

Some Emendments to Calcareous Nannoplankton Taxonomy

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Abstract: As a result of reviewing calcareous nannoplankton taxonomy for the Nannotax website various emendments are proposed here. These affect extant *Helicosphaera* holococcoliths, the extant genus *Anacanthoica*, Neogene *Triquetrorhabdulus* species, Palaeogene *Calcidiscus* species, and various Mesozoic taxa. In total twenty one new combinations and one new genus, *Tripinnalithus*, are proposed.

1. Introduction

We have been summarising many aspects of nannofossil and extant coccolithophore taxonomy on the Nannotax website (<http://ina.tmsoc/Nannotax3>). This is primarily a matter of documenting established knowledge and practice. However, sometimes synthesising knowledge highlights anomalies. In particular, we have encountered several cases where generic use is inconsistent or where informal taxonomy is commonly used. In order to avoid introducing taxonomic innovations on a website without permanent documentation, we propose the changes here, and we intend to publish similar notes in the JNR the future as necessary.

We introduce here one new genus, *Tripinnalithus* and twenty one new combinations. We also revise the scope of the family Ceratolithaceae to include *Triquetrorhabdulus* and *Orthorhabdus*, and introduce a revised terminology for the holococcolith phases of *Helicosphaera*. The various taxa discussed are arranged in approximately stratigraphic sequence, starting with the most recent.

2. Taxonomic recommendations

2.1 Revised terminology of *Helicosphaera* holococcolith stages.

Modern *Helicosphaera* is known from combination coccosphere evidence to have an alternate holococcolith forming stage, as shown by Lecal-Schlauder (1961) Cros *et al.* (2000), Geisen *et al.* 2004 and Couapel *et al.* (2009). In addition, this life-cycle transition has been observed in cultures (Hagino, pers comm.). Fortunately all the holococcoliths shown to be associated with *Helicosphaera* were formerly assigned to the genus *Syracolithus* and have the same distinctive ultrastructure, consisting of a central disk formed of layers of rhombohedra arranged in rhombohedral arrays and an outer tube of rhombohedra in an hexagonal array. Some other holococcolith species were assigned to *Syracolithus* on the grounds of similar overall morphology but they have different ultrastructure and have been shown to be associated with other heterococcoliths (Geisen *et al.* 2002, Frada *et al.* 2009).

However, the situation is complicated by the fact that there are four living species of *Helicosphaera* and four extant holococcolith “species” with the distinctive ultrastructure of *Helicosphaera* holococcoliths (figure 1); *H. carteri*, *H. wallichii*, *H. pavementum*, *H. hyalina*, *Syracolithus catilliferus*, *S. confusus*, *S. dalmaticus* and *S. ponticuliferus*. Cros *et al.* (2000) showed that *H. carteri* and *S. catilliferus* can form combination coccospheres indicating a life-cycle transition. They also showed that *S. catilliferus* and *S. confusus* sometimes co-occurred on coccospheres. From this they inferred that *S. confusus* was a thicker and more heavily calcified variant of *S. catilliferus* and that both were alternate phases of *H. carteri*. Subsequently Geisen *et al.* (2004) presented a possible combination coccosphere of *H. wallichii* with *S. dalmaticus*, Couapel *et al.* (2009) presented an unambiguous combination coccosphere of *H. wallichii* and *S. ponticuliferus* and, finally, Hagino (pers comm.) observed transition from *H. wallichii* to *S. catilliferus* in culture. So, although the association of the *Helicosphaera* heterococcolith stage, with the rhombohedral-array *Syracolithus* species, is now well established, there is a rather confusing network of associations between the different heterococcolith and holococcolith “species” in the group. The terminology proposed by Cros *et al.* (2000) and Young *et al.* (2003) predates the conflicting evidence from *Helicosphaera wallichii* and so needs to be modified. The basic problem is that although we can confidently predict that the four holococcolith morphotypes are all formed by *Helicosphaera*, we cannot predict which heterococcolith species any given holococcolith specimen is formed by. So, it seems appropriate to adopt a terminology that reflects this, i.e., which states that the specimens are holococcoliths formed by *Helicosphaera* and then give an informal term to indicate the morphotype - as shown in the table below. This system is straightforward and accurately reflects our current state of knowledge, although obviously it will need to be emended when definitive data on the actual life-cycle associations are available. It also should be noted that this is an informal system for recording life-cycle phases not an emendment to the formal taxonomy.

Traditional name	Young <i>et al.</i> 2003	new term proposed here
<i>Syracolithus catilliferus</i>	<i>H. carteri</i> HOL solid	<i>Helicosphaera</i> HOL <i>catilliferus</i> type
<i>Syracolithus confusus</i>	<i>H. carteri</i> HOL perforate	<i>Helicosphaera</i> HOL <i>confusus</i> type
<i>Syracolithus dalmaticus</i>	<i>S. dalmaticus</i>	<i>Helicosphaera</i> HOL <i>dalmaticus</i> type
<i>Syracolithus ponticuliferus</i>	<i>S. ponticuliferus</i>	<i>Helicosphaera</i> HOL <i>ponticuliferus</i> type

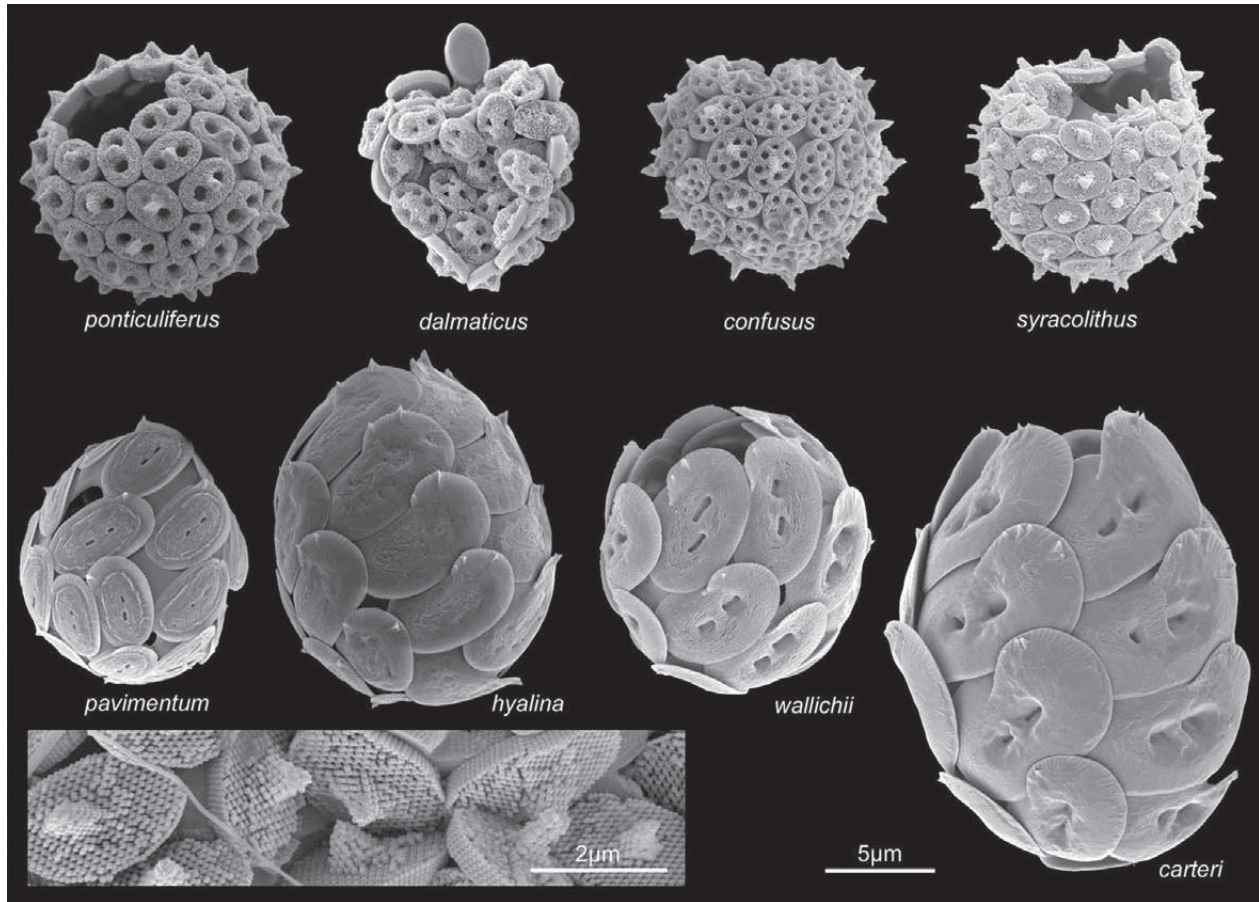


Figure 1 Holococcolith and heterococcolith phases of modern *Helicosphaera*. SEM images of the different coccosphere types from the plankton, and inset at larger scale image of *Helicosphaera* HOL *catilliferus* type showing the coccolith structure.

Image details: *Helicosphaera* HOL *ponticuliferus* type 284-35, W. Mediterranean, Villefranche; *Helicosphaera* HOL *dalmaticus* type 125-24 W. Mediterranean, MATER Cruise; *Helicosphaera* HOL *confusus* type 277-65 W. Mediterranean, Villefranche; *Helicosphaera* HOL *catilliferus* type 109-P233B3-14 NE Atlantic, Canaries; *Helicosphaera* *pavimentum* 125-11 W. Mediterranean, MATER Cruise; *Helicosphaera* *hyalina* 237-21 S. Atlantic AMT16; *Helicosphaera* *wallichii* CSF-0027 Gulf of Mexico; *Helicosphaera* *carteri* 108-6, NE Atlantic, CODENET2 cruise; *Helicosphaera* HOL *catilliferus* type detail - 098-25 Puerto Rico, INA7 cruise.

2.2 Transfer of *Anacanthoica* species to *Acanthoica* and *Cyrtosphaera*

The genera *Acanthoica* and *Anacanthoica* are used for extant Rhabdosphaeraceae species with similar coccoliths but, respectively, with specialized apical and antapical coccoliths or only with body coccoliths. However, the type of the genus *Anacanthoica*, *Anacanthoica acanthos*, has body coccoliths that are virtually identical to those of *Acanthoica quattrosipina* - Kleijne (1992) suggests they have a slightly broader rim. Such coccospheres are only very occasionally observed (single specimens are illustrated in Kleijne (1992) and Cros & Fortuno (2002) and in our experience are never sufficiently common to be sure they are not simply specimens of *Acanthoica* in which the spines are not preserved and/or visible. So, it is possible that *A. acanthos* is not actually a discrete species but if it is it is almost certainly very closely related to *A. quattrosipina*. Hence it seems appropriate to place *A. acanthos* in *Acanthoica*. This combination already formally exists, since it was the combination under which the species was originally described. This leaves one remaining *Anacanthoica* species, *A. cidaris*. This is another extremely

rare species but is distinctive and a good specimen was recently illustrated by Yang *et al.* (2012). Kleijne (1992) noted that this species shows significant varimorphism and this is confirmed by the specimen figured by Yang *et al.* (2012), hence it is appropriate to transfer it to *Cyrtosphaera*, as tentatively suggested by Kleijne (1992).

Cyrtosphaera cidaris (Schlauder 1945) comb. nov.

Basionym: *Acanthoica cidaris* Schlauder 1945 p. 7, plate 1 fig. 1; Recherches sur les flagellés calcaires de la Baie d'Alger, PhD Thesis, Université d'Alger, Algiers, 1-51 pp.

2.3 Revision of the genera *Triquetrorhabdulus* and *Orthorhabdus*

As discussed in Young (1998) the family Triquetrorhabdulaceae includes two distinctly different sets of species; a Late Oligocene-Early Miocene set of species in which the crystallographic c-axis is parallel to the length of the nannolith, and an Early to Late Miocene group in which the crystallographic c-axis is perpendicular to the length of the nannolith. This is an important difference in crys-

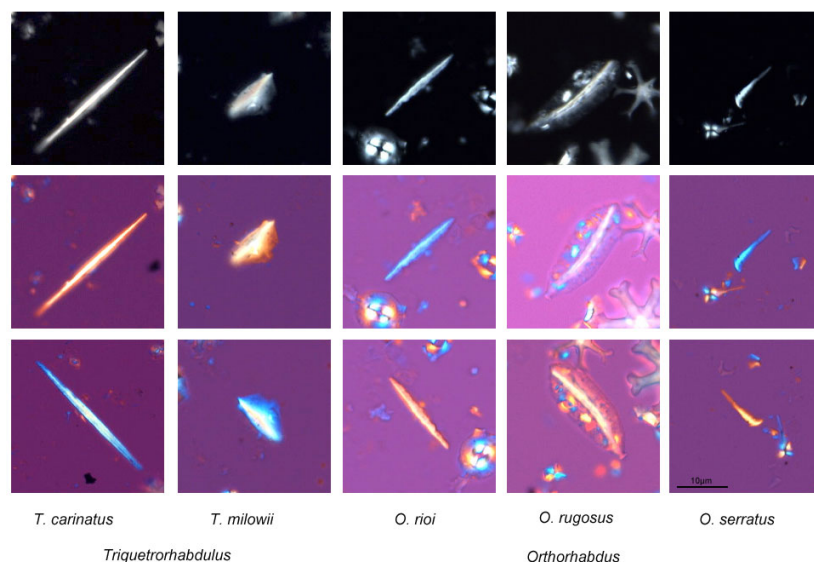


Figure 2 *Triquetrorhabdulus* and *Orthorhabdus*. Images of specimens of five species each in cross-polarised light (top) and in cross-polarised light with addition of gypsum plate with the specimens oriented NE-SW (middle row) and NW-SE (bottom row). In the images of *O. serratus* there is also a specimen of *Sphenolithus heteromorphus* which is formed of calcite crystals with radial c-axes, this can be used as an index to the colours shown.

Image details: All specimens are at the same scale and from DSDP Site 242, Madagascar Channel. *T. carinatus* - 242-9-4 130cm NP25; *T. milowii* 242-8-1 86cm, NN5; *O. rioi* 242-7-4 105cm NN6; *O. rugosus* - 242-5-4 93cm, NN11 ; *O. serratus* 242-8-1 86cm, NN5

tallography, similar to that used as the basis for separating *Amaurolithus* and *Ceratolithus* and it is easily confirmed in cross-polarised light by use of the gypsum plate or similar (plate 2). However at present this separation is not reflected in the taxonomy since all the species except one are included in the genus *Triquetrorhabdulus*. The exception is *Orthorhabdus serratus*, which is separated on the grounds of having a distinctive tapering shape and frequently lying in an orientation where it shows high birefringence. *Orthorhabdus serratus* also has its c-axis perpendicular to the nannolith length whilst the type species of *Triquetrorhabdulus* is *T. carinatus* in which the c-axis is parallel to the nannolith length. Given this, all that is necessary for the nomenclatural taxonomy to reflect the crystallography, and hence the likely phylogeny, is for the species of *Triquetrorhabdulus* with c-axes parallel to their length to be transferred to *Orthorhabdus* and to emend the diagnoses of the genera *Triquetrorhabdulus* and *Orthorhabdus*.

Triquetrorhabdulus Martini 1965 emend

Diagnosis: Elongate, tri-radiate nannolith formed of a single calcite crystal with the crystallographic c-axis parallel with the length of the nannolith.

Remarks: Rather curiously the original diagnosis of the genus of Martini (1965) included the statement “Optic axis of the calcite approximately at right angles to the length of the rod”, however, this was some kind of mistake since the type species is *T. carinatus* in which the c-axis is definitely parallel with the length of the nannolith, as noted by Bramlette & Wilcoxon (1967). During diagenetic overgrowth the three laths fuse, as shown by

images in Blaj & Young (2010), thus they must be formed from a single crystal. Species remaining within *Triquetrorhabdulus* include *T. carinatus*, *T. challengeri*, *T. longus*, and *T. milowii*.

Orthorhabdus Bramlette & Wilcoxon 1967 emend

Diagnosis: Elongate, tri-radiate nannolith formed of a single calcite crystal with the crystallographic c-axis perpendicular to the length of the nannolith.

Remarks: The nannoliths may lie with the c-axis vertical (low birefringence) or inclined (significant birefringence).

Orthorhabdus rugosus

(Bramlette and Wilcoxon, 1967)
comb. nov.

Basionym: *Triquetrorhabdulus rugosus* Bramlette and Wilcoxon, 1967 p. 128, plate 9, figs. 17, 18; *Tul. Stud. Geol. Paleontol.*, **5**: 93-131.

Orthorhabdus extensus (Theodoridis, 1984) comb. nov.

Basionym: *Triquetrorhabdulus extensus* Theodoridis, 1984, p. 89, plate 11, figs 4-6; *Utrecht Micropaleontol. Bull.*, **32**: 1-271.

Orthorhabdus finifer (Theodoridis, 1984) comb. nov.

Basionym: *Triquetrorhabdulus finifer* Theodoridis, 1984, p. 89, plate 11, figs 7-10; *Utrecht Micropaleontol. Bull.*, **32**: 1-271.

Orthorhabdus striatus (Müller, 1974) comb. nov.

Basionym: *Triquetrorhabdulus striatus* Müller, 1974, p. 593, plate 12, fig 5; plate 19 figs 11, 19; *Init. Repts. DSDP*, **25**: 579-633..

Orthorhabdus rioi (Olafsson, 1989) comb. nov.

Basionym: *Triquetrorhabdulus rioensis* Olafsson, 1989 p.19-20, plate 1, figs 9-10; *Procs. ODP: Sci. Res.*, **108**: 9-22.

Remarks: Since the name of this species was based on a person, Professor Domenico Rio, not a place, the correct orthography for the name is *rioi* not *rioensis*, as noted by de Kaenel & Villa (1993).

2.4 Inclusion of the genera *Triquetrorhabdulus* and *Orthorhabdus* in the Ceratolithaceae

Raffi *et al.* (1998) provided strong stratophenetic evidence that the genera *Ceratolithus*, *Amaurolithus* and *Nicklithus* all evolved from *Orthorhabdus rugosus*, supporting earlier suggestions of Gartner (1967), Gartner & Bukry (1975), Perch-Nielsen (1977, 1985a) based on

general morphology and crystallography. Obviously this implies that the family Ceratolithaceae is a descendant of the family Triquetrorhabdulaceae, and since both families have very few genera it makes sense to combine them. Moreover, the phylogenetic scheme proposed by Raffi *et al.* (1998) makes the family Ceratolithaceae polyphyletic, since the horseshoe shaped ceratolith morphology is inferred to have evolved three times, from the rod-like morphology of the Triquetrorhabdulaceae. Given this, it seems useful to revise the higher taxonomy of the group, to include both sets of taxa in one family. The name Ceratolithaceae Norris 1965 has priority over Triquetrorhabdulaceae Lipps 1969, so, we propose to include the genera *Triquetrorhabdulus* and *Orthorhabdus* in the family Ceratolithaceae.

2.5 Recombination of various species tentatively assigned to *Calcidiscus* in *Umbilicosphaera*

Bown (2005) documented exceptionally preserved Paleogene nannofossils recovered by the Tanzania Drilling Project. Amongst other observations this work established that the Calcidiscaceae are more abundant and diverse in the Palaeogene than previously described and two species with open central areas were described and tentatively assigned to *Calcidiscus*: *C? henrikseniae* and *C? parvicrucis*. In addition two previously described species with some similarities to these were observed and were recombined in *Calcidiscus*?: *C? protoannulus* and *C? pacificanus*. Subsequently, Bown *et al.* (2007) demonstrated that the genus *Umbilicosphaera* could be confidently identified in the Paleogene and recombined the species *Cyclolithus bramlettei* in *Umbilicosphaera*. Since both *Umbilicosphaera* and *Calcidiscus* are now being used for Paleogene Calcidiscaceae it is necessary to have a consistent criterion for separating them. We propose placing all species with clear open central areas in *Umbilicosphaera*. Most species can easily be assigned to *Umbilicosphaera* or *Calcidiscus* but there are some ambiguous types with narrow open central areas, and for these a criterion of central area diameter being >25% of the distal shield diameter seems appropriate. (i.e., distal shield rim <1.5x central opening width). On this basis the following recombinations are proposed. We would, however, note that the *Umbilicosphaera/Calcidiscus* divide is arguably artificial and so a revision may well be needed when more stratophenetic data is available.

We would also note that although the use of a question mark in a taxon name - e.g. *Calcidiscus? protoannulus* - appears attractive as a way of indicating uncertainty it can cause problems with electronic databases and especially with taxon searches. This is because the question mark has special meaning in database queries, and cannot be used in filenames in many operating systems. Taxon names with question marks in them have caused numerous problems in Nannotax and in other work on databasing nannofossil taxonomy (R. Howe pers. comm.). So, we would urge authors to avoid the use of question marks in taxon names.

Umbilicosphaera henrikseniae
(Bown, 2005) comb. nov.

Basionym: *Calcidiscus? henrikseniae* Bown, 2005 p. 29, plate 9 figs 31-34; *J. Nannoplankton Res.*, **27**(1): 21-95.

Umbilicosphaera protoannula
(Gartner, 1971) comb. nov.

Basionym: *Cyclococcolithina protoannula* Gartner, 1971 p. 109, plate 5, figs 1-2; *Tul. Stud. Geol. Paleontol.*, **8**: 101-121.

Synonym: *Calcidiscus protoannulus* (Gartner, 1971) Loeblich & Tappan, 1978

Umbilicosphaera detecta
(de Kaenel & Villa, 1996) comb. nov.

Basionym: *Ericsonia detecta* de Kaenel & Villa, 1996 p. 125, plate 4 figs 1-6; *Procs. ODP Sci. Res.*, **149**: 79-145.

Synonym: *Calcidiscus? detectus* (de Kaenel & Villa, 1996) Bown & Dunkley Jones, 2012; *J. Nannoplankton Res.*, **32**(2): 3-51.

Umbilicosphaera edgariae
(Bown & Dunkley Jones, 2012) comb. nov.

Basionym: *Calcidiscus? edgariae* Bown & Dunkley Jones, 2012 p. 25 plate 2 figs 36-49; *J. Nannoplankton Res.*, **32**(2): 3-51.

2.6 New combination *Bomolithus bramlettei*

Paleocene precursors to *Discoaster* include cycles of elements that are birefringent in plan view. Some of these were at one time included in the genus *Discoasteroides*, including the species *Discoasteroides bramlettei* Bukry & Percival 1971. However, Romein (1979) noted that the type species of *Discoasteroides* was *Discoaster kuepperi*, which does not have a birefringent cycle so he regarded the genus *Discoasteroides* as a junior synonym of *Discoaster*. Following this he recombined the species formerly included in *Discoasteroides* into *Discoaster* including *D. bramlettei*. However, the name *Discoaster bramlettei* had already been proposed by Martini (1958) for another species. Hence, according to Romein (1979), *Discoaster bramlettei* (Bukry and Percival 1971) Romein 1979 was a junior homonym of *Discoaster bramlettei* Martini 1958. To rectify this Romein (1980) proposed the alternative name *Discoaster drieri*.

However, an alternative taxonomic approach is to continue to distinguish the discoaster-like nannoliths with birefringent cycles, and place them in the genera *Heliolithus* Bramlette & Sullivan 1961 and *Bomolithus* Roth 1973. We have used this approach in recent publications, Bown & Dunkley Jones (2006) and Bown (2010). With this taxonomy the epithet *bramlettei* can be again be used since it is no longer a homonym [Also, the species described as a discoaster by Martini (1958) was subsequently used by Stradner (1961) as the type species of a separate genus, *Trochastrites*]. Hence we propose the new combination *Bomolithus bramlettei*.

Bomolithus bramlettei

(Bukry & Percival 1971) n. comb

Basionym: *Discoasteroides bramlettei* Bukry & Percival 1971 p. 129, plate 3 figs 10-12. *Tul. Stud. Geol. Paleontol.*, **8**: 123-146

Remarks: The LM images (but not SEM holotype) of *Markalius variabilis* Perch-Nielsen 1977 show specimens of *B. bramlettei*.

2.7 New combination *Lapideacassis wisei*

The Lapideacassaceae are a rare group of nannoliths of uncertain affinities, although of some interest since several species appear to have survived the K/Pg mass extinctions. Perch-Nielsen and Franz (1977) and Perch-Nielsen (1985a, b) distinguished two genera, *Lapideacassis* with two or more distal tiers of elements and *Scampanella* with only one. Burnett (1997, 1998), however, argued that this distinction was often difficult to make, especially in the light microscope and so that it was not useful to distinguish the genera *Lapideacassis* and *Scampanella*. Following this she recombined three species described by Perch-Nielsen and Franz (1977) into *Lapideacassis* - *L. asymmetrica*, *L. bispinosa* and *L. magnifica*. However, she did not recombine a fourth species, *S. wisei*, since she had not encountered it. For cataloguing purposes it is anomalous to have this one species left in *Scampanella* so it is recombined here.

Lapideacassis wisei

(Perch-Nielsen & Franz 1977) n. comb.

Basionym: *Scampanella wisei* Perch-Nielsen & Franz 1977 p. 853, plate 5, figs. 2, 5, 8 Plate 6 Figs. 1-3, 10, 11, 18-20; text-fig 3-13; *Init. Repts. DSDP*, **39**: 849-862.

2.8 Recombination of *Vekshinella* species into *Staurolithites*

Various names have been proposed for loxolith mureliths with an axial cross but it is now generally accepted that *Staurolithites* has priority. So our recent practice has been to include all such species in *Staurolithites*. The vast majority of such recombinations have already been proposed, but when cataloguing the species for Nannotax we encountered three valid species that had not been formally recombined into *Staurolithites* yet, hence these combinations are proposed here.

Staurolithites acutiferrus (Vekshina, 1959) comb. nov.

Basionym: *Ephippium acutiferrus* Vekshina, 1959 p. 69, plate 2 figs 7a, b; *Siberian Sci. Res. Inst. Geol. Geophys. Mineral. Raw Materials*, **2**: 56-81.

Staurolithites dibrachiatus (Gartner, 1968) comb. nov.

Basionym: *Vekshinella dibrachiata* Gartner, 1968 p. 30 plate 5 figs 23, 24; *Univ. Kansas Paleontol. Contrib.*, **Art. 48**: 1-56.

Staurolithites pseudocarinolithus

(Applegate & Bergen, 1988) comb. nov.

Basionym: *Vekshinella pseudocarinolithus* Applegate & Bergen, 1988 p. 317, plate 16, figs 1-9; *Procs. ODP. Sci. Res.*, **103**: 293-348

2.9 Transfer of species to *Corollithion* and *Diadorhombus*

The Stephanolithionaceae is a diverse Mesozoic family of small coccoliths. The genera are primarily defined by shape in plan view, in particular rhombic species are placed in *Rhombolithion*; hexagonal species in *Corollithion*; elliptical species in *Stradnerlithus*, and; elongate truncate-ended species in *Truncatoscapus*. This is arguably an artificial system but in the absence of reliable phylogenetic data on this diverse group it is a practical basis for taxonomy. Cataloguing the species for Nannotax, however, highlighted some obvious inconsistencies in the current classification which are addressed here.

Stoverius acutus

(Thierstein in Roth and Thierstein, 1972) comb nov.

Basionym: *Corollithion acutum* (Thierstein in Roth and Thierstein, 1972), p. 438, plate 2, figs. 1-9; *Init. Repts. DSDP*, **14**: 546-559.

Stoverius protosignum (Worsley, 1971) comb. nov

Basionym: *Corollithion protosignum* Worsley, 1971 p. 1307, plate 1, figs. 27-29; *Procs. Second Plankt. Conf. Roma 1971*, pp. 1301-1321.

Rhombolithion minutum

(Rood, Hay and Barnard, 1971) comb. nov.

Basionym: *Diadorhombus minutus* Rood, Hay and Barnard, 1971, p. 258, plate 2, fig. 6; *Eclog. Geol. Helv.*, **64**: 245-272.

Rhombolithion scutulatum (Medd, 1971) comb. nov.

Basionym: *Zycolithus scutulatus* Medd, 1971, p. 828, plate 3, figs 1, 2; *Procs. Second Plankt. Conf. Roma 1971*, pp. 821-844.

2.10 Recombination of *Polypodorhabdus* species into *Retecapsa*

The family Cretarhabdaceae includes several poorly separated genera. A particularly noticeable anomaly is *Polypodorhabdus* which is not at all clearly separated from *Cretarhabdus* and *Retecapsa* (two genera which are also very close). Three species are conventionally included in the genus. Of these *P. madingleyensis* has already been recombined into *Cretarhabdus*. The other two species are recombined here in *Retecapsa*.

Retecapsa escaigii (Noël, 1965) comb. nov.

Basionym: *Polypodorhabdus escaigii* Noël, 1965, p. 109, plate 10, figs 6-8, text-fig. 32; *Éditions du CNRS, Paris*.

Retecapsa beckii (Medd, 1979) comb. nov.

Basionym: *Polypodorhabdus beckii* Medd, 1979, p. 65, plate 6, fig. 6; *Eclog. Geol. Helv.*, **72**: 19-109.

2.11 New genus for the species *Triquetrorhabdulus? shetlandensis*

T? shetlandensis is a nannolith described from the Early Cretaceous by Perch-Nielsen (1988). It is morphologically similar to *Triquetrorhabdulus* species such as *T. milowii* and was placed tentatively in *Triquetrorhabdulus*. However, Perch-Nielsen (1988) noted that it was very unlikely to be directly related to the Oligo-Miocene forms given the very long stratigraphic break between them. Also the basic morphology of three laths elongated parallel to the calcite c-axis is one which can readily be formed from calcite and is also shown, for example, by many planktonic foraminifera spines and by sphenolith spines as well as by *Triquetrorhabdulus* – i.e., it is a morphology that can be evolved repeatedly. The most likely explanation of the similar morphology is that the Early Cretaceous *T? shetlandensis* and Oligo-Miocene *Triquetrorhabdulus* are homoeomorphs. Hence, it is logical to revise the taxonomy to reflect this. This is particularly worthwhile as databasing of taxonomy makes this type of anomaly much more prominent and more likely to lead to misinterpretations. So we propose a new genus for this species.

Tripinnalithus gen. nov.

Type species: *Tripinnalithus shetlandensis* (Perch-Nielsen 1988) comb. nov.

Etymology: latin, three feathered stone

Diagnosis: Elongate to diamond-shaped nannolith with triradiate cross-section, c-axis parallel to nannolith length.

Tripinnalithus shetlandensis
(Perch-Nielsen 1988) comb. nov.

Basionym: *Triquetrorhabdulus? shetlandensis* Perch-Nielsen 1988 p. 35-36, plate 1, figs 15, 16; *Newsl. Int. Nannoplankton Assoc.*, **10**(1): 30-37.

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