz dokembriya Tyan-Shanya: Izvestiya Vysshikh Uchebnikh Zavedenii, Geologiya i Razvedka, v. 3, p. 156–158.

Maithy, P. K., 1975, Micro-organisms from the Bushimay System (Late Pre-cambrian) of Kanshi, Zaire: The Palaeobotanist, v. 22, no. 2, p. 133–149.

Martin, F., 1969, Les acritarches de l'Ordovicien et du Silurien belges: Détermination et valeur stratigraphique: Institut royal des sciences naturelles de Belgique, Mémoires, v. 160, p. 1–175.

Martin, F., 1972, Les acritarches de l'Ordovicien inférieur de la Montagne Noire (Herault, France): Bulletin de l'Institut royal des sciences naturelles de Belgique, Sciences de la terre, v. 48, no. 10, p. 1–61.

Martin, F., 1973, Ordovicien supérieur et Silurien inférieur à Deerlijk (Belgique). Palynofaciès et microfaciès: Institut royal des sciences naturelles de Belgique, Mémoires, v. 174, p. 1–71.

Martin, F., 1975, Acritarches du Cambro-Ordovicien du Massif du Brabant, Belgique: Bulletin de l'Institut royal des sciences naturelles de Belgique, Sciences de la terre, v. 51, no. 1, p. 1–33.

Martin, F., 1984, New Ordovician (Tremadoc) acritarch taxa from the middle member of the Survey Peak Formation at Wilcox Pass, southern Canadian Rocky Mountains, Alberta: Geological Survey of Canada, Current Research, Part A, Paper, v. 84-1A, p. 441–448.

Martin, F., 1992, Uppermost Cambrian and lower Ordovician acritarchs and lower Ordovician chitinozoans from Wilcox Pass, Alberta: Ottawa, Geological Survey of Canada, Bulletin 420, 57 p.

Martin, F., and W. T. Dean, 1981, Middle and Upper Cambrian and Lower Ordovician acritarchs from Random Island, eastern Newfoundland: Ottawa, Geological Survey of Canada, Bulletin 343, 43 p.

Martin, F., and W. T. Dean, 1983, Late Early Cambrian and early Middle Cambrian acritarchs from Manuels River, eastern Newfoundland: Current Research, Part B, Geological Survey of Canada, v. Paper 83, no. 1B, p. 353–363.

Martin, F., and W. T. Dean, 1984, Middle Cambrian acritarchs from the Chamberlains Brook and Manuels River formations at Random Island, eastern Newfoundland: Current Research, Part A, Geological Survey of Canada, v. Paper 84, no. 1A, p. 429–440.

Martin, F., and W. T. Dean, 1988, Middle and Upper Cambrian acritarch and trilobite zonation at Manuels River and Random Island, eastern Newfoundland: Energy, Mines and Resources Canada, Geological Survey of Canada, Bulletin 381, 91 p.

Martin, F., and L. Yin, 1988, Early Ordovician acritarchs from southern Jilin province, northeast China: Palaeontology, v. 31, no. 1, p. 109–127.

Mikhailova, N. S., 1986, Novye nakhodki mikrofitofossilij iz otlozhenij verkhnego rifeya Krasnoyarskogo kraya [New occurrences of microphytofossils from the Upper Riphean of the Krasnoyarsk region], *in* B. S. Sokolov, ed., Aktual'nye Voprosy Sovremennoj Paleoal'gologii [Curent Questions in Contemporary Paleoalgology]: Kiev, Naukova Dumka, p. 31–37.

Moczydłowska, M., 1988, New Lower Cambrian acritarchs from Poland: Review of Palaeobotany and Palynology, v. 54, no. 1–2, p. 1–10, doi:10.1016/0034-6667(88)90002-4.

Moczydłowska, M., 1991, Acritarch biostratigraphy of the Lower Cambrian and the Precambrian-Cambrian boundary in southeastern Poland: Universitetsforl. Oslo, Fossils and Strata 29, 127 p.

Moczydłowska, M., 1998, Lower Cambrian acritarch biochronology in Baltoscandia: p. 9–16.

Moczydłowska, M., and T. P. Crimes, 1995, Late Cambrian acritarchs and their age constraints on an Ediacaran-type fauna from the Booley Bay Formation, Co. Wexford, Eire: Geological Journal, v. 30, no. 2, p. 111–128, doi:10.1002/gj.3350300203.

Moczydłowska, M., and M. Stockfors, 2004, Acritarchs from the Cambrian–Ordovician boundary interval on Kolguev Island, Arctic Russia: Palynology, v. 28, no. 1, p. 15–73.

Moczydłowska, M., and G. Vidal, 1986, Lower Cambrian acritarch zonation in southern Scandinavia and southeastern Poland: Geologiska Föreningen i Stockholm Förhandlingar, v. 108, no. 3, p. 201–223, doi:10.1080/11035898609454685.

Moczydłowska, M., and G. Vidal, 1988, Early Cambrian acritarchs from Scandinavia and Poland: Palynology, v. 12, no. 1, p. 1–10, doi:10.1080/01916122.1988.9989333.

Molyneux, S. G., 1987, II. Appendix. Acritarchs and chitinozoa from the Arenig Series of south-west Wales: Bulletin of the British Museum, Natural History, Geology, v. 41, no. 3, p. 309–364.

Molyneux, S. G., and A. W. A. Rushton, 1988, The age of the Watch Hill Grits (Ordovician), English Lake District: structural and palaeogeographical implications: Earth and Environmental Science Transactions of the Royal Society of Edinburgh, v. 79, no. 01, p. 43–69, doi:10.1017/S0263593300014097.

Moorman, M., 1974, Microbiota of the Late Proterozoic Hector Formation, southwestern Alberta, Canada: Journal of Paleontology, v. 48, no. 3, p. 524–539.

Morbey, S. J., 1975, The Palynostratigraphy of the Rhaetian Stage, Upper Triassic in the Kendelbachgraben, Austria: Palaeontographica Abt. B, v. 152, no. 1-3, p. 1–75.

Muir, M. D., 1977, Late Precambrian Microfossils: Geological Magazine, v. 114, no. 5, p. 395–397, doi:10.1017/S0016756800036712.

Mullins, G. L., 2001, Acritarchs and prasinophyte algae of the Elton Group, Ludlow Series, of the type area: Monograph of the Palaeontographical Society, v. 155, no. publication no. 616, p. 1–154.

Naumova, S. N., 1939, Spores and pollen of the coals of the USSR, *in* Report of the XVII International Geological Congress, 1937: p. 353–364.

Naumova, S. N., 1949, Obshchaya morfologicheskaya kharakteristika spor nizhnego kembriya [The general morphological characteristic of the Lower Cambrian spores]: Izvestiya Akademiya Nauk SSSR, Seriya Geologicheskaya, v. 4, p. 49–56.

Naumova, S. N., 1950, Spory nizhnego silura [Spores of the Lower Silurian], *in* Moscow: Geograficheskii Facultet, Izdatelstvo Moskovskogo Universiteta, p. 165–190.

Naumova, S. N., 1961, Sporovo-pyltsevye kompleksy rifeiskikh i nizhne kembriiskikh otlozhenii SSSR [Spore-pollen complexes of the Riphean and Lower Cambrian in USSR], *in* Doklady Soviet Geologists, Copenhagen: p. 109–117.

Naumova, S. N., 1968, Zonal’nye kompleksy rastitel’nykh mikrofossiliy dokembriya i nizhnego kembriya Evrazii i ikh stratigraficheskoe znachenie [Zonal assemblages of Precambrian and Lower Cambrian plant microfossils of Eurasia and their stratigraphic significance], *in* Stratigrafia Nizhnego Paleozoya Tsentralnoi Evropy [Stratigraphy of the Lower Palaeozoic of central Europe]: Mezhdunarodnyi Geologicheskii Kongres, XXIII Sessiya, Doklady Sovetskikh Geologov, Problema, p. 30–39.

Nautiyal, A. C., 1983, Algonkian (upper to middle) micro-organisms from the Semri Group of Son Valley (Mirzapur distr.), India: Geoscience journal, v. 4, no. 2, p. 169–198.

Newton, E. T., 1875, “Tasmanite” and Australian “White Coal:” Geological Magazine, v. Decade II, 2, no. 8, p. 337–342, doi:10.1017/S001675680016008X.

Norris, G., and W. A. S. Sarjeant, 1965, A descriptive index of genera of fossil Dinophyceae and Acritarcha: New Zealand Geological Survey, Paleontological Bulletin, v. 40, p. 1–72.

Paalits, I., 1992a, Upper Cambrian acritarchs from boring core M-72 of North Estonia: Proceedings of the Estonian Academy of Sciences, v. 41, p. 29–37.

Paalits, I., 1992b, Upper Cambrian acritarchs from the Petseri Formation (East European Platform): Acta et Commentationes Universitatis Tartuensis, v. 956, p. 44–55.

Paalits, I., 1995, Acritarchs from the Cambrian–Ordovician boundary beds at Tõnismägi, Tallinn, North Estonia: Proceedings of the Estonian Academy of Sciences. Geology, v. 44, no. 2, p. 87–96.

Paalits, I., 2005, Distribution of Furongian (Upper Cambrian) organic-walled microfossils, *in* A. Põldvere, ed., Mehikoorma (421) Drill Core: Tallinn, Geological Survey of Estonia, Estonian Geological Sections 6, p. 30–31.

Palacios, T., 2008, Middle Cambrian acritarch zones in the Oville Formation and their correlation with trilobite zones in the Cantabrian Mountains, northern Spain: Advances in Trilobite Research, Cuadernos del Museo Geominero, v. 9, p. 289–295.

Palacios, T., 2010, Middle–Upper Cambrian acritarchs from the Oville and Barrios Formations, Cantabrian Mountains, northern Spain, *in* Abstracts, Warsaw: p. 50–53.

Palacios, T., S. Jensen, S. M. Barr, and C. E. White, 2009, Acritarchs from the MacLean Brook Formation, southeastern Cape Breton Island, Nova Scotia, Canada: New data on Middle Cambrian–Lower Furongian acritarch zonation: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 273, no. 1–2, p. 123–141, doi:10.1016/j.palaeo.2008.12.006.

Palacios, T., and G. Vidal, 1992, Lower Cambrian acritarchs from northern Spain: the Precambrian-Cambrian boundary and biostratigraphic implications: Geological Magazine, v. 129, no. 4, p. 421–436, doi:10.1017/S0016756800019518.

Paris, F., and J. Deunff, 1970, Le paleoplancton Llanvirnien de la Roche-au-Merle (Commune de Vieux-Vy-sur-Couesnon, Ille-et-Vilaine): Bulletin de la Société Géologique et Mineralogique de Bretagne, sér. C, v. 2, no. 1, p. 25–43.

Parsons, M. G., and M. M. Anderson, 2000, Acritarch microfloral succession from the Late Cambrian and Ordovician (early Tremadoc) of Random Island, eastern Newfoundland, and its comparison to coeval microfloras, particularly those of the East European Platform: Dallas, Texas, American Association of Stratigraphic Palynologists Foundation, AASP Contributions Series 38, 138 p.

Paškevičienė, L. T., 1980, Akritarkhi pogranichnykh otlozhenii venda i kembriya Zapada Bostochno-Evropeyskoi platformy [Acritarchs of the Vendian and Cambrian boundary deposits of the western part of the East European Platform]: Akademiya Nauk SSSR, Izdatelstvo Nauka, Moskva, p. 1–74.

Pittau, P., 1985, Tremadocian (Early Ordovician) acritarchs of the Arburese Unit, Southwest Sardinia (Italy): Bollettino della Società Paleontologica Italiana, v. 23, no. 2, p. 161–204.

Pocock, S. A. J., 1972, Palynology of the Jurassic Sediments of Western Canada. Part 2. Marine Species: Palaeontographica Abt. B, v. 137, no. 4-6, p. 85–153.

Potonié, R., 1958, Synopsis der Gattungen der Sporae dispersae. II. Teil: Sporites (Nachträge), Saccites, Aletes, Praecolpates, Polyplicates, Monocolpates: Geologisches Jahrbuch, Beihefte, v. 31, p. 1–113.

Potter, T. L., 1974, The Stratigraphic Palynology of Some Cambrian Successions in North Wales, England and North-West Spain, Unpublished PhD thesis: University of Sheffield, Department of Geology.

Pozaryski, W., G. Vidal, and W. Brochwicz-Lewinski, 1981, New data on the Lower Cambrian at the southern margin of the Holy Cross Mts (SE Poland): Bulletin de l’Academie polonaise des sciences, série des sciences de la terre, v. 29, no. 2, p. 167–174.

Pyatiletov, V. G., 1978, Mikrofossilii Manskogo progiba [Microfossils of the Mansk Trough], *in* Geologicheskoe Stroenie Manskogo Progiba i Ego Poloshenie b Sayano- Altaiskikh “Baikalidakh” [Geological Constitution of Mansk Trough and its position in the Sayan-Altai “Baikalides”]: Akademiya Nauk SSSR, Sibirskoe Otdelenie, Institut Geologii i Geofiziki, Novosibirsk, Trudy 400, p. 175–211.

Pykhova, N. G., 1966, Mikrofossilii nizhnekembriyskikh i dokembriyskikh otlozheniy irkutskogo amfiteatra [Microfossils in the Lower Cambrian and Pre-cambrian of the south of eastern Siberia], *in* The Importance of Palynological Analysis for the Stratigraphic and Paleofloristic Investigations.: Academiya Nauk SSSR, Papers for the 2nd International Palynology Conference, p. 45–50.

Pykhova, N. G., 1967, Microfossils of Lower Cambrian and Precambrian deposits in eastern Siberia: Review of Palaeobotany and Palynology, v. 5, no. 1–4, p. 31–38, doi:10.1016/0034-6667(67)90206-0.

Pykhova, N. G., 1969, Akritarkhi yugo-vostoka Sibirskoi platformy, *in* A. Y. Rozanov, ed., Tommotskii yarus i problema nizhnei granitsy kembriya [Tommotian Stage and the Cambrian lower boundary problem]: Moscow, Academiya Nauk SSSR, Ordena Trudovogo Krasnogo Znameni Geologicheskii Institut, Trudy 206, p. 236–250.

Pykhova, N. G., 1973, Dokembriiskie akritarkhi Moskovskogo grabena i yuzhnogo Urala, ikh stratigraficheskoe znachenie (Precambrian acritarchs of the Moscow Graben and southern Urals and their stratigraphic significance): Bull. Moskovskogo ObshestvaIspytatelei Prirody, Otdel Geologicheskii, novaya seriya, v. 48, no. 1, p. 91–107.

Raevskaya, E., and E. Golubkova, 2006, Biostratigraphical implication of Middle–Upper Cambrian acritarchs from Severnaya Zemlya (high Arctic of Russia): Review of Palaeobotany and Palynology, v. 139, no. 1–4, p. 53–69, doi:10.1016/j.revpalbo.2005.07.010.

Raevskaya, E. G., and T. Servais, 2009, *Ninadiacrodium*: A New Late Cambrian Acritarch Genus and Index Fossil: Palynology, v. 33, no. 1, p. 219–239, doi:10.2113/gspalynol.33.1.219.

Rasul, S. M., 1974, The Lower Palaeozoic acritarchs *Priscogalea* and *Cymatiogalea*: Palaeontology, v. 17, no. 1, p. 41–63.

Rasul, S. M., 1976, New species of the genus *Vulcanisphaera* (Acritarcha) from the Tremadocian of England: Micropaleontology, v. 22, no. 4, p. 479–484.

Rasul, S. M., 1979, Acritarch zonation of the Tremadoc series of the Shineton shales, Wrekin, Shropshire, England: Palynology, v. 3, no. 1, p. 53–72.

Rauscher, R., 1973, Recherches micropaléontologiques et stratigraphiques dans l’Ordovicien et le Silurien en France: Etude des Acritarches, des Chitinozoaires et des spores: Université Louis Pasteur de Strasbourg, Institut de géologie, Mémoire, Sciences Géologiques, v. 38, p. 1–224.

Rudavskaya, V. A., 1973a, Akritarkhi pogranichnykh otlozhenii rifeya i kembriya yuga vostochnoi Sibiri [Acritarchs from the Riphean-Cambrian boundary deposits in the south of east Siberia], *in* Proceedings of the Third International Palynological Conference, Nauk: p. 17–21.

Rudavskaya, V. A., 1973b, Gruppa Acritarcha Evitt, 1963. In. Drevnie Rasteniya, *in* Novye Vidy Drevnikh Rastenii i Bespozvonochnykh SSSR [New species of the old plants and vertebrates of the USSR]: Vsesoyuznyi Neftyanoi Nauchno-Issledovatelskii Geologorazvedochnyi Institut, Leningrad (VNIGRI), Trudy 318, p. 7.

Sarjeant, W. A. S., 1968, Microplankton from the Upper Callovian and Lower Oxfordian of Normandy: Revue de micropaléontology, v. 10, no. 4, p. 221–242.

Sarjeant, W. A. S., 1967, Observations on the Acritarch genus *Micrhystridium* (Deflandre): Revue de micropaléontologie, v. 9, no. 4, p. 201–208.

Sarjeant, W. A. S., and R. P. W. Stancliffe, 1994, The *Micrhystridium* and *Veryhachium* Complexes (Acritarcha: Acanthomorphitae and Polygonomorphitae): A Taxonomic Reconsideration: Micropaleontology, v. 40, no. 1, p. 1, doi:10.2307/1485800.

Sarjeant, W. A., and R. P. Stancliffe, 1996, The acritarch genus *Polygonum*, Vavrdová emend Sarjeant and Stancliffe 1994: a reassessment of its constituent species: Annales de la Société géologique de Belgique, v. 117, no. 2, p. 355–369.

Sarjeant, W. A. S., and R. P. W. Stancliffe, 2000, Acritarch taxonomy: certain controverted questions: Modern Geology, v. 24, no. 2, p. 159–176.

Sarjeant, W. A., and M. Vavrdová, 1997, Taxonomic reconsideration of *Multiplicisphaeridium* Staplin, 1961 and other acritarch genera with branching processes: Geolines, v. 5, p. 1–52.

Schaarschmidt, F., 1963, Sporen und Hystrichosphaerideen aus dem Zechstein von Büdingen in der Wetterau: Palaeontographica Abt. B, v. 113, no. 1-4, p. 38–91.

Schopf, J. W., 1968, Microflora of the Bitter Springs formation, late Precambrian, central Australia: Journal of Paleontology, v. 42, no. 3, p. 651–688.

Shepeleva, E. D., 1962, Rastitelneiye(?) ostatki neizvestnoi systematicheskoi prinadlezhnosti iz otlozhenii Bavlinskoi serii Volgo-Uralskoi neftenosnoi probintsii [Plant(?) fossils of unknown taxonomic position from the deposits of the Bavlinskaya Series in the Volga-Urals oil province]: Dokl. Akad. Nauk SSSR, v. 142, no. 2, p. 170–171.

Shepeleva, E. D., 1963, Compleksy spor (?) iz otlozhenii Bavlinskoi serii Volgo-Uralskoi oblasti [Spore (?) complexes in deposits of the Bavlinskoy Series of the Volga Ural area], *in* Sporovo-pyltsevye Kompleksy i Stratigrafiya Verkhnego Proterozoya, Paleozoya i Mezozoya Volgo-Uralskoi Oblasti i Srednei Azii: Vsesoyuznyi Neftyanoi Nauchno-Issledovatelskii Geologorozvedochnyi Institut, Leningrad (VNIGNI), p. 7–16.

Shepeleva, E. D., and B. V. Timofeev, 1963, K mikropaleofitologicheskoj kharakteristike Pachelmskoj serii i ee stratigraficheskikh analogov: Dokl. Akad. Nauk SSSR, v. 153, no. 5, p. 1158–1159.

Shukla, M., V. C. Tewari, R. Babu, and A. Sharma, 2006, Microfossils from the Neoproterozoic Buxa Dolomite, West Siang district, Arunachal Lesser Himalaya, India and their significance: Journal of The Palaeontological Society of India, v. 51, no. 1, p. 57–73.

Slavíková, K., 1968, New finds of acritarchs in the Middle Cambrian of the Barrandian (Czechoslovakia): Věstn. Ústřed. Útav. Geol., v. 43, no. 3, p. 199–205.

Song, Z., C. He, Z. Qian, Z. Pan, G. Zheng, and Y. Zheng, 1978, On the Paleogene dinoflagellates and acritarchs from the coastal region of Bohai: Beijing, Science Press, 190 p. [referred to as "Jiabo 1978"]

Staplin, F. L., 1961, Reef-controlled distribution of Devonian microplankton in Alberta: Palaeontology, v. 4, no. 3, p. 392–424.

Staplin, F. L., J. Jansonius, and S. A. Pocock, 1965, Evaluation of some acritarchous hystrichosphere genera: Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, v. 123, no. 2, p. 167–201.

Stockmans, F., and Y. Willière, 1962, Hystrichosphères du Dévonien belge (Sondage de l'Asile d'alienés à Tournai): Bulletin de la Société belge de géologie, de paléontologie et d'hydrologie, v. 71, p. 41–77.

Stockmans, F., and Y. Willière, 1963, Les Hystrichosphères ou mieux les acritarches du Silurien belge. Sondage de la Brasserie Lust à Courtrai (Kortrijk): Bulletin de la Société belge de géologie, de paléontologie et d'hydrologie, v. 71, no. 3, p. 450–481.

Stockmans, F., and Y. Willière, 1974, Acritarches de la "Tranchée de Senzeille" (Frasnien supérieur et Famennien inférieur): Académie royale des sciences, des lettres et des beaux artes de Belgique, Classe des sciences, Mémoires, v. 41, p. 3–79.

Strother, P. K., 1996, Chapter 5. Acritarchs, *in* J. Jansonius, and D. C. McGregor, eds., Palynology: Principles and Applications: Salt Lake City, American Association of Stratigraphic Palynologists Foundation. Publishers Press, p. 81–106.

Strother, P. K., 2008, A new Cambrian acritarch from the Nolichucky Shale, eastern Tennessee, U.S.A.: Palynology, v. 32, no. 1, p. 205–212, doi:10.1080/01916122.2008.9989658.

Szczepanik, Z., 2000, The Cambrian of the western part of the Pomeranian Caledonides foreland, Peribaltic Syneclise: microfloral evidence: Geological Quarterly, v. 44, no. 3, p. 261–273.

Thusu, B., 1973, Acritarchs of the Middle Silurian Rochester formation of southern Ontario: Palaeontology, v. 16, no. 4, p. 799–826.

Timofeev, B. V., 1957, O novoi gruppe iskopaemykh spor: Ezhegodnik Vsesoyuznogo Paleontologicheskogo Obshchestva, v. 16, p. 280–284.

Timofeev, B. V., 1958, Über das Alter sächsischer Grauwacken. Mikropaläontologische Untersuchungen von Proben aus der Weesensteiner und Lausitzer Grauwacke: Geologie, v. 7, no. 3-6.

Timofeev, B. V., 1959, Drevneishaya flora Pribaltiki i ee stratigraficheskoe znachenie: Vsesoyuznyi Neftyanoi Nauchno-Issledovatelskii Geologorazvedochnyi Institut, Leningrad (VNIGRI), Trudy, v. 129, p. 1–136.

Timofeev, B. V., 1960, Sur la caractéristique micropaléontologique de la formation de Visingsö: Geologiska Föreningen i Stockholm Förhandlingar, v. 82, no. 1, p. 28–42, doi:10.1080/11035896009455369.

Timofeev, B. V., 1962, Teodolitnyi paleontologicheskii stolik (novyi metod issledovaniya iskopaemogo mikroplanktona) obshchie zamechaniya: Vsesoyuznvi Neftyanoi Nauchno-Issledovatelskii Geologorazvedochnyi Institut Leningrad (VNIGRI), Trudy, Paleontologicheskii Sbornik, v. 196, no. 3, p. 601–647.

Timofeev, B. V., 1963, Lebensspuren in Meteoriten. Resultate einer microphytologischen Analyse: Grana Palynologica, v. 4, no. 1, p. 92–99.

Timofeev, B. V., 1966, Mikropaleofitologicheskoe issledovanie drevnikh svit [Micropalaeophytological research into ancient strata]: Academiya Nauk SSSR, Isdatelskvo Nauka, Moskva, p. 1–147.

Timofeev, B. V., 1969, Sferomorfidy proterozoya: Leningrad, Akademiya Nauk SSSR, Leningradskoe Otdelenie Izdatelstva Nauka, 145 p.

Timofeev, B. V., 1973, Mikrofitofossilii proterozoya i rannego paleozoya [Proterozoic and Early Palaeozoic microfossils], *in* Proceedings of the Third International Palynological Conference, Moscow: Nauk, p. 7–12.

Timofeev, B. V., T. N. German, and N. S. Mikhailova, 1976, Mikrofossilii dokembriya, kembriya i ordovika [Precambrian, Cambrian, and Ordovician Microfossils]: Leningrad, Akademiya Nauk SSSR, Institut Geologii i Geokhronologii Dokembriya, Leningradskoe Otdelenie, Izdatelskva Nauka, 106 p.

Tiwari, R. S., and G. K. B. Navale, 1967, Pollen and spore assemblage in some coals of Brazil: Pollen et spores, v. 9, no. 3, p. 583–605.

Traverse, A., 2007, Paleopalynology: Springer, 816 p.

Turner, R. E., 1984, Acritarchs from the type area of the Ordovician Caradoc Series, Shropshire, England: Palaeontographica Abt. B, v. 190, no. 4-6, p. 87–157.

Turner, R. E., 1985, Acritarchs from the type area of the Ordovician Llandeilo series, South Wales: Palynology, v. 9, no. 1, p. 211–234, doi:10.1080/01916122.1985.9989296.

Tynni, R., 1975, Ordovician hystrichospheres and chitinozoans in limestone from the Bothnian Sea: Geological Survey of Finland, v. 297, p. 39–81.

Umnova, N. I., 1975, Akritarkhi ordovika i silura Moskovskoi sineklizy i Pribaltiki [Acritarchs of the Ordovician and Silurian of the Moscow syneclise and Baltic province]: Izdatelskva Nedra, p. 1–167.

Umnova, N. I., and E. K. Fanderflit, 1971, Kompleksy akritarkh kembriiskikh i nizneordovikskikh otlozhenii zapada i severo-zapada Russkoi platformy [Acritarch assemblages from Cambrian and early Ordovician sediments of the western and northwestern Russian Craton], *in* V. K. Golubstov, ed., Palinologicheskie issledovaniia v Belorussii i drugikh raionakh SSSR [Palynology research in the Byelorussia and other regions of the USSR], Novosibirsk, Russia: Upravlenie geologii pri Sovete Ministrov BSSR. Belorusskii nauchno-issledovatel'skii geologorazvedochnyi institut, p. 45–72.

Uutela, A., 2008, Distribution of Cambrian, Ordovician and lowermost Silurian acritarchs, *in* A. Põldvere, ed., Männamaa (F-367) Drill Core: Tallinn, Geological Survey of Estonia, Estonian Geological Sections 9, p. 18–23.

Valensi, L., 1949, Sur quelques microorganismes planctoniques des silex du Jurassique moyen du Poitou et de Normandie: Société géologique de France, Bulletin, v. 18, p. 537–550.

Vanguestaine, M., 1973a, Etude palynologique du Cambro-Ordovicien de Belgique et de l'Ardenne française. Systématique et Biostratigraphie: Unpublished PhD thesis, University of Liège.

Vanguestaine, M., 1973b, New acritarchs from the Upper Cambrian of Belgium, *in* Proceedings of the Third International Palynological Conference, Novosibirsk, 1971: p. 28–30.

Vanguestaine, M., 1974, Espèces zonales d'acritarches du Cambro-Trémadocien de Belgique et de l'Ardenne Française: Review of Palaeobotany and Palynology, v. 18, no. 1–2, p. 63–82, doi:10.1016/0034-6667(74)90010-4.

Vanguestaine, M., 1978, Critères palynostratigraphiques conduisant a la reconnaissance d'un pli couche revinien dans le sondage de Grand-Halleux: Annales de la Société géologique de Belgique, v. 100, no. 1977, p. 249–276.

Vanguestaine, M., 1986, Progrès récents de la stratigraphie par Acritarches du Cambro-Ordovicien d'Ardenne, d'Irlande, d'Angleterre, du Pays de Galles et de Terre-Neuve orientale: Annales de la Société Géologique du Nord, v. 105, p. 65–76.

Vanguestaine, M., 1991, Datation par acritarches des couches cambro-trémadociennes les plus profondes du sondage de Lessines (bord méridional du Massif du Brabant, Belgique): Annales de la société géologique de Belgique, v. 114, p. 213–231.

Vanguestaine, M., 2002, The Late Cambrian acritarch *Cristallinium randomense*: morphology, taxonomy and stratigraphical extension: Review of Palaeobotany and Palynology, v. 118, no. 1, p. 269–285.

Vanguestaine, M., and P. M. Brück, 2008, A Middle and Late Cambrian age for the Booley Bay Formation, County Wexford, Ireland: New acritarch data and its implications: Revue de Micropaléontologie, v. 51, no. 1, p. 67–95, doi:10.1016/j.revmic.2007.12.001.

Vanguestaine, M., and J. Van Looy, 1983, Acritarches du Cambrien Moyen de la vallée de Tacheddirt (Haut-Atlas, Maroc) dans le cadre d'une nouvelle zonation du Cambrien: Annales de la Société Géologique de Belgique, v. 106, p. 69–85.

Vavrdová, M., 1965, Ordovician acritarchs from central Bohemia: Vestnik Ustredniho Ustavu Geologickeho, v. 40, no. 5, p. 351–357.

Vavrdová, M., 1966, Palaeozoic microplankton from central Bohemia: Casopis pro Mineralogii a Geologii, v. 11, no. 4, p. 409–414.

Vavrdová, M., 1972, Acritarchs from Klabava Shales (Arenig): Věstn. Ústřed. Ústavu Geol., v. 47, p. 79–86.

Vavrdová, M., 1976, Excystment mechanism of Early Paleozoic acritarchs [Mechanismus excystace u rane paleozoickych akritarch]: Cãsopis pro mineralogii a geologii, v. 21, no. 1, p. 55–64.

Vavrdová, M., and J. Bek, 2001, Further palynomorphs of Early Cambrian age from clastic sediments underlying the Moravian Devonian (borehole Němčičky-3): Bulletin of Geosciences, v. 76, no. 2, p. 113–125.

Vecoli, M., and G. Playford, 1997, Stratigraphically significant acritarchs in uppermost Cambrian to basal Ordovician strata of northwestern Algeria: Grana, v. 36, p. 17–28.

Vetluzhskikh, L. I., O. R. Minina, and L. N. Neberikutina, 2009, Regional'nye biostratigraficheskie podrazdeleniya amginskogo yarusa srednego kembriya zapadnogo zabajkal'ya: Vestnik Voronezhskogo gosudarstvennogo universiteta. Seriya: Geologiya, no. 1, p. 50–62.

Vidal, G., 1974, Late Precambrian microfossils from the basal sandstone unit of the Visingsö Beds, South Sweden: Geologica et Palaeontologica, v. 8, p. 1–14.

Vidal, G., 1976, Late Precambrian microfossils from the Visingsö Beds in southern Sweden: Fossils and Strata, v. 9, p. 1–57.

Vidal, G., 1981, Lower Cambrian acritarch stratigraphy in Scandinavia: Geologiska Föreningen i Stockholm Förhandlingar, v. 103, no. 2, p. 183–192, doi:10.1080/11035898109454517.

Vidal, G., and T. D. Ford, 1985, Microbiotas from the late proterozoic chuar group (northern Arizona) and uinta mountain group (Utah) and their chronostratigraphic implications:

Precambrian Research, v. 28, no. 3–4, p. 349–389, doi:10.1016/0301-9268(85)90038-5.

Vidal, G., and J. S. Peel, 1993, Acritarchs from the Lower Cambrian Buen Formation in North Greenland: Geological Survey of Greenland, Bulletin, Gronlands Geologiske Undersogelse 164, 35 p.

Vidal, G., and A. Siedlecka, 1983, Planktonic, acid-resistant microfossils from the Upper Proterozoic strata of the Barents Sea region of Varanger Peninsula, East Finnmark, northern Norway: Norges Geologiske Undersokelse Bulletin, v. 382, p. 45–79.

Volkova, N. A., 1968, Acritarchs from the Precambrian and Lower Cambrian deposits of Estonia, *in* Problematic Riphean-Cambrian layers of the Russian Platform, the urals and Kazakhstan: Moscow, Akademia Nauk SSSR, Nauka, Trudy Geologischeskogo Instituta, p. 8–36.

Volkova, N. A., 1969, Akritarkhi severo-zapada Russkoi platformy [Acritarchs of the north-west Russian Platform], *in* A. Y. Rozanov, ed., Tommotskii yarus i problema nizhnei granitsy kembriya [Tommotian Stage and the Cambrian lower boundary problem]: Moscow, Academiya Nauk SSSR, Ordena Trudovogo Krasnogo Znameni Geologicheskii Institut, Trudy 206, p. 224–236.

Volkova, N. A., 1974, Akritarkhi iz pogranichnykh sloev nizhnego-srednego kembriya Zapadnoi Latvii [Acritarchs from the Lower-Middle Cambrian boundary of western Latvia], *in* Biostratigrafiya i paleontologiya nizhnego kembriya Evropy i Severnoi Azii [Biostratigraphy and palaeontology of the Lower Cambrian of Europe and Northern Asia]: Nauka.

Volkova, N. A., 1980, Akritarki srednego i verkhnego kembriya Moskovskoy sineklizy [Acritarchs of the Middle and Upper Cambrian in the Moscow Syneclise]: Izvestiya Akademii Nauk SSSR, v. 12, p. 49–57.

Volkova, N. A., 1984, *Elenia*, a new genus of acritarchs from the Cambrian-Ordovician deposits of the Russian platform: Journal of Micropalaeontology, v. 3, no. 2, p. 7–10, doi:10.1144/jm.3.2.7.

Volkova, N. A., 1988, Novye vidy akritarkh iz nizhnego tremdoka Estonii [New species of acritarchs from the Lower Tremadocian of Estonia], *in* A. F. Chlonova, ed., Palynology in the USSR. Papers of the Soviet Palynologists to the VII International Palynological Congress, Brisbane, Australia: p. 79–82.

Volkova, N. A., 1990, Akritarkhi srednego i verkhnego kembriya vostochno-evropejskoj platformy [Middle and Upper Cambrian acritarchs in the East-European Platform]: Moscow, Nauka, Trudy 454, 116 p.

Volkova, N. A., 1993a, Taksonomitscheskij sostav akritarch I klimat v rannem tremadoke baltijskoi fitoplanktonnoj provintsii: Stratigrafiya - Geologicheskaya Korrelyatsiya, v. 1, no. 5, p. 39–43.

Volkova, N. A., 1993b, Akritarchi pogranitschnich otloschenij kembriya I ordovika priglintovoj polosi estonii (skvaschina M-56) [Acritarchs from the Cambrian–Ordovician boundary beds (boring M-56) of the Estonian near-clint area]: Proc. Est. Acad. Sci., Geol, v. 42, p. 15–22.

Volkova, N. A., 1995, Acritarchs of the Cambrian–Ordovician boundary deposits of the Baltic phytoplankton province: Stratigra ya Geologiycheskaya Korreljatsiya, v. 3, no. 4, p. 362–374.

Volkova, N. A., and I. N. Golub, 1985, Novye akritarkhi verkhnego kembriya Leningradskoy oblasti (Ladozhskaya svita) [New Upper Cambrian acritarchs from the Leningrad Oblast (Ladoga Formation)]: Paleontologicheskii Zhurnal, v. 19, no. 4, p. 90–98.

Volkova, N. A., V. V. Kiryanov, L. V. Piskun, L. T. Paškevičienė, and T. V. Jankauskas, 1979, Rastitelnye mikrofossilii [Plant microfossils], *in* A. V. Peive, B. M. Keller, and A. Y. Rozanov, eds., Paleontologiya verkhnedokembriiskikh i kembriiskikh otlozhenii vostochno-Evropeiskoi platformy [Upper Precambrian and Cambrian palaeontology of the east European Platform]: Moscow, Akademiya Nauk SSSR, Ordena Trudovogo Krasnogo Znameni Geologicheskii Institut, Izdatelstvo Nauka, p. 4–38. [published English translation dated 1983; see below]

Volkova, N. A., V. V. Kiryanov, L. V. Piskun, L. T. Paškevičienė, and T. V. Jankauskas, 1983, Plant microfossils, *in* A. Urbanek, and A. Y. Rozanov, eds., Upper Precambrian and Cambrian Palaeontology of the East-European Platform: p. 7–46. [original Russian version dated 1979; see above]

Walcott, C. D., 1899, Pre-Cambrian fossiliferous formations: Geological Society of America, Bulletin, v. 10, p. 199–244.

Wang, F., 1985, Middle-upper proterozoic and lowest phanerozoic microfossil assemblages from SW China and contiguous areas: Precambrian Research, v. 29, no. 1–3, p. 33–43, doi:10.1016/0301-9268(85)90057-9.

Wang, F., and Q. Chen, 1987, Spiniferous acritarchs from the lowest Cambrian, Emei, Sichuan, southwestern China: Review of Palaeobotany and Palynology, v. 52, no. 2–3, p. 161–177, doi:10.1016/0034-6667(87)90052-2.

Wang, F., Q. Chen, and X. Zhao, 1987, Precambrian Algal Fossils from southwest China and their Geological Significance: Chongqing, The People's Publishing House.

Wang F., and Q. Luo, 1982, Precambrian acritarcha: A cautionary note: Precambrian Research, v. 16, no. 4, p. 291–302, doi:10.1016/0301-9268(82)90065-1.

Wang, F., and Q. Luo, 1984, New material of microbial fossils from Sinian–Cambrian age sediments in Abazhai-Qingzhen and Wuge-Taijiang, Guizhou Province, *in* The Upper Precambrian and Sinian–Cambrian Boundary in Guizhou: Guiyang, Guizhou People's Publishing House, p. 153–170.

Ważyńska, H., 1967, Wstepne badania mikroflorystyczne osadów sinianu i kambru z obszaru Białowiezy [Preliminary microfloristic examinations of the Sinian and Cambrian deposits from the Białowicza area]: Kwartalnik Geologiczny, v. 11, no. 1, p. 10–20.

Welsch, M., 1986, Die Acritarchen der höheren Digermul-Gruppe, Mittelkambrium bis Tremadoc, Ost-Finnmark, Nord-Norwegen: Palaeontographica Abt. B, v. 201, no. 1-4, p. 1–109.

Wetzel, O., 1933, Die in organischer Substanz erhaltenen Mikrofossilien des baltischen Kreide-Feuersteins mit einem sediment-petrographischen und stratigraphischen Anhang: Palaeontographica Abt. A, v. 78, p. 1–110.

Wicander, E. R., 1974, Upper Devonian-Lower Mississippian acritarchs and prasinophycean algae from Ohio, USA: Palaeontographica, v. 148, no. 1-3, p. 9–43.

Wicander, R., and G. Playford, 1985, Acritarchs and Spores from the Upper Devonian Lime Creek Formation, Iowa, U.S.A.: Micropaleontology, v. 31, no. 2, p. 97–138, doi:10.2307/1485481.

Wolf, R., 1980, Lithology and acritarchs of the Lower Ordovician formations of Celtiberia (NE Spain) with stratigraphic and palaeoenvironmental implications, Ph.D.: Würzburg, Julius-Maximilians- Universität, 236 p.

Wood, G. D., and J. A. Clendening, 1982, Acritarchs from the lower Cambrian Murray Shale, Chilhowee group, of Tennessee, U.S.A.: Palynology, v. 6, p. 255–265, doi:10.1080/01916122.1982.9989244.

Xing, Y., 1962, Stratigraficheskoe pozdnego dokembriya, kembriya i ordovika nekotorykh rajonov Russkoj platformy po palinologicheskim dannym: Leningrad, Izdatel'stvo LGU.

Xing, Y., and K. Liu, 1973, On Sinian microflora in Yenliao region of China and its geological significance: Acta Geologica Sinica, no. 1, p. 1–64.

Xing, Y., and K. Liu, 1978, Sinian microplant and algal fossils, *in* Stratigraphy and Paleontology, Sinian to Permian, East Gorge Area: Shansha Stratigraphic Division, Hubei Geological Survey, p. 109–126.

Xing, Y., and K. Liu, 1980, Micropalaeoflora from the Sinian Suberathem of W. Hubei and its stratigraphic significance: Professional Papers of Stratigraphy and Palaeontology, v. 8, p. 1–14.

Xing, Y., K. Liu, W. Luo, Z. Wang, Y. Yan, L. Ding, C. Yin, and L. Gao, 1979, Micropalaeophyta, *in* Y. Xing, C. Duan, Y. Liang, and R. Cao, eds., Late Precambrian Palaeontology of China: Beijing, Geological Publishing House, Geological Memoirs, ser. 2 2, p. 7–67.

Yang, R., and L. Yin, 2001, Acritarch assemblages from the Early-middle Cambrian Kaili formation of east Guizhou Province and biostratigraphic implication: Acta Micropalaeontologica Sinica, v. 18, no. 1, p. 55–69.

Yao, J., S. Xiao, L. Yin, G. Li, and X. Yuan, 2005, Basal Cambrian Microfossils from the Yurtus and Xishanblaq Formations (Tarim, North-West China): Systematic Revision and Biostratigraphic Correlation of *Micrhystridium*-Like Acritarchs: Palaeontology, v. 48, no. 4, p. 687–708, doi:10.1111/j.1475-4983.2005.00484.x.

Yin, C., and L. Gao, 1996, The Early Evolution of the Acanthomorphic Acritarchs in China and Their Biostratigraphical Implication: Acta Geologica Sinica - English Edition, v. 9, no. 2, p. 193–206, doi:10.1111/j.1755-6724.1996.mp9002007.x.

Yin, C., and G. Liu, 1988, Micropaleofloras, *in* Z. Zhao, Y. Xing, Q. Ding, G. Liu, Y. Zhao, S. Zhang, X. Meng, C. Yin, B. Ning, and P. Han, eds., The Sinian System of Hubei: Wuhan, China University of Geosciences Press, p. 170–180.

Yin, L,, 1980, Late Precambrian microfossils from the Diaoyutai Formation, eastern Liaoning: Nanjing Institute of Geology and Palaeontology, Academia Sinica, p. 1–18.

Yin, L., 1985, Microfossils of the Doushantuo Formation in the Yangtze Gorge district, western Hubei: Palaeontologia Cathayana, v. 2, p. 229–249.

Yin, L., 1986, Acritarchs, *in* J. Chen, ed., Aspects of Cambrian- Ordovician Boundary in Dayangcha, China: Beijing, China Prospect Publishing House, p. 314–373.

Yin, L., 1987, New data of microfossils from Precambrian–Cambrian cherts in Ningqiang, southern Shaanxi: Acta Palaeontologica Sinica, v. 26, no. 2, p. 187–195.

Yin, L., Y. Zhao, R. Yang, and J. Peng, 2010, Acritarchs from the Early-Middle Cambrian Kaili Formation in the Wuliu-Zengjianya section, east Guizhou Province, China: Acta Palaeontologica Sinica, v. 49, p. 164–173.

Young, T., F. Martin, W. T. Dean, and A. W. A. Rushton, 1994, Cambrian stratigraphy of St Tudwal's Peninsula, Gwynedd, northwest Wales: Geological Magazine, v. 131, no. 3, p. 335–360, doi:10.1017/S0016756800011109.

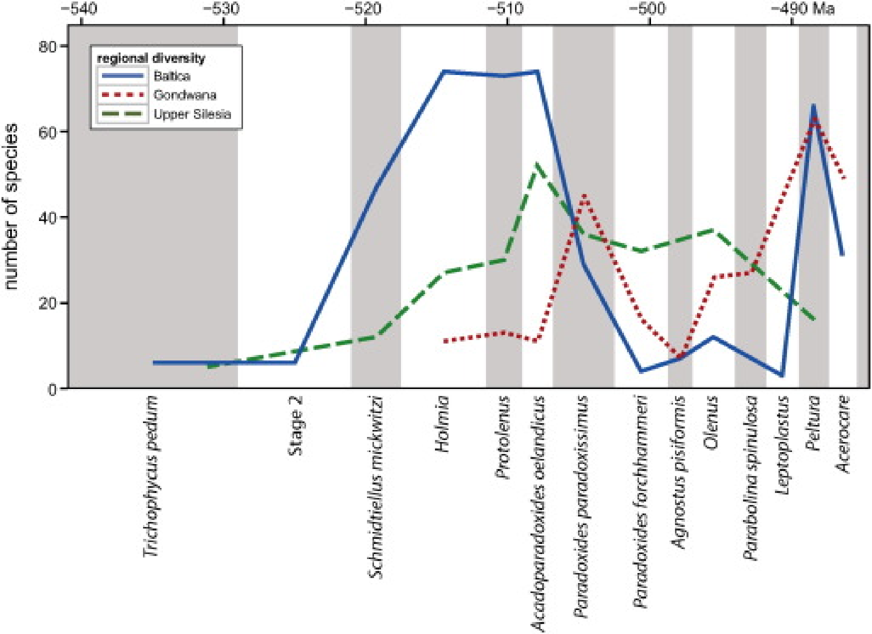
Zalessky, M. D., 1917, On marine sapropelite of Silurian age formed by a blue-green alga: Izvestiya Imperatroskoi Akademiya Nauk, IV. Ser., v. 1, p. 3–18.

Zang, W., 1992, Sinian and Early Cambrian floras and biostratigraphy on the South China Platform: Palaeontographica Abt. B, v. 224, no. 4-6, p. 75–119.

Zang, W., and M. R. Walter, 1992, Late Proterozoic and Early Cambrian microfossils and biostratigraphy, northern Anhui and Jiangsu, central-eastern China: Precambrian Research, v. 57, no. 3–4, p. 243–323, doi:10.1016/0301-9268(92)90004-8.

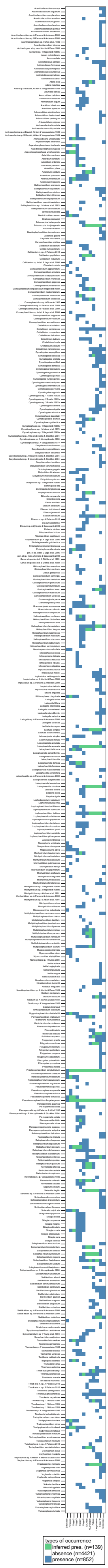
Zhong, G., 1978, Sinian and Silurian Micropalaeoflora. Paleontological Atlas of Central-Southern China, vol. 4, Microfossils: Beijing, Hubei Institute of Geological Sciences, Geological Publishing House, p. 113–115.

Żylińska, A., and Z. Szczepanik, 2009, Trilobite and acritarch assemblages from the Lower-Middle Cambrian boundary interval in the Holy Cross Mountains (Poland): Acta Geologica Polonica, v. 59, no. 4, p. 413–458.

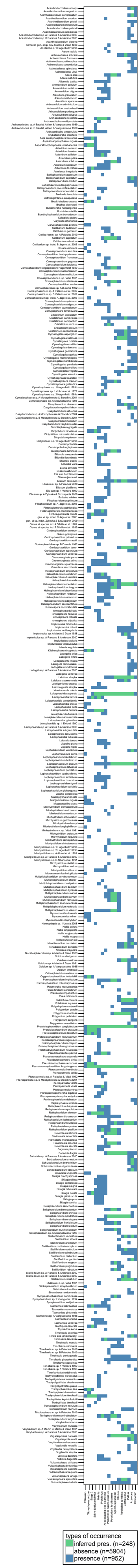


−540
−530
−520
−510
−500
−490 Ma
80
60
40
20
0
number of species
regional diversity
Baltica
Gondwana
Upper Silesia
Trichophycus pedum
Stage 2
Schmidtiellus mickwitzi
Holmia
Protolenus
Acadoparadoxides oelandicus
Paradoxides paradoxissimus
Paradoxides forchhammeri
Agnostus pisiformis
Olenus
Parabolina spinulosa
Leptoplastus
Peltura
Acerocare

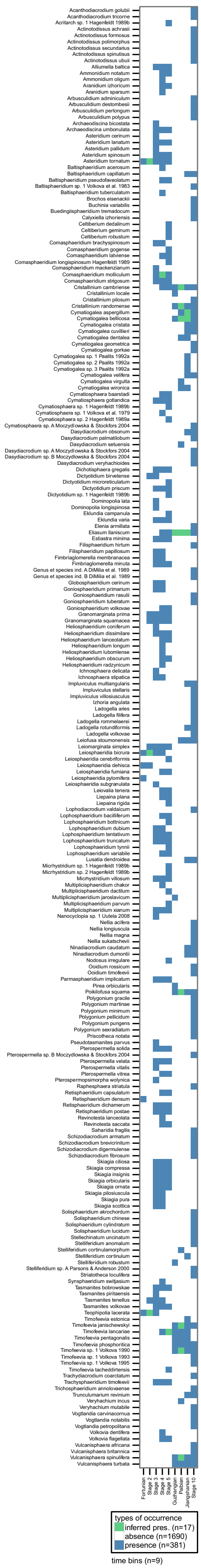
S4


types of occurrence
inferred pres. (n=139)
absence (n=4421)
presence (n=852)
time bins (n=12)
taxa (n=451)

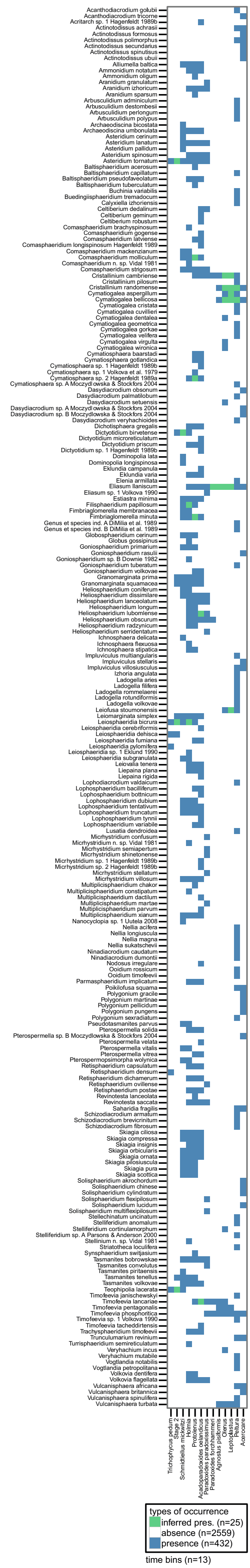
S5

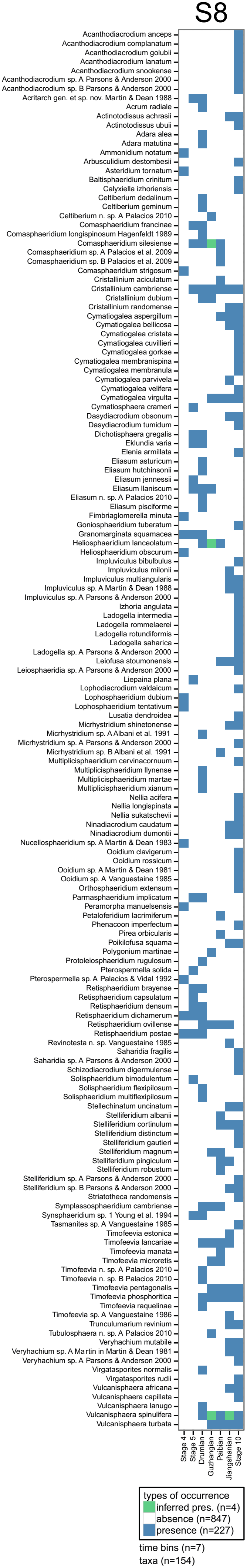

types of occurrence
inferred pres. (n=248)
absence (n=5904)
presence (n=952)
time bins (n=16)
taxa (n=444)

S6

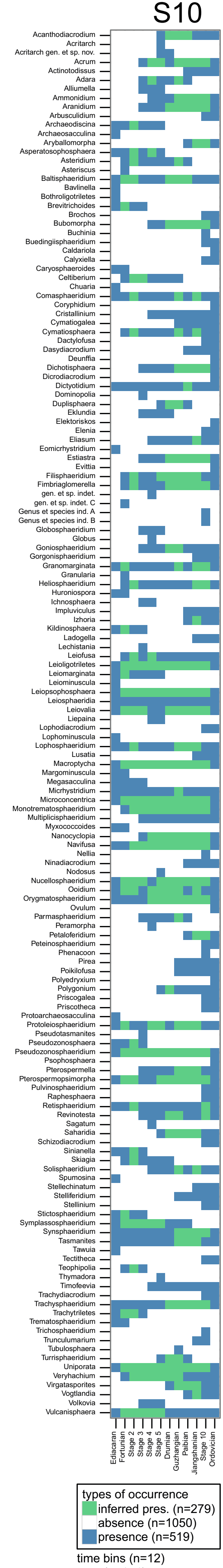

types of occurrence
inferred pres. (n=17)
absence (n=1690)
presence (n=381)
time bins (n=9)
taxa (n=232)

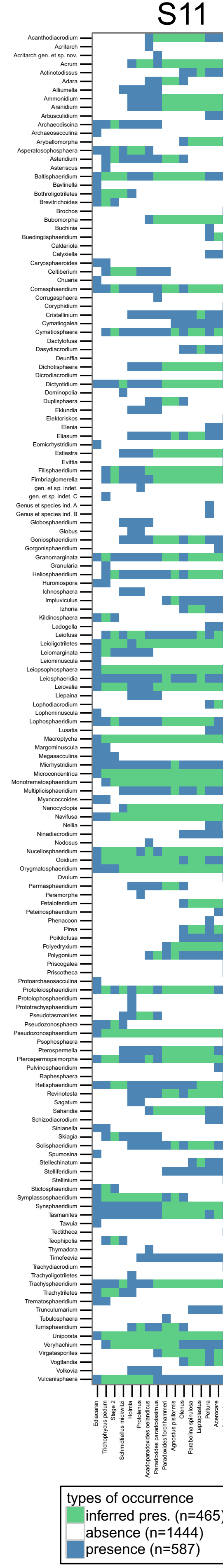
S7


types of occurrence
inferred pres. (n=25)
absence (n=2559)
presence (n=432)
time bins (n=13)
taxa (n=232)


S8
Stage 4
Stage 5
Drumian
Guzhangian
Paibian
Jiangshanian
Stage 10
types of occurrence
inferred pres. (n=4)
absence (n=847)
presence (n=227)
time bins (n=7)
taxa (n=154)


S9
Holmia
Protolenus
Acadoparadoxides oelandicus
Paradoxides paradoxissimus
Paradoxides forchhammeri
Agnostus pisiformis
Olenus
Parabolina spinulosa
Peltura
Acerocare
types of occurrence
inferred pres. (n=9)
absence (n=1293)
presence (n=268)
time bins (n=10)
taxa (n=157)


S10
Ediacaran
Fortunian
Stage 2
Stage 3
Stage 4
Stage 5
Drumian
Guzhangian
Paibian
Jiangshanian
Stage 10
Ordovician
types of occurrence
inferred pres. (n=279)
absence (n=1050)
presence (n=519)
time bins (n=12)
taxa (n=154)


S11
Ediacaran
Trichophycus pedum
Stage 2
Schmidtiellus mickwitzi
Holmia
Protolenus
Acadoparadoxides oelandicus
Paradoxides paradoxissimus
Paradoxides forchhammeri
Agnostus pisiformis
Olenus
Parabolina spinulosa
Leptoplastus
Peltura
Acerocare
Ordovician
types of occurrence
inferred pres. (n=465)
absence (n=1444)
presence (n=587)
time bins (n=16)
taxa (n=156)