The Year 2000 Classification of the Agglutinated Foraminifera

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ABSTRACT

A reclassification of the agglutinated foraminifera (subclass Textulariia) is presented, consisting of four orders, 17 suborders, 27 superfamilies, 107 families, 125 subfamilies, and containing a total of 747 valid genera. One order (the Loftusiida, Kaminski & Mikhailевич), five suborders (the Verneuilinina Mikhailевич & Kaminski, Nezzazatina, Lofusina Kaminski & Mikhailевич, Biokovinina, and Orbitolinina), two families (the Syrianidae and the Debarinidae) and five subfamilies (the Polychasmminae, Praesphaerammininiae Kaminski & Mikhailевич, Flatschkoefeliiniae, Gerochelliniae and the Scythiolidiniae Neagu) are new. The classification is modified from the suprageneric scheme used by Loeblich & Tappan (1992), and incorporates all the new genera described up to and including the year 2000. The major differences from the Loeblich & Tappan classification are (1) the use of suborders within the hierarchical classification scheme (2) use of a modified Mikhailевич (1995) suprageneric scheme for the Astorhizida (3) transfer of the Ammodiscaceae to the Astorhizida (4) restriction of the Lituolina to forms with simple wall structure (5) suppression of the order Trochaminina, and (6) inclusion of the Carterinida within the Trochamminaceae (7) use of the new order Loftusiida for forms with complex inner structures (8) broadening the definition of the Textulariida to include perforate forms that are initially uniserial or planispiral. Numerous minor corrections have been made based on the recent literature.

INTRODUCTION

The agglutinated foraminifera constitute a diverse and geologically long-ranging group of organisms. Morphologically, they form a heterogeneous group that has its origins in the Vendian, latest Pre-Cambrian (Gaucher & Sprechmann, 1999). The group is here defined as a subclass consisting of four orders that are based upon gross morphology, wall structure, and cement composition. The cement that binds the test together may be organic (as in the Astorhizida), calcareous and canalicate (as in the Textulariida), or of mixed nature (as in the Lituolida and Loftusiida, which contains both organically-cemented, calcareous, and microgranular types). Over the past two decades, a number of studies have emphasised the importance of wall structure and cement composition as an important criterion for suprageneric classification (Desai & Banner, 1987; Bender, 1989, 1995; Brönnimann et al. 1992; Loeblich & Tappan, 1987, 1988, 1989, 1992). However, there does not appear to be any consensus regarding the taxonomic level at which wall structure and cement composition ought to be used (see discussions by Haynes, 1990; Mikhailевич & Debenay, 2001; Mikhailевич, this volume).

The current classification scheme is based to a large extent on the last-published scheme used by Loeblich & Tappan (1992, 1994), which recognised four orders of agglutinated foraminifera subdivided into 19 superfamilies, 87 families, and 100 subfamilies. However, recent findings have rendered the Loeblich & Tappan classification inadequate to encompass the complete diversity of the group. The number of new genera and higher systematic groupings has been growing at a steady pace since the publication of Loeblich & Tappan’s (1987) monumental book (Figure 1). As new groups of foraminifera are described each year, the need for an updated classification scheme increases. Moreover, the outline classification published by Loeblich & Tappan in 1992 did not list the genera included within the families and subfamilies. The purpose of this paper is to compile a more complete classification that incorporates the 139 new genera, families, and subfamilies of agglutinated foraminifera published subsequent to Loeblich & Tappan’s book, thereby providing a firmer basis for taxonomical studies at the beginning of the 21st century.

RESULTS

The Year 2000 Classification

For the sake of consistency (if for no other reason), I have used the outline suprageneric framework of Loeblich & Tappan (1992) as a starting point for the updated classification of the agglutinated foraminifera. This scheme is here modified and enlarged to incorporate the new genera and higher taxa described since 1987, and makes...
fuller use of higher taxonomic rankings (i.e., subclasses, orders, suborders) that result from elevation of the foraminifera from an order to a class. The new classification scheme also takes into account several “partial” revisions of the group that have been published since 1987. For example, the classification of the Astrorhizida used herein largely follows the reclassification of the group published by Mikhalevich (1995), and the classification of the Trochoinacea is based on the work of Brönnimann & Whittaker (1988, 1990). The taxonomy of the Jurassic litulid families is based on the work of Septfontaine (1988), but their higher-order classification mostly follows Loeblich & Tappan (1992). The new suprageneric framework of the agglutinated foraminifera presented herein now places the group into a single subclass (the Textulariia) consisting of four orders, 17 suborders, 27 superfamilies, 107 families, 125 subfamilies, and contains a total of 747 valid genera (see below). The complete descriptions and references for the new taxa can be found in Kaminski (2000, this volume) and in the “Agglut-2003” electronic database distributed Grzybowski Foundation.

**DISCUSSION**

**The rank of the Foraminifera**

The discovery that the Foraminifera were Protozoa by Dujardin (1835) lead d’Orbigny (1939) to raise the group to the status of a class with six orders based on chamber arrangement, with a seventh for the single-chambered forms. Subsequent to d’Orbigny’s original classification, later workers variously regarded the group to be of lower taxonomic rank. However, over the last 25 years or so, Protozoologists in both Russia and North America have assigned the group to a much higher rank. Among western systematicists, Margulis (1974) first elevated the Foraminifera to the rank of a phylum, a rank that is maintained in her popular textbook “Five Kingdoms” (Margulis & Schwartz, 1988). In his expanded classification of the Kingdom Protozoa, Cavalier-Smith (1993) first regarded the Foraminifera as a subphylum of the phylum Reticulosa (= Granuloareticulosa of earlier authors), but in his latest revision Cavalier-Smith (1998) quotes cytological evidence that removes the naked athalamids from that phylum (also cited by Alimov, 2000). As a result, Cavalier-Smith removes the Granuloareticulosa/ Reticulosa from his classification and elevates the foraminifera to the status of a phylum.

Meanwhile in Russia, foraminiferal workers were quick to embrace the idea of a higher rank for the Foraminifera, with Mikhalevich (1980) and Saidova (1981) both regarding the group as a subphylum. Since 1992, Mikhalevich has assigned the group the status of phylum. This rank has been adopted in the monumental volume “Protista Handbook on Zoology” recently published by the Russian Academy of Sciences (Alimov, 2000), which adopts the foraminiferal classification of Mikhalevich (1998, 2000).

Clearly for the purpose of this paper, a decision must be made regarding the rank of the Foraminifera. The class ranking commonly accepted by Micropalaeontologists is now one level “out of step” with the ranking assigned by many Protozoologists. As this classification is intended for use by the micropalaeontological community, I have retained the class ranking used by most Micropalaeontologists, following the North American usage presented in the second edition of the “Illustrated Guide to the Protozoa” (Lee et al., 2000). Although only dealing with modern genera, this classification was prepared by a working group consisting of nine biologists and micropalaeontologists, and appears to represent the latest consensus, at least in the western hemisphere. The classification presented herein differs fundamentally from the Lee et al. scheme, in that I have attempted to include all the fossil and living genera of the agglutinated foraminifera into the classification. Interestingly, at least one of the authors of this classification (J.-P. Debenay) already assigns the foraminifera to a higher rank (Mikhalevich & Debenay, 2001).

The classification adopted by Loeblich & Tappan (1987, 1992, 1994) separated the orders of foraminifera based upon test composition and mineralogy. Surprisingly, in their 1992 classification, these authors did not make full use of the systematic hierarchy that the Linnean system allows, for example there were no subclasses in their scheme. If the class rank for the foraminifera is retained, and the foraminiferal wall structure is used as the defining criterion at the highest taxonomic level, the main systematic groupings within the Foraminifera can now be defined at the rank of a subclass. The actual number of subclasses within the Foraminifera would then become eight (Allogromiia, Textulariia, Fusulinia, Miliolidia, Silicoloculina, Spirillinia, Rotalia, and Robertinia). The discussion of the whole class Foraminifera is beyond the scope of this paper, and only the agglutinated subclass Textulariia is considered below:

**Importance of wall structure in agglutinated foraminifera**

Since the mid 19th century, wall structure has been regarded as a prime criterion for classification at a higher level. Carpenter (1862) first subdivided the Foraminifera into two suborders (Perforata and Imperforata) based on the presence or absence of perforations in the test wall. In his classification, Carpenter also took into account the composition of the wall and remarked “The imperforate sub-order may be divided into three very natural groups, according as the nature of the envelope is membranous, porcellaneous, or arenaceous; and thus we have the families Gromidia, Miliolida, and Lituolida”. In 1876, T.R. Jones raised the status of the “arenaceous” forms to that of a third group of equal rank with the perforate and porcellaneous forms. Jones’ idea of grouping the agglutinated forms into a single higher-order grouping was later used in classifications published by Schwager (1877) and in part by Delage & Hérouard (1896). However, the popularly-used classifications of Brady (1884), and Cushman (1927, 1948) did not group the foraminiferal families into higher categories. Glaessner (1945) was the first modern worker to reinstate the use of wall composition to define higher categories of foraminiferal families, and placed all the agglutinated forms into two superfamilies: the nonseptate Astrorhizidea and the chambered Lituolidea.
The highest-order taxonomic level adopted here for the agglutinated foraminifera is based on the concepts adopted by Loeblich & Tappan (1964, 1974, 1987), who regarded wall composition and microstructure as the defining character for the higher foraminiferal groups. Loeblich & Tappan (1964, 1974, 1987) placed all agglutinated families into the suborder Textulariina, irrespective of the composition of the cement used to bind the agglutinated grains, or the presence of any perforations. Similarly, Saidova (1981) placed all the agglutinated forms in a single class, the “Textulariacea” (with the notable exception of the rzehakinids), which were regarded as miliolids, and Lee (1990) recognised the order Textulariida with all the agglutinated groups listed as suborders (including the aforementioned rzehakinids).

Other workers, however, have split out individual groups of the agglutinated foraminifera, adopting classifications in which a number of groupings had been given equal rank. For example, Brönnimann & Whittaker (1988) defined the order Trochamminida as a group with organically-cemented walls bound by inner and outer organic membranes. This group was adopted by Loeblich & Tappan in their 1989 subdivision of the agglutinated foraminifera and in their 1992 outline re-classification.

Research into the microstructure of the organic cement in agglutinated foraminifera by Heike Bender has demonstrated at least four main cement types can be determined. In a preliminary study presented at the Second International Workshop on Agglutinated Foraminifera (Vienna, 1986), Bender reported that the organic cement occupying the intergranular space within the wall may be present in the form of strands, meshwork, or foam (Bender & Hemleben, 1988). In her thesis published in 1989, Bender defined a fourth category called “undifferentiated organic cement”, in which the intergranular space is empty and cement is present only at the grain contacts. Bender & Hemleben (1988) stated in their paper that “further experimental work should clarify the mode of test formation (...) and establish their value in group systematics and phylogeny”.

In a controversial paper published the following year, Loeblich & Tappan (1989) formally defined four suborders of agglutinated foraminifera that were based to a large extent on the preliminary work of Bender & Hemleben (1988). Loeblich & Tappan (1989) were of the opinion that “the basically distinct types of cement in the agglutinated foraminifers, demonstrated by controlled cultures as well as by mineralogical and ultrastructural studies, indicate that they should be recognised at the subordinal level”. The suborder Astrorhizida Jirovic, 1953 was understood to have organic cement in the form of strands, the Trochamminida Brönnimann & Whittaker, 1988 was redefined as possessing cement in the form of an organic network or foamy mass, and the suborder Textulariina Delage & Hérouard, 1896 was redefined to include solid or canalicate forms that have foreign particles encased in an organic coating and held together by biogenically deposited low-Mg calcite in the form of bundles of tiny rod-shaped crystals. The suborder Haplophragmmina was used as a catch-all category for organically-cemented forms not explicitly placed in the other three suborders. Criteria such as mono- or polythalamous test, simple or alveolar structure, flexible or firm test, were implicitly assigned lower-ranking status.

At the Fourth International Workshop on Agglutinated Foraminifera (Kraków, 1993), a consensus was reached to ignore the suborders of Loeblich & Tappan (1989) until such time that more information on cement microstructures becomes available. In the proceedings volume of that conference, Bender (1995) published her SEM observations on the cement microstructure of 140 species of modern agglutinated foraminifera. Bender pointed out that different species of the same genus often show different cement morphotypes, and this fact was demonstrated in the case of the genera Bathysiphon, Rhadammina, Tharammina, Milamminia, Atrondiscus, Reophax, Cribrasteroides, Anmmosalaria, Eggerelloloids, Paratrochammina, and Triaxis). Moreover, the cement microstructure is not preserved in fossil specimens (Hemleben & Kaminski, 1990), thereby rendering this feature useless for classifying the fossil forms. Bender (1995) was of the opinion that “if it is desirable to prevent unnecessary proliferation of new generic names, then the organic cement microstructures must be regarded as having systematic value only at the lower-ranking species level”.

In the discussion section of her paper, Bender writes “the three suborders recognised by Loeblich & Tappan (1989) must be rejected in favour of a single suborder to encompass all forms with organic cement.” Bender further states “in my opinion the Textulariina should be split into only two super-groups, both having the status of a suborder”. Although Bender presented sufficient data to revise the suborders recognised by Loeblich & Tappan (1989, 1992), she did not go as far as to propose any formal revision of the higher systematics of the agglutinated foraminifera.

In the outline classification published by Loeblich & Tappan in 1992, the Foraminifera were recognised as a class, following the ranking of Lee (1990) published in the “Handbook of Protocistia” (Margulis et al., 1990). In their newly revised scheme, the various foraminiferan suborders were elevated to the rank of orders, and the three orders of organically-cemented agglutinated foraminifera (Astrochizida, Lithoida, and Trochamminida) were simply described as having “a firmly cemented test consisting of foreign particles cemented to an organic matrix”. The order Lithoida was substituted for the suborder Haplophragmmina published three years earlier. Curiously, in their discussion of the agglutinated groups, Loeblich & Tappan (1992) made no mention of organic cement microstructures. It is possible that Loeblich & Tappan themselves had at least partially abandoned their earlier subdivision of the agglutinated foraminifera based on cement microstructure, as there is no mention of Bender’s work in this paper. Instead, Loeblich & Tappan listed “mode of wall formation for test enlargement” alongside “the nature of cement in agglutinated tests” as an important feature for classification. Their order Astrochizida contained all the unchambered or two-chambered tubular genera that display, at most, minor wall constrictions produced by intermittent growth of a basically tubular test. The order Lithoida contained mostly the chambered families, but without further explanation also included the superfamly Ammodiscacea, the order Trochamminida.
contained all the low trochospirally-coiled genera, and the Textulariida contained all the calcareous canaliculate groups.

In the second edition of the “Illustrated Guide to the Protozoa” (Lee et al., 2000), the Foraminifera are regarded as a class that is subdivided into 16 orders. Lee et al. abandoned the use of cement type in the classification of the agglutinated orders and instead reverted to morphological criteria. These authors recognised only two orders: Astrorhizida for unilocular or two-chambered forms (including the Ammodiscacea), and the Textulariida for all multichambered forms, irrespective of cement type. Lee et al. regarded any attempts to group the multilocular agglutinated families into orders based on cement type as “premature”.

Suprageneric changes adopted herein

The current classification recognises wall structure and composition to be the defining character for the foraminiferal groups. Although a number of protozoologists consider the foraminifera to represent a separate phylum (e.g., Margulis & Schwartz, 1988; Cavalier-Smith, 1998), most western Micropalaeontologists still regard the Foraminifera to constitute a class (although with the removal of the afoamamids from the Granuloreticulosa and loss of the latter group from the recent classifications of the Protozoa, this opinion is likely to change). Although there have been recent noteworthy attempts to de-emphasise the importance of wall structure and to define the higher groups of foraminifera using evolutionary relationships reflected by gross morphology and aperture characteristics (e.g., Güleç, 1977, Haynes, 1981, Mikhailheivich, 1992, 1998, 2000, this volume; Vdovenko, 1993; Mikhailheivich & Debenay, 2001), the criteria most widely accepted by western Micropalaeontologists for highest level classification of the foraminifera still remain the structure, composition, and mineralogy of the test wall (e.g., Loeblich & Tappan, 1987, 1988, 1992, 1994).

If test composition and wall structure is retained as defining criteria at the highest taxonomic level within the Textularia, four main groups emerge that are here regarded at the level of an order. These groups are here defined based on test composition and wall structure, and are equivalent in rank to the orders defined by Loeblich & Tappan (1992, 1994). The classification adopted herein, however, both modifies the definitions of the four orders, and institute a variety of changes within the orders themselves. The current definition of each order is given within the body of the text, changes to their definitions are discussed below. Minor changes to the classification scheme, (e.g., regarding the suppression, reinstatement, or suprageneric position of various genera), are explained in footnotes in the body of the text.

1. The Order Astrorhizida

This classification adopted here recognises four suborders of the Astrorhizida that are distinguished by morphological criteria (the tubular Astrorhizina, single-chambered or pseudocolonial Saccamminina, two-chambered Hippocrepinina, and the coiled Ammodiscina). The subdivision of the group draws heavily upon the suprageneric revision by Mikhailheivich (1995), with some important differences mainly involving the rank of categories above the level of the family. In the Mikhailheivich scheme, the group was assigned the rank of a class (the Astrorhizata Saidova, 1981, emend. Mikhailheivich, 1995), containing five orders (the Astrorhizida, Dendrophyrida, Saccamminida, Pararhurammina, and Hippocrepina). Mikhailheivich described a total of 12 new families and subfamilies, and her scheme constitutes a major reclassification of the group. Mikhailheivich regarded the Astrorhizata to comprise all unilocular, pseudo-two-chambered, pseudo-multichambered, or pseudocolonial genera with agglutinated or microgranular walls. The current classification differs from the Mikhailheivich scheme in (1) the ranking of certain groups above the level of family, and (2) the restriction of the Astrorhizida to forms with organically-cemented tests only. The microgranular pararhuramminids, paratikhinellids, Pilammina, Rectiplammina, and the Paulbronninimanniinae are here kept separate from the Astrorhizida and are regarded as belonging in the Fusulinida, in agreement with Loeblich & Tappan (1992).

This classification also differs from the Mikhailheivich scheme in some details. For example, the current classification recognises the Komokiaceae as a separate superfamiliy within the Astrorhizina, rather than as families dispersed within the group of dendrophyrids. The presence of abundant stercomata within the test and its loosely cemented wall is sufficient reason to regard the group as a separate superfamiliy. On the other hand, Kamenskaya (1992, 2000) is of the opinion that the komoki are so different that they are not foraminifera at all, but constitute a separate incertae sedis order within the Rhizopoda. The superfamiliy Ammodiscacea is here transferred back to the order Astrorhizida. Loeblich & Tappan (1964, 1974) had placed the group alongside the tubular and unilocular forms (in their superfamiliy Ammodiscacea Reuss, 1862), but in later classifications had included the group within the lituolids (Loeblich & Tappan, 1992, 1994). This superfamiliy possesses an undivided tubular second chamber similar in mode of growth to the Hippocrepinae, which were regarded by Loeblich & Tappan (1992) to belong in the Astrorhizida. Considering the identical mode of growth and the fact that the Ammodiscacea constitutes an ancient group extending back to the early Cambrian (Culver, 1991), this classification accepts the original opinions of Glassner (1945) and Pokorny (1958) in ranking the Ammodiscacea among the Astrorhizida.

2. The Order Lituolida

The Lituolidae are here understood to comprise all the noncanalicate agglutinated groups that possess well-defined chambers, at least in the adult stage, and a simple imperforate wall. The Ammodiscacea are therefore transferred back into the Astrorhizida. The group also contains a few forms that are pseudochambered (e.g., Hormosinella), or are unchambered or have only rudimentary chambers in the early growth stages (i.e., Paratrochamminoides and Lituotuba), which are probably closely related to the Ammodiscacea. In the Lituolidae, cement composition (organic vs. calcareous) is regarded to have less importance than the presence of a bilamellar wall with alveo-
lae, internal rafters and pillars, pseudopores or canaliculae, which is used to distinguish the Lofthusiida and Textulariida. There are several examples of lituolid genera having organically-cemented and calcareous-cemented isomorphs which may be phylogenetically related (e.g., Uvigerinammina & Falsogaudryinella, or Lomarssonella & Protonarssonella). The occurrence of calcitic cement is probably a feature that evolved independently in various lineages (Desai & Banner, 1987; Mikhailевич, 1992). Therefore, the importance of cement composition (organic, microgranular, or regular calcitic) is de-emphasised in this classification. Unfortunately, by excluding the “larger foraminifera” with complex inner structure and the calcitic canaliculate forms from the group means that the Lituolida is a grouping that is defined by negative criteria. This is not the optimal situation if we wish to achieve a coherent phylogeny-based or “natural” classification (see discussion by Cavalier-Smith, 1993). For the purpose of this paper, however, this morphology-based subdivision is adopted for purely practical purposes. The Lituolida thus comprises a large, heterogeneous, and most probably polyphyletic grouping that encompasses families which possess a simple, compact, non-labyrinthic, and nonperforate agglutinated wall. The order is herein subdivided into seven suborders based on both morphology and wall structure.

The Rzehakinina are here listed among the Lituolida, even though members of the group may in fact be more closely related to the miliolid. The subfamilies of Saidova (1981), who separated planispiral genera from those that are coiled like miliolids, are reinstated. Molecular work may eventually resolve the affinities of forms such as Milammina.

The Hormosinina is here understood to consist of forms with pseudochambers (the Hormosinellacea) and forms with true chambers (the Hormosinacea). This classification therefore differs from that of Mikhailевич (1995) who listed pseudochambered forms such as Caudammina within the Astrophyllida. Additionally, the Thomasinellidae were removed to the Textulariina, as these forms possess canaliculate walls. The group is now much more homogeneous in terms of wall structure.

The Lituolina consist of the Lituotubacea, Lituolacea, Haplophragmacea, Recurvadoceae, and Nezzazatacea which include forms with both organic and microgranular calcite cement. The new superfamilies Lituotubacea likely represent an evolutionary transition from the Ammodiscaceae. The Lituotubacea were originally placed among the Lituolacea by Loeblich & Tappan, in spite of the fact that the latter group was described as planispiral and multilocular. The separation of the Lituotubacea from the Lituolacea is then similar to the separation between the Hormosinellacea and the Hormosinaceae. The streptospiral genera with simple walls are here placed in the new superfamilies Recurvadoceae, whereas the genera with alveolar walls are removed to the Lofthusiida. Finally, the microgranular forms are placed within the new superfamilies Nezzazatacea, encompassing genera that display planispiral to low trochospiral coiling with simple walls, which may contain plates or pillars within the chambers. This group currently includes the Nautiloculinidae, Mayncinidae, Nezzazatidae, Barkerinidae, and the new family Debarinidae. More work needs to be done to resolve the affinities of these small microgranular forms. The Spiroplectamminina are differentiated from the Lituolina based on morphological criteria (the presence of an uncoiled biserial to uniserial part).

The Trochamminina is here regarded as a suborder within the Lituolida that is defined on gross morphology, rather than as a separate order defined on wall structure. As mentioned above, Brönnimann & Whittaker (1988) defined the order Trochamminida as possessing organically-cemented walls bound by inner and outer organic membranes. However, a subsequent study of test ultrastructure by Brönnimann et al. (1992) revealed that diverse species from supposedly unrelated genera such as Ammodiscus, Glomospira, Ammobaculites, and Haplophragmoidea also possess this type of wall structure. Clearly, by adopting this wall-structure based criterion, the group of “trochamminids” would grow so far beyond the boundaries of its traditional definition as to render the term meaningless. I therefore revert to the older (morphological) definition of the group, following suggestions of Brönnimann et al. (1992), and regard the group to have the status of a suborder. The Trochamminina therefore comprise the low-trochospirally coiled forms, while the Verneullinina encompass the high trochospiral genera with simple walls. Within this group, forms with a complex apertural tube are separated out into the new family Reophacellidae. The Nezzazatina are here raised to the status of a suborder, and encompass those mostly microgranular forms with a simple wall structure.

Finally, the “Carteriniida” which Loeblich & Tappan (1992) considered to be a separate order on account of its supposedly secreted “spicules”, is here considered to be just a minor subgroup within the Trochamminacea. This classification follows the suggestions of Brönnimann & Whittaker (1988, 1990) who listed the carterinids as a subfamily of the Trochamminidae.

3. The Order Lofthusiida ord.nov.

This name is used for the Mesozoic to Recent forms that have a complex agglutinated wall with either organic, microgranular, or calcitic cement, with advanced genera possessing a bilamellar wall differentiated into an imperforate outer layer, and a thicker inner layer that is either perforate, alveolar, or forms internal partitions. This group encompasses the so-called “larger agglutinated foraminifera” and their close relatives. In this classification, the group is understood to consist of five suborders, three of which are new: the Lofthusiina, Biokovina, Cyclolinina, Ataxophragmmina, and the Orbitolinina. These suborders are differentiated by morphology and on the type of inner structure. The former (Lofthusiina) has an alveolar wall, and includes the Haplophragmacea, which is here restricted to forms with complex inner structure. The Biokovina have perforations, and the Cyclolinina have internal partitions. The predominantly high trochospiral to conical Ataxophragmmina and Orbitolinina possess internal partitions and interseptal pillars.

4. The Order Textulariida

The presence of calcitic cement with canaliculi or pseu-
Dopores is an advanced feature in the evolution of the agglutinated foraminifera. Loeblich & Tappan (1987) regarded the superfamily Textulariacea to be canaliculate, but in 1989 provided an emended definition of the group based on wall structure, and noted that the wall may be solid or canaliculate. In their 1992 paper, however, Loeblich & Tappan reverted back to their older definition, and stated the Textulariida are characterised by “canaliculate agglutinated walls in which both ends of the pores are closed by an organic sheet”. In fact, Loeblich & Tappan (1987) were not always always consistent in assigning genera to the Textulariacea, and even (mistakenly) included some forms with organic cement such as Eggerelloides and Claucaoammina. As already pointed out by Banner & Desai (1985), perforations in the test wall of calcitic-cemented agglutinated foraminifera have arisen independently in different lineages during the Mesozoic and Paleogene. Banner et al. (1991) were of the opinion that to separate such closely related pairs of genera such as Praedorothia-Dorothia, and Protomassonella - Massonella into different orders "would produce a suprageneric classification that would be misleading both phylogenetically and taxonomically". In spite of the fact that canaliculi in the test wall have polyphyletic origins, most workers list this feature as the basis for defining the order Textulariida.

Detailed investigations by Neagu (1999) have shown that (largely) biserial forms with perforate walls first evolved during the earliest Cretaceous. The genus Kaminska, placed by Neagu (1999) in a new subfamily of the Textulariidae, differs from all other genera in the group (with the exception of Spirorutilus) in possessing an initial planispirally coiled part. Neagu (1999), however, did not provide an emended diagnosis of the Textulariacea. In the scheme adopted here, the definition of the order Textulariida is emended to include those perforate genera that possess a planispiral or uniserial initial stage. The order contains three main groups: the initially trochosorial or triserial Eggerellidae, the mostly biserial Textulariaceae (including the Kamianthidae); and the trochosorial Chrysalinaeaceae. The Thomasinellidae is here tentatively included within the Textulariacea, even though these uniserial attached forms are probably unrelated. Because of the presence of canaliculate forms that are initially planispiral, it is conceivable that some modern representatives of the Textulariacea have evolutionary links to the Spiroplectamminacea.

The Chrysalinaeaceae (=Chrysalinidae as emended by Banner et al., 1991) consist of Mesozoic high trochosphoral (triserial, quadriserial and quinqueserial) forms that have solid, protocanalicate or canaliculate microgranular walls. In some genera, such as the Jurassic paravalvulinids, canalulae only appear in late ontogenetic stages. This raises the question of whether or not these forms ought to be included in the Textulariida. This classification follows Banner et al. (1991) and Loeblich & Tappan (1992) in including the Chrysalinaeaceae within the Textulariidae, albeit only tentatively.

The identification of biogenically deposited aragonitic cement in a species of Textularia may make it necessary to further subdivide the order Textulariida (or even the subclass Textulariia). In a study of the species Textularia crenata Cheng & Zheng using Raman spectoscopy, Roberts & Murray (1995) documented the presence of aragonitic cement. In the discussion section of their paper Roberts & Murray pointed out that the calcareous perforate orders Robertinida and Involutinida of Loeblich & Tappan are distinguished based on their aragonitic tests. They concluded with a typical understatement that if the mineralogy of the cement is genetically controlled, “this would have implications for foraminiferal classification”. Obviously, any internally coherent classification of the foraminifera that includes aragonitic perforate orders should also have a separate order for the agglutinated aragonitic forms. Clearly, more research is needed on this topic, as well as on the nature of canaliculae in the Mesozoic genera.

**Molecular Systematics**

Preliminary studies of molecular systematics of foraminifera based on analysis of ribosomal DNA sequences (reviewed in Lee et al., 2000) appear to substantiate a separation between the astrorhizids and other groups of agglutinated foraminifera. The phylogenetic tree of the foraminifera based on SSU rDNA published by Lee et al. demonstrates that astrorhizids form a coherent cluster together with the allogromids, while multichambered forms such as Haplophragmoides, Eggerelloides, and Ammobaculites display closer affinities to the calcareous lagenids and rotalids. Interestingly, the two canaliculate agglutinated genera studied (Bigenerina and Textularia) form a separate subcluster within the multichambered agglutinated-rotalid cluster. Although the studies of molecular phylogeny are based on no more than 40 genera, at the moment they tend to uphold the morphology-based systematics, and especially the distinction between the astrorhizids, lituolids, and textulariids.

**Class FORAMINIFERA d’Orbigny, 1826**

Subclass Textulariaria Mikhalevich, 1980

Test agglutinated, foreign particles held in organic or mineralised ground mass.

**ASTRORHIZIDA** Lankester, 1885

Test free or attached, irregular, rounded, tubular, branching, or coiled; nonseptate or only irregularly constricted, with interior undivided or only partially subdivided into a proloculum and unchambered second chamber. Wall agglutinated, nonperforate, simple or thickened on the inside, may have simple labyrinthine structures or inner protrusions partially subdividing the chamber, cement organic.

**ASTRORHIZINA** Lankester, 1885

ASTRORHIZACEA Brady, 1881

ASTRORHIZIDAE Brady, 1881

ASTRORHIZA Sandahl, 1858

ASTRORHIZOIDES Shchedrina, 1969

CLADOS Schröder, Medioli & Scott, 1989

CYSTINGARHIZA Bell, 1996

CYLINDRAMMINA Bell, 1996

GLOBODENDRINA Plewes, Palmer & Haynes, 1993

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1 The genus *Pelosina* Brady, 1879 was removed to the Xenophyophoria by Mikhalevich & Voronova (1999).
Revised Classification of the Agglutinated Foraminifera

RADICULA Christiansen, 1958

VANHOEFFENELLIDAE Saidova, 1981

INAURIS J.E. Conkin, B.M. Conkin & Thurman, 1979

VANHOEFFENELLA Rumbler, 1905

RHABDAMMINIDAE Brady, 1884

RHABDAMMININAE Brady, 1884

LINEA Schröder, Medioli & Scott, 1989

MARIPELLA Norman, 1878

RHABDAMMINA M. Sars in Carpenter, 1869

BATHYSPHINONINAE Avnimelech, 1952

BAHIANOTUBUS Brönnimann, Zaninetti, & Moura, 1979

BATHYSPHON Sars, 1872

BOGDANOWICZIATishvanova & Vyalov, 1967

NOThIA Pflaumann, 1964

PSAMMOSIPHONELLA Avnimelech, 1952

RHABDAMMINA de Folin, 1887

HIPPOCREPINELLIDAE A. Dressel, 1850

KOMOKIACEA Tendal & Hessler, 1977

KOMOKIIDAE Tendal & Hessler, 1977

CEREBRUM Schröder, Medioli & Scott, 1989

GLOBIPELORHIZA Cedhagen & Mattson, 1991

IPOA Tendal & Hessler, 1977

KOMOKIA Tendal & Hessler, 1977

LANA Tendal & Hessler, 1977

RETICULUM Schröder, Medioli & Scott, 1989

NORMANINAE Mikhailovich, 1995

NORMANINNA Cushman, 1928

SEPTUMA Tendal & Hessler, 1977

RHIZAMMINIDAE Wieser, 1931

RHIZAMMINA Brady, 1879

TESTULORHIZA Avnimelech, 1952

BACULELLIDAE Tendal & Hessler, 1977

ARBOR Schröder, Medioli & Scott, 1989

BACULELLA Tendal & Hessler, 1977

CATENA Schröder, Medioli & Scott, 1989

CHONDRODAPSIS Mullineaux, 1988

EDGERTONIA Tendal & Hessler, 1977

SACCAMMINIDAE Brady, 1884

SACCAMMININAE Brady, 1900

AMPHIFENESTRELLACEAE Mikhailovich, 1995

AMPHIFENESTRELLA Rumbler, 1935

BLASTAMMINA Eisenack, 1932

STEGERNOVINCIDEAE Moreman, 1930

ANICTOSPHAERASTACAMMININAE Mikhailovich, 1995

BYKOVACHEINAINailed, 1969

CERATAMMINA Linné, 1758

GASTROAMMINA Dunn, 1942

LUEKAKIETELZHigulina, 1999

PSEUDASTRORHIZAEisenack, 1932

RAIBOSAMMINA Moreman, 1930

SPICULOSIPHON Christiansen, 1964

STEGERNOVINCIDEAE Moreman, 1930

STORThRHIZA Schultze, 1875

THEKAMMINA Dunn, 1942

THURAMINOIDEES Plummer, 1945

HEMISPHERAMMININAE Loeblich & Tappan, 1961, emend Mikhailovich, 1995

HEMISPHERAMMINA Loeblich & Tappan, 1957

FAIRIELLESummer, 1958

SOROSPHAERELLINConkin, Conkin & Thurman, 1979

SACCAMMINIDAE Brady, 1884

CAUSINAE Mikhailovich, 1995

CAUSIA Rumbler, 1938


Includes the genus Oculosiphon Avnimelech, 1952.

Fossilized from the Saccammininae by Mikhailovich (1995).

Transferred from the Bathysphonidae by Mikhailovich (1995) because of the constricted apertures.

Mikhailovich (1995) regarded the group to be of family rank.

Transferred from the Astartorhizidae by Mikhailovich (1995) because of its long slender, branching arms.

Mikhailovich (1995) regarded the group to be of family rank.


Retained here in the Foraminifera despite Kamensky’s (1992, 2000) views that they constitute a separate order within Rhizopoda, incertae sedis. Mikhailovich (1995) placed the komokiid families within their order Dendrophyrida, considered here to be within the Astartorhizacea.

Transferred to the Komokiacea in accordance with findings of Gooday & Cook (1984). The subfamily Rhizamminidae is therefore reinstated herein.

Placed by Mikhailovich (1995) in the subfamily Rhizammininae, but its affiliation to the Komokiacea has not been verified.

Regarded by Mikhailovich (1995) to comprise a suborder, this group of single forms is here assigned superfamil y rank.


Transferred from the Vanhoefellinidae by Mikhailovich (1995) because of its circular (not tubular) test.


SACCAMMININAE Brady, 1884
BRACHYSIPHON Chapman, 1906
CRIBROTHALAMMINA Goldstein & Barker, 1988
HYPERAMMINITA Crespin, 1958
LAGENAMMINA Rhumbler, 1911
MARSUPULINOIDEES Brönimann, 1988
OVAMMINA Dahlgren, 1962
PULULINELLA Saidova, 1975
PLACENTAMMINA Thaliman, 1947
PSAMMOPHAGA Arnold, 1982
PSEUDOSACCULINELLA Yassini & Jones, 1995
SACCAMMINA Carpenter, 1869
SACCAMMINELLA Brönimann, Whittaker & Zaninetti, 1992
SACCULINELLA Crespin, 1958
STOMASPHAERA Mound, 1961
TECHINITELLA Norman, 1878
TITANOTHEKA Gaucher & Sprechmann, 1999
PULULINAE Brady, 1884
PULULINA Carpenter, 1870
THURAMMINAE Miklukho-Maklay, 1963
ASTRAMMINA Rhumbler, 1931
BAHIANOFUSUS Brönimann, Zaninetti, & Moura, 197911
ORBULINELLOIDES Saidova, 1975
ORDOVINICA Eisenack, 1938
PSEUDOTHURAMMINA Scott, Medioli & Williamson, 1981
THURAMMINA Brady, 1879
COLONAMMININAE Rauser-Chernousova & Reitlinger, 1993
SACCAMMINA Moreman, 1930
JASCOTTIELLA Huddleston & Haman, 198222
NUBECULARIELLA Averintsev, 191127
THOLOSINAE Mikhailевич, 1995
IRIDIA Heron-Allen & Earland, 191422
MESAMMINA Pichler, 197122
SCYPHOCodon Kristan-Tollmann, 197122
THOLOSINA Rhumbler, 189527
CRITHIONINIDAE Hofker, 197224
DAITRONINAE Mikhailевич, 1995
DAITRONTA Loeblich & Tappan, 1961
NEPHROPHAEARA Kristan-Tollmann, 1971
CRITHIONININAE Hofker, 1972
CRITHIONINA Goes, 1894
PSEUDOWEBBINELLA Shchedrina, 1962
VERRUCINA Goes, 1896
ORYCTODERMINAE Saidova, 1981
DISCOBOTELLLINA Collins, 1958
ORYCTODERMA Loeblich & Tappan, 1961
MASONELLA Brady, 188925
PSAMMOSPHAERACEA Haeckel, 189428
PSAMMOSPHAERIDAE Haeckel, 1894
PSAMMOSPHAERINAe Haeckel, 1894

27 Transferred from the Hormosinacea by Mikhailевич (1995) because the group is colonial and lacks true chambers.
29 Transferred from the Allogromiida by Mikhailевич (1995).
11 Transferred from the Halyphasmidae by Mikhailевич (1995) because of its saccamminid aperture.
26 Regarded by Mikhailевич (1995) to comprise a suborder, this group of pseudocolonial forms is here assigned superfamly rank.

CELLONINA Kristan-Tollmann, 1971
PSAMMOPHAX Rhumbler, 1931
PSAMMOSPHAERA Schulze, 1875
SOROSPHAERA Brady, 1879
THURAMMINOPSIS Haeusler, 1883
TELAMMINIDAE Loeblich & Tappan, 1985 emend, Mikhailевич, 199527
METAMORPHINA Browne, 1963
ROPOSTRUM Jonasson & Schröder-Adams, 1996
TELAMMINA Gooday & Haynes, 1983
TUMIDOTUBUS Gooday & Haynes, 1983
POLYSACCAMMINIDAE Loeblich & Tappan, 198428
POLYSACCAMMINAE Loeblich & Tappan, 1984
GOATAPITIGBA Narchi, 1962
POLYSACCAMMINA Scott, 1976
SACCAMMINOIDES Geroch, 1955
SACCAMMINIS Ireland, 1960
AMPHICERVICINAE Mikhailевич, 1995
SACCAMMINIDINAE Mikhailевич, 1995
SACCAMMININAE Mikhailевич, 1995
COLOMULINAE Storr, 1984
HYPERAMMINA Crespin, 1958
HYPERAMMINIDAE Rhumbler, 1895
HYPERAMMININAE Mikhailевич, 1995
GIRALIARELLA Crespin, 1958
HYPOCREPININA Saidova, 1981
HYPOCREPINACEAe Rhumbler, 1895
HYPOCREPINIDAE Rhumbler, 1895
HYPOCREPININAE Rhumbler, 1895
GIRALIARELLA Crespin, 195811
HYPOCREPINA Parker, 1870
HYPERAMMINOIDIDAE Cushman & Waters, 192811
PSEUDOHYPERAMMINA Crespin, 195811
JACULELLINAE Mikhailевич, 1995
ACICULELLINA Vyalov, 196628
ARENOSIPHON Grubbs, 193912
JACULELLA Brady, 187912
KECHENOTIKE Loeblich & Tappan, 198411
SANSAABMINA Loeblich & Tappan, 198411
TASMANAMMINA Gutschick & Wulliner, 198311
HYPERAMMINIDAE Eimer & Pickert, 189913
HYPERAMMININAE Eimer & Pickert, 1899
ARENICOLUS Eisenack, 1969
HYPERAMMINA Brady, 1878
PLATYSOLENITES Eichwald, 186013
SACCARARENA Loeblich & Tappan, 198415
SACCORHIZINAE Eimer & Fickert, 1899
SACCARENA Chernykh, 1969
SACCORHIZA Eimer & Fickert, 1899
BOTELLINIDAE Chapman & Parr, 1936
BOTELLINA Carpenter, Jeffreys & Thomson, 1870
PROTOBOTELLINA Heron-Allen & Earland, 1929
AMMOVOLUMINAE Chernykh, 1967
AMMOVOLUMINA Chernykh, 1967
HYPERBATHOIDEIS Ireland, 1966
PSAMMONYX Döderlein, 1892
SERPENULINA Chernykh, 1967

AMMODISCINA Mikhailovich, 1980
AMMODISCACEA Reuss, 1862
AMMODISCIDA Reuss, 1862
AMMODISCINAE Reuss, 1862
AGATHAMMINOIDES Vangrow, 1964
AMMODISCOIDES Cushman, 1909
AMMODISCUS Reuss, 1862
ARENOTURRISPIRILLINA Tairov, 1956
BIFURCAMMINA Ireland, 1939
HEMIDISCUS Schellwien, 1898
RECTOAMMODISCUS Reitlinger, 1993
SPIRILLINOIDES Rhumbler, 1938
SPIROSOLENITES Gaessner, 1979
TOLYPAMMININAE Cushman, 1928
AMMODISCCELLA Ireland, 1956
AMMODISCCELLITES Resig & Glenn, 1997
AMMOLAGENA Eimer & Fickert, 1899
AMMOVERTELLA Cushman, 1928
HEMIDISCCELLA Bock, 1968
SATURNELLA Hedinger, 1993
SERPULOPSIS Girty, 1911
TOLYPAMMINA Rhumbler, 1895
AMMOVERTELLININAE Saidova, 1981
AMMOVERTELLINA Suleymannov, 1959
ANNECTINA Suleymannov, 1963
ARENOMEANDROSPIRA Jones & Wonders, 2000
GLOMOSPIRELLA Plummer, 1945
PILAMMINELLA Salaj, 1978
RECTOGLOMOSPIRA Trifonova, 1978
VOSTOKOVELLA Pronina, 1972
USBEKISTANIINAE Vyalov, 1968
FLAGROSPIRA Vyalov, 1977
GLOMOSPIRA Rzebak, 1885
REPMANINA Suleymannov, in Arapova & Suleymannov, 1966
TURRITELLELLA Rhumbler, 1905
USBEKISTANIA Suleymannov, 1960

LITUOLIDA Lankester, 1885
Test free or attached, multilocular or becoming so, uniserial, biserial, multiserial, or coiled in early stage, later may uncoil; chamber interior simple, or may be partially divided by septula in advanced forms; wall agglutinated with organic, microgranular, or calcitic cement; simple and nonperforate.

RZEHAKININA Saidova, 1981
RZEHAKINACEA Cushman, 1933
RZEHAKINIDAE Cushman, 1933
RZEHAKININAE Cushman, 1933
PSAMMINOPELTA Tappan, 1957
RZEHAKINA Cushman, 1927
SPIROLOCAMMINA Earland, 1934
MILIAMMININAE Saidova, 1981
AMMOFLINTINA Earland, 1934
BIRSTEINIOLLA Mayer, 1974
MILIAMMINA Heron-Allen & Earland, 1930
SILICOMASSILINA Serova, 1966
SILICOSIGMOILINA Cushman & Church, 1929
SPIROSIGMOILINELLA Matsunaga, 1955
TRILOCULARENA Loeblich & Tappan, 1955

HORMOSININA Mikhailovich, 1980
HORMOSINELLACEA Rauser & Reitlinger, 1986
OXINOXISIDAE Vyalov, 1968
OXINOXIS Gutschick, 1962
HORMOSINILLIDAE Rauser & Reitlinger, 1986
ARCHIMERISMUS Loeblich & Tappan, 1984
CAUDAMMINA Montanaro-Gallitelli, 1955
HORMOSINELLA Shchedrina, 1969
REOPHANUS Saidova, 1970
ROCKFORDINA Rauser & Reitlinger, 1986
SUBREOPHAX Saidova, 1975

HORMOSINACEA Haeckel, 1894
ASCHEMOCELLIDAE, Vyalov, 1966
ASCHEMOCELLA Vyalov, 1966
CALOS Schröder, Medioli & Scott, 1989
KALAMOPSIS de Folin, 1883
REOPHACIDAE Cushman, 1927
ADELÜNGIA Suleymannov, 1966
HORMOSINOIDES Saidova, 1975
LEPTOHALYSIS Loeblich & Tappan, 1984
NODULINA Rhumbler, 1895
REOPHAX de Montfort, 1808
HORMOSINIDAE Haeckel, 1894

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36 Regarded by Loeblich & Tappan to be in the synonymy of the Hipparcospinidae, reinstated by Mikhailovich (1995)
37 Considered a synonym of the Hyperamminidae by Loeblich & Tappan (1987), reinstated and raised in rank from a subfamily by Mikhailovich (1995). This family includes the pseudo-labyrinthic forms with sponge spicules protruding into the chamber lumen.
38 Transferred from the Hyperamminidae by Mikhailovich (1995).
39 These loosely coiled forms were transferred from the Ammodiscacea by Mikhailovich (1995), who regarded them to be transitional to the ammodiscids.
40 The Triassic microgranular genera Gandinella, Pilaminina, and Rectopilaminina are here removed to the Earlandiacea.
41 Bender (1995) showed that the type species G. gordialis possesses an initial portion that coils as in Repmanina.
42 Nom. transl. ex order Rzehakinida Saidova, 1981.
43 Reinstated herein for planispiral genera. Includes the Spirolocammininae Saidova, 1981.
44 Reinstated herein for genera that are initially coiled in various planes. The genus Rothina is a junior synonym of Caudammina (Bubik, 1997).
45 Nom. transl. ex order Hormosinida Mikhailovich, 1980.
46 Transferred from the Lituolacea, as its chamber arrangement is irregular, not coiled as reported by L&J‘97. Gutschick (1962) originally regarded Oxinopsis as transitional between saccamminids and neoplicatids.
47 This family was placed in the Asterochizida by Mikhailovich (1995) because of the absence of true septa between chambers.
48 Includes Silicotuba Vyalov, 1966, here considered to be a junior synonym. The family Silicotubidae is therefore removed from this classification.
CUNEATINAES Loeblich & Tappan, 198449
ACOSTATA Brönnimann, Whittaker & Valleri, 1992
CUNEATA Fursenko, 1979
SULCOPHAX Rhumbler, 1931
WARRENITA Loeblich & Tappan, 1984
POLYCHASMININAE subfam.nov.

Test free, initially uniserial with broad and low chambers, later branching dichotomously.

BIREOPHAX Bolli, 1961
POLYCHASMINA Loeblich & Tappan, 1946
HORMOSININAE Haeckel, 1894
GINESINA Bermúdez & Key, 1952
HOROSMINA Brady, 1879
LOEBLICHOPSIS Hofker, 1967
PSEUDONodosinella Saidova, 1970
SILICONODOSARINA Colom, 1963
NODOSININAE Saidova, 1981
CRIBRATINOIDES Saidova, 1975
KUNKLERINIDAE Rauser & Reitlinger, 1986
SCHEROCHORELLA Loeblich & Tappan, 1984
DUSENBURYINIDAE Haynes & Nwabufo-Ene, 1998
DUSENBURYNINA Bermúdez & Key, 1952
GLAUCOAMMINIDAE Saidova, 1981
GLAUCOAMMININA Seiglie & Bermúdez, 1969
PSAMMOLINGULINA A. Silvestri, 190451

LITUOLINA Lankester, 1885
LITUOTUBACEA Loeblich & Tappan, 198452
LITUOTUBIDAE Loeblich & Tappan, 1984
LITUOTUBA Rhumbler, 1895
PARATROCHAMMINIDAE Soliman, 1972
PLAGIOPHARE Kristan-Tollmann, 1973
CONGLOPHRAGMIUM Bermúdez & Rivero, 196353
TROCHAMMINIDAE Haynes & Nwabufo-Ene, 199850
SOKOTINA Haynes & Nwabufo-Ene, 1998
TROCHAMMINOIDES Cushman, 1910

LITUOLACEA de Blainville, 1827
HAPLOPHRAGMOIDIDAE Maync, 1952
AMMOSIPHONIA He, 1977
APPOSTROPHOIDES McNeil, 1997
ASANOSPIRA Takayanagi, 1960
BUZASINA Loeblich & Tappan, 1985
ELOVUTINELLA Mjatiuk, 1971
GOBBETTIA Dhillon, 1968
HAPLOPHRAGMOIDES Cushman, 1910

LABROSPIRA Höglund, 1947
TREMATEPHRAGMOIDES Brönnimann & Keij, 1986
TROCHAMMINITA Cushman & Brönnimann, 1948
UNITENDINIA Alekseychik-Mitskevich, 1973
VELERONINOIDEA Saidova, 1981
DISCAMMINIDAE Mikhailевич, 1980
AMMOSCALARIA Höglund, 1947
DISCAMMINA Lacroix, 1932
GLAPHYRAMMINA Loeblich & Tappan, 1984
STAROBOGATOVELLA Mikhailевич, 1994
SPHAERAMMINIDAE Cushman, 1933
SPHAERAMMININAE Cushman, 1933
AMMOSPHAERULINA Cushman, 1912
CANAPAIA Boltovskoy, 1961
SPHAERAMMINA Cushman, 1910
PRAESPHAERAMMININAE Kaminski & Mikhailевич, subfam.nov.

Test planispiral and involute, later chambers almost completely enclosing earlier ones; aperture areal, rounded to slitlike, without a tooth.
PRAESPHAERAMMINA Kaminski & Filipescu, 2000
PONCEAMMINIDAE Seiglie, 1991
PONCEAMMINA Seiglie, 1991
LITUOLIDAE de Blainville, 1827
AMMOMARGINULINAE Podobina, 1978
AGARDHELLA Nagy & Basov, 1998
AMMOBACULARIA Kristian-Tollmann, 1964
AMMOBACULITES Cushman, 1910
AMMOMARGINULINA Wiessner, 1931
AMMOTIUM Loeblich & Tappan, 1953
ERATIDUS Saidova, 1975
HAYMANELLA Sirel, 1999
KUTSEVELLA Dain, 1978
LAMINA Voloshina, 1972
OSTIOBACULITES Brönnimann, Whittaker & Zaninetti, 1992
SCLUPTOBACULITES Loeblich & Tappan, 1984
SIMOBACULITES Loeblich & Tappan, 1984
FLABELLAMMININAE Podobina, 1978
AMMOPALMULA Lindenberg, 1966
FLABELLAMMINA Cushman, 1928
PETERAMMINA Hamaoui, 1965
TRIPLASIA Reuss, 1854
LITUOLINAE de Blainville, 1827
ATACTOLITUOLA Loeblich & Tappan, 1984
BULBOBUCCIRCRENATA Kerdany & Eissa, 1973
KOLCHIDINA Morozova, 1967
LITUOLA Lamarck, 1804
AMMOASTUTINAE Loeblich & Tappan, 1984
AMMOASTUTA Cushman & Brönnimann, 1948
PRAEAMMOASTUTA Burch, 1952
PLACOPSILINIDAE Rhumbler, 1913
PLACOPSILININAE Rhumbler, 1913
ACRULIAMMINA Loeblich & Tappan, 1946
AMMOCIBICIDES Earland, 1934
AMMOCIBICOIDES Saidova, 1975
LAPILLINCOLA Wilson, 1986
PLACOPSILINA d'Orbigny, 1850
SUBBDELLOIDINA Frentzen, 1944
FLATSCHKOFELINAE subfam.nov.

49 Emended by Brönnimann et al. (1992) to include only the bilaterally symmetrical (i.e. non-branching) forms. However, these authors did not erect a subfamily for those genera that were excluded from the Cuneatininae.

50 Transferred from the Textulariidae because of its noncalcareous wall. Globoammina has a bilamellar wall with open intergranular spaces between the layers, not true canaliculae.

51 Transferred from the Cuneatininae by Popescu (2000), who reported that the wall is thick and traversed by meandering pores.

52 Here separated from the Lituolacea, since members of this superfamily display irregular coiling and/or rudimentary chambers, and may possess a monoseptate early portion.

53 Placed in the synonymy of Paratrocchamminoides by Loeblich & Tappan (1987), the genus is here reinstated for the fully chambered forms with basal apertures.
Test attached, chambers of early stage irregularly coiled, later biserial then rectilinear; wall agglutinated, solid.

FLATSKOFELIA Rettori, Senowbari-Daryan & Zühlke, 1996

ADHAERENTINAE Loeblich & Tappan, 1986

ADHAERENTIA Plummer, 1938

RECURVOIDACEA Alekseychik-Mitskevich, 1973

AMMOSPHAEROIDINIDAE Cushman, 1927

AMMOSPHAEROIDINAE Cushman, 1927

AMMOSPHAEROIDINA Cushman, 1910

CYSTAMMINA Neumayr, 1889

PRAECYSTAMMINA Krasheninnikov, 1973

RECURVOIDINAE Alekseychik-Mitskevich, 1973

BUDASHEVIELLA Loeblich & Tappan, 1964

CRIBROSTOMELLUS Saidova, 1970

CRIBROSTOMOIDEIS Cushman, 1910

RECURVOIDELLA Uchio, 1960

RECURVOIDES Earland, 1934

THALMANNAMMINA Pokorný, 1951

PLECTORECURVOIDAE Loeblich & Tappan, 1964

PLECTORECURVOIDES Noth, 1952

POKORKYAMMINA Neagu & Platon, 1994

AMMOBACULINIDAE Saidova, 1981

AMMOBACULININA Saidova, 1981

AMMOBACULINUS Saidova, 1975

BULBOBACULITES Maync, 1952

NAVARELLA Cyri & Rat, 1951

TELATYNELLINA Gawor-Biedowa, 1987

TELATYNELLA Gawor-Biedowa, 1987

ACUPEINIDAE Brönnimann & Zaninetti, 1984

ACUPEINA Brönnimann & Zaninetti, 1984

SPIROPLECTAMMININA Mikhailievaich, 1992

SPIROPLECTAMMINACEA Cushman, 1927

SPIROPLECTAMMINIDAE Cushman, 1927

SPIROPLECTAMMININAE Cushman, 1927

AMMOBACULOIDEIS Plummer, 1932

BOLIVINOPSIS Yakovlev, 1891

HETERANTYX Loeblich & Tappan, 1982

ORECTOSTOMINA Seiglie, 1965

PALUSTRELLA Brönnimann, Whittaker & Zaninetti, 1992

QUASIPIROPECTAMMINA Cushman, 1927

SPIROPECTAMMINA Loeblich & Tappan, 1982

SPIROPECTAMMINA Cushman, 1927

SPIROPECTELLA Earland, 1934

SPIROPECTEINELLA Kiselman, 1972

VULVULININAE Saidova, 1981

AMMOSPIRATA Cushman, 1933

VULVULINA d ‘Originey, 1826

SPIROTEXTULARINAE Saidova, 1975

SEPTIGERINA Keijzer, 1941

SPIROTEXTULARIA Saidova, 1975

NOVALESINAE Loeblich & Tappan, 1984

NOVALESIA Magniez, 1974

MORULAEPECTINAE Saidova, 1981

MORULAEPECTA Höglund, 1947

DUQUEPSAMMINIIDAE Sieglie & Baker, 1987

DUQUEPSAMMINA Sieglie & Baker, 1987

TEXTULARIOSPIDAE Loeblich & Tappan, 1982

AAPTOTOICHUS Loeblich & Tappan, 1982

BICAZAMMINA Neagu & Neagu, 1995

BIMONILINA Eicher, 1960

HAGHIMASHELLA Neagu & Neagu, 1995

HAIMASIIELLA Loeblich & Tappan, 1982

MINYAICHME Loeblich & Tappan, 1982

MONOTALEA Brönnimann, Whittaker & Zaninetti, 1992

PLECTINELLA Marie, 1956

PLEUROSTOMELLOIDES Majron, 1943

RASHNOVAMMINA Neagu & Neagu, 1995

TEXTULARIOSPIS Banner & Pereira, 1981

TRUNCULOCAVUS Brönnimann & Whittaker, 1993

PSEUDOBOLIVINIDAE Wiesner, 1931

LACROIXINA Saidova, 1981

PARVIGENERINA Vella, 1957

PSEUDOBOLIVINA Wiesner, 1931

NOURIIDAE Chapman & Parr, 1936

ABDULLAEVIA Suleymanov, 1965

NOURIA Heron-Allen & Earland, 1914

PAVONITINACEAE Loeblich & Tappan, 1961

MARIETIDAE Loeblich & Tappan, 1986

HENSONIA Marie, 1954

MARIEITA Loeblich & Tappan, 1964

PAVONITINIDAE Loeblich & Tappan, 1961

SPIROPSAMMINIDAE Sieglie & Baker, 1984

SPIROPSAMMIA Seiglie & Baker, 1984

PAVONITINIDAE Loeblich & Tappan, 1961

PAVONITINA Schubert, 1914

PAVOPSAMMINA Seiglie & Baker, 1984

PSEUDOTRIPLASIA Mayercker, 1954

ZOTHECULIFIDA Loeblich & Tappan, 1957

TROCHAMMININA Saidova, 1981

TROCHAMMINACEAE Schrager, 1877

TROCHAMMINIDAE Schrager, 1877

TROCHAMMININAE Schrager, 1877

AMMOANITA Seiglie & Baker, 1987

CALYPTAMMINA Nagy & Basov, 1998

AMMOGLOBIGERINA Eimer & Fickert, 1899

ASAROTAMMINA Brönnimann, 1986

CAMURAMMINA Brönnimann & Kett, 1986

GLOBOTROCHAMMINOPSIS Brönnimann & Zaninetti, 1984

LEPIDOPATROCHAMMINA Brönnimann & Whittaker, 1986

LINGUITROCHAMMINA Hercogová, 1987

PARATROCHAMMINA Brönnimann, 1979

PATELLOVALVULINA Neagu, 1975

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54 Nom. transl. ex family Recurvoidinaceae Alekseychik-Mitskevich, 1973. This superfamily is here separated from the superfamily Haloplagmaceae (sensu Loeblich & Tappan, 1987) on account of its simple wall.

55 Transferred from the Haloplagnoididae because of its reportedly streptosporal coiling.

56 As above, Jones et al. (1993) demonstrated that the types pecies is streptosporal, especially in the early stage.

57 Transferred from the Spirelopectamminacea, as the group is displays closer afffinity to Recurvoides.


59 The subfamily Palustrellinae Brönnimann, Whittaker & Zaninetti, 1992 is not recognised here.

60 Includes the subfamily Monotaleinae Brönnimann Whittaker & Zaninetti (1992), which is isomorphic but differs in its stratigraphical occurrence.
PORTATROCHAMMINA Echols, 1971
PSEUDADERCOTRYMA Saidova, 1981
TRITAXIS Schubert, 1921
TROCHAMMINA Parker & Jones, 1859
TROCHAMMINOPSIS Brönnimann, 1976
ARENOPARRELLINA Saidova, 1981
ARENOPARRELLA Andersen, 1951
TROCHAMMINULINA Schchedrina, 1955
CARTERININAE Loeblich & Tappan, 1955\textsuperscript{61}
CAR TERINA Brady, 1884
JADAMMININAE Saidova, 1981
ENTZIA Daday, 1883
JADAMMINA Bartenstein & Brand, 1938
POLYSTOMAMMINAE Brönnimann & Bearlen, 1977
BALTICAMMINA Brönnimann, 1976
DEUTERAMMINA Brönnimann, 1976
LEPIDODEUTERAMMINA Brönnimann & Whittaker, 1983
POLYSTOMAMMINA Seigle, 1965
ROTIALIAMMINAE Saidova, 1981
ROTALIAMMINA Cushman, 1924
SIPHOTROCHAMMINA Saunders, 1957
TIPHOTROCHA Saunders, 1957
TORETAMMINAE Brönnimann, 1986
TROCHAMMINELLA Cushman, 1943
VIALOVINAE Suleymanov, 1983
ARENIONIELLA Marks, 1951
VIALOVA Suleymanov, 1966
ZAVODOVSKININA Brönnimann & Whittaker, 1988
ZAVODOVSKINA Brönnimann & Whittaker, 1988
ADERCOTRYMIDAE Brönnimann & Whittaker, 1988
emend. Brönnimann & Whittaker, 1990
ADERCOTRYMA Loeblich & Tappan, 1952
INSculPTARELNA Loeblich & Tappan, 1985
BYKOVIELINA Loeblich & Tappan, 1984\textsuperscript{62}
BYKOVIELLA V. I. Korchagin, 1964
POLSKIAMMINA Brönnimann, Zaninetti & Whittaker, 1987
SEPETIBAEILLA Brönnimann & Dias-Brito, 1982
REMANEICIDAE Loeblich & Tappan, 1964, emend. Brönnimann & Whittaker, 1990\textsuperscript{63}
ASTEROTROCHAMMINAE Brönnimann,
Zaninetti & Whittaker, 1983
ASTEROTROCHAMMINA Bermúdez & Seigle, 1963
REMANEICINAE Loeblich & Tappan, 1964

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\textsuperscript{61} Brönnimann & Whittaker (1988, 1990) regarded it to be a subfamily within the Trochamminidae. Loeblich & Tappan (1992) regarded the Carterinina as a separate order.

\textsuperscript{62} Placed in the Adercotrymidae by Brönnimann & Whittaker (1990)

\textsuperscript{63} Elevated to superfamly rank by Brönnimann & Whittaker (1990); it is here regarded as a family of the Trochamminacea.

BRUNEICA Brönnimann, Keij & Zaninetti, 1983
REMANEICA Rhumber, 1938
REMANEICELLA Brönnimann, Zaninetti, & Whittaker, 1983\textsuperscript{64}
ZANINETTINAE Brönnimann & Whittaker, 1983
ABYSSOTHERMA Brönnimann, Van Dover & Whittaker, 1989
ZANINETTA Brönnimann & Whittaker, 1983

VERNEUILININA Mikhailovich & Kaminski \textit{subord. nov.}
Test high trochosorial throughout or only in the initial part, later part may have an increased or decreased number of chambers per whorl or may become uniserial or cyclical; wall simple; aperture basal at least initially, later may become terminal, single or multiple, some genera with inner apertural structures.

VERNEUILINACEA Cushman, 1911
CONOTROCHAMMINIDAE Saidova, 1981
CONOTROCHAMMINA Finlay, 1940
PROLIXOPLECTIDAE Loeblich & Tappan, 1985
ARENOSAUDRYINA Podobina, 1975
CONVALLINA McNeil, 1997
DANUBINA Neagu, 1997
EGGERELLOIDES Haynes, 1973\textsuperscript{65}
EOMARSSONELLA Levina, 1972
GEROCHAMMINA Neagu, 1990
KADRIAYINA Al-Najli, 1975
KARRERULINA Finlay, 1940
MAGNOSOINA Patterson, 1987
NEAGUAMMINA Kaminski, Holbourn & Geroch, 1997
ORIENTALIA N.K. Bykova, 1947
PLECTINA Marsson, 1878
PRAEDOROTHIA Desai & Banner, 1987
PROTOMARSSONELLA Desai & Banner, 1987
PROLIXOPLECTA Loeblich & Tappan, 1985
RIYADHELIA Redmond, 1965
VERNEUILINELLA Tairov, 1956
TRITAXIIDAE Plotnikova, 1979
BITAXIA Plotnikova, 1978
TRITAXIA Reuss, 1860
VERNEUILINIDAE Cushman, 1911
VERNEUILINOIDINAE Suleymanov, 1973
DUOTAXIS Kristan, 1957
EGGERELLINA Marie, 1941
FLOUREINSINA Marie, 1938
GAUDRYINOPSIS Podobina, 1975
MOOREINELLA Cushman & Waters, 1928
PALEGAUDRYINA Said & Barakat, 1958
PARAGAUDRYINA Suleymanov, 1958
TALIMUELLA Zeng & Li, 1982
VERNEUILINOIDES Loeblich & Tappan, 1949
VIALOVELLA Voloshina, 1972
REOPHACELLIDAE Mikhailovich & Kaminski, (this volume)
REOPHACELLIDAE Mikhailovich & Kaminski, (this volume)
REOPHACELLA Kaptarenko-Chernousova, 1956
FALSOAUDRYINELLA Bartenstein, 1977
UVIGERINAMMINA Majzon, 1943

\textsuperscript{64} Septotrochamminia Zheng, 1979 is here tentatively regarded as a synonym (see discussion by Brönnimann & Whittaker, 1990, p. 124).

\textsuperscript{65} Here transferred from the Eggerellinae because of its compact, noncalcareaous wall.
PSEUDOREOPHAXINAE Mikhailovich & Kaminski, (this volume)
PSEUDOREOPHAX Geroch, 1961
CARONIINAE Brönnimann, Whittaker & Zaninetti, 1992
CARONIA Brönnimann, Whittaker & Zaninetti, 1992
SPIROPECTINATINAE Cushman, 1928
BELORUSSIELLA Akimets, 1958
GAUDRINOIDES Geodakchan, 1969
SPIROPECTINA Schubert, 1902
SPIROPECTINATA Cushman, 1927
VERNEUILININAE Cushman, 1911
GAUDRYINA d'Orbigny, 1839
GAUDRYINELLA Plummer, 1931
LATENTOVERNEUILINA Loeblich & Tappan, 1985
PARAMIGROS Adb-Elshafty & Ibrahim, 1990
PSEUOOGAUDRYINELLA Cushman, 1936
SIPHOGAUDRYINA Cushman, 1935
VERNEUILINELLA d'Orbigny, 1839
BARROURINELLINAE Saidova, 1981
BARBOURRENELLIA Bermúdez, 1940
BERMUDEZINNA Cushman, 1937
HETEROSTOMELLA Reuss, 1866
PIALLINIDAE Rettori & Zaninetti, 1993
PIALLINA Rettori & Zaninetti, 1993

NEZZAZATINA subord. nov. 67
Test free, low trochospirial to planispiral with a simple non-lamellar, microgranular wall. May possess internal plates or simple partitions and/or multiple apertures.
NEZZAZATAACEA Hamaoui & Saint-Marc, 1976
NAUTILOCOCCINELLA Loeblich & Tappan, 1985
Murgeina Bilotte & Decrouez, 1979
NAUTILOCOCCINELLA Mohler, 1930
MAYNCINIDAE Loeblich & Tappan, 1985
BICONCAVA Hamaoui, 1965
CARASUELLA Neagu, 2000
COMALIAMMA Loeblich & Tappan, 1985
DAXIA Cuvillié & Szakall, 1949
DEUTEROSPIRA Hamaoui, 1965
FLABELLOCYCLOLINA Gendrot, 1964
FREIXIALINA Ramalho, 1989
GENDROTELLA Maync, 1972
HINOGAMMINA Neagu, 2000
MAYNCINA Neumann, 1965
NONIONAMMINA Neagu, 2000
PHENACOPHRAGMA Applin, Loeblich & Tappan, 1950
STOMATOSTOECHEA Applin, Loeblich & Tappan, 1950
DEBARINIDAE fam. nov.
Test free, planispiral, involute, chambers numerous; wall microgranular, probably agglutinated, structure simple; aperture a row of pores at the base of the apertural face.
DEBARINA Fourcade, Raoult & Vila, 1972
NEZZAZATIDAE Hamaoui & Saint-Marc, 1970
NEZZAZATINAEM Hamaoui & Saint-Marc, 1970
BIPLANATA Hamaoui & Saint-Marc, 1970
LUPEROSINIA Farinacci, 1996
MERLINGINA Hamaoui, 1965
NEZZAZATA Omara, 1956
NEZZAZATINELLA Darmoian, 1976
PYRENINA Peyrenes, 1984
TEKKEINA Farinacci & Yeniay, 1994
TROCHOSPIRA Hamaoui, 1965
COXITINAE Hamaoui & Saint-Marc, 1970
ANTALYNA Farinacci & Koyluoglu, 1985
COXITES Smout, 1956
DEMIRINA Özcan, 1994
RABANITINA Smout, 1956
BARKERINIDAE Smout, 1956
BARKERINA Frizzell & Schwartz, 1950

LOFTUSIDIDA Kaminski & Mikhailovich, ord. nov.
Test free or attached, multilocular, coiled in early stage, later may uncoil; wall agglutinated with organic, microgranular, or calcite cement; with advanced forms possessing a bilamellar wall differentiated into an imperforate outer layer, and a thicker inner layer that is perforate, alveolar, or forms internal partitions.

LOFTUSINIA Kaminski & Mikhailovich, subord. nov.
Test free or attached, multilocular, coiled or uncoiling, with an alveolar wall.

LOFTUSIAE Brady, 1884
MESOENDOTHYRIDAE Voloshinova, 1958
MESOENDOTHYRINAE Banner, 1966
AUDIENUSINA Bernier, 1985
MESOENDOTHYRA Dain, 1958
PLANISEPTINAE Septfontaine, 1988 nom. nudum
PLANISEPTA Septfontaine in Kamiński, 2000
PALEOMAYNCINA Septfontaine in Kamiński, 2000
ORBITOSELLINAE Hottinger & Caus, 1982
CYCLORBITOSELLA Cherchi, Schroeder & Zhang, 1984
ORBITAMMINA Berthelin, 1893
ORBITOSELLA Munier-Chalmas, 1902

67 The superfamily is here restricted to Mesozoic families that possess complex inner structure (alveolar, septal plates, or traverse partitions, and includes wholly uniserial forms such as Cribratina. The genera with simple walls are here removed to the Recurvoidae.
66 Here transferred from the Hormosinacea because of its alveolar wall.
65 Transferred from the Haplophragmoididae because of its microgranular wall.
64 Transferred from the subfamilies Orbitosellinae & Labyrinthininae to the Mesoendothyridae.
63 Removed from the Cyclolinidae by Loeblich & Tappan (1992), who transferred the subfamilies Orbitosellinae & Labyrinthininae to the Mesoendothyridae.
61 Here transferred from the Hormosinacea because of its alveolar wall.
LABYRINTHININAE Septfontaine, 1988
LABYRINTHINA Weynschenk, 1951
LEVANTINELLINAE Fourcade, Mouty & Teherani, 1997
LEVANTINELLA Fourcade, Mouty & Teherani, 1997
SYRIANIDAE fam.nov.
Test compressed and fan-shaped, with an initial conical stage that is probably trochospiral, followed by an uncoiled uniserial part. Chambers subdivided by many vertical radial subepidermal partitions. Median zone of the chambers is not subdivided. Apertures multiple.
SYRIANA Fourcade & Mouty, 1995
HOTTINGERITIDAE Loeblich & Tappan, 1985
HOTTINGERITA Loeblich & Tappan, 1985
EVERTICYCLAMMINIDAE Septfontaine, 1988
EVERTICYCLAMMINA Redmond, 1964
RECTOCYCLAMMINA Hottinger, 1967
CYCLAMMINIDAE Marie, 1941
BUCCICREATINAE Loeblich & Tappan, 1985
BUCCICRETANA Loeblich & Tappan, 1949
ALVEOLOPHRAGMIANAE Saidova, 1981
ALVEOLOPHRAGMIUM Shchedrina, 1936
POPOVIA Suleymanov, 1965
QUASICYCLAMMINA Belford, 1977
RETICULOPHRAGMIUM Maync, 1955
SABELLOVOLUTA Loeblich & Tappan, 1985
HEMICYCLAMMINIDAE Banner, 1966
ALVEOCCYCLAMMINA Hillebrandt, 1971
FLABELLAMMINOPSIS Mahoeki, 1954
HEMICYCLAMMINA Maync, 1953
CHOFFATELLINAE Maync, 1958
ABUHAMMADINA Abd-Elsahy & Ibrahim, 1990
BRAMKEMPPEL Redmond, 1964
CHOFFATELLA Schlumberger, 1905
PARACYCLAMMINA Yabe, 1946
TORINOSUELLA Maync, 1959
PSEUDEOHOFFATELLINAE Loeblich & Tappan, 1985
BALKHANIA Mamontova, 1966
BROECKINELLA Henson, 1948
DHRUMELLA Redmond, 1965
MONTSECHIANA Aubert, Coustau & Gendrot, 1963
PSEUDEOHOFFATELLA Deloffre, 1961
TORREMIROELLA Brun & Camerot, 1979
CYCLAMMININAE Marie, 1941
CYCLAMMINA Brady, 1879
ECOGULLIDAE Loeblich & Tappan, 1985
ECOGUELLA Arnaud-Vanneau, 1980
SPIROCYCLINIDAE Munier-Chalmas, 1887
MARTIGUESIA Maync, 1959
PSEUDOSPIROCYCLINA Hottinger, 1967
QATARIA Henson, 1948
REISSELLA Hamaoui, 1963
SAUDIA Henson, 1948
SORNAYINA Marie, 1960
SPIROCYCLINA Munier-Chalmas, 1887
STREPTOCYCLAMMINA Hottinger, 1967
THOMASELLA Sirel, 1998

VANIA Sirel & Gunduz, 1985
LOFTUSIIDAE Brady, 1884
LOFTUSIA Brady, 1870
PRAETRICULINELLA Deloffre & Hamaoui, 1970
RICULINELLA Cuvillier, Bonnefous, Hamaoui & Tixier, 1970

BIOKOVININA subord.nov.
Test free or attached, may be coiled in the early stage, later uncoiled or branched. Wall finely agglutinated, traversed by pores, or with a coarsely perforate or canaliculate inner layer and an outer imperforate layer.
COSCINOPHRAGMATEACEA Thalmann, 1951
HADDONIIDAE Saidova, 1981
HADDONIA Chapman, 1898
STYLOLINA Karrer, 1877
COSCINOPHRAGMATIDAE Thalmann, 1951
ALPINOPHRAGMIUM Flugel, 1967
AMMOTROCHOIDES Janin, 1984
BDELLOIDINA Carter, 1877
GOELLIPORA Senowbari-Daryan & Zankl, 2000
COSCINOPHRAGMA Thalmann, 1951

BIOKOVINACEA Grünek, 1977
CHARENTITAEAE Loeblich & Tappan, 1985
CHARENTIA Neumann, 1965
ISMAILIA El-Dakkak, 1974
KARASELLA Kurbatov, 1971
MELATHROKERION Brönnimann & Conrad, 1967
MONCHARMONTIA De Castro, 1967
PRAEKARAISELLA Kurbatov, 1972
PRAEPENEROPLIS Hofker, 1952
LITUOLIPORIDAE Grünke & Velč, 1978
LITUOLIPORA Grünke & Velč, 1970
BIOKOVINIDAE Grünke, 1977
BIOKOVINA Grünke, 1977
BOSNIELLA Grünke, 1977
TROCHAMJIIELLA Athersuch, Banner & Simmons, 1992

CYCLOLININA Mikhailевич, 1992
CYCLOLINACEA Loeblich & Tappan, 1964
CYCLOLINIDAE Loeblich & Tappan, 1964
AMMOCYCLOLOCULINA Maync, 1958
CYCLOLINA d’Orbigny, 1846
CYCLOPSINELLA Galloway, 1933
MANGASHTIA El-Dakkak, 1970
ELERDORBINAE Loeblich & Tappan, 1988

74 Includes Feurtilla Maync, 1958, considered a junior synonym of Everticyclammina by Septfontaine (1988)
75 Originally regarded as a synonym of Lithol by Loeblich & Tappan (1987); reinstated by Cicha et al., (1998), and transferred to the Haddoniidae by Popescu (2000).
76 Regarded by Septfontaine (1988) to be closely related to, if not synonymous with Paleomayncina and belonging in the Planispinatae.
77 Septfontaine (1988) regarded the wall of this form to be mechanically eroded, exposing the alveolae to the exterior. Therefore, Septfontaine regarded the genus to be imperforate, and reassigned it to the Mesozoodithryinae.
78 Original suprageneric assignment by Athersuch et al. (1992).
ATAXOPHRAGMIINA  Fursenko, 1958
ATAXOPHRAGMIACEA Schwager, 1877
ATAXOPHRAGMIIDAE Schwager, 1877
ATAXOPHRAGMIINAE Schwager, 1877
ARENObULINUMa Cushman, 1927
ATAXOORBIGNYNA Voloshina, 1965
ATAXOPHRAGMIUM Reuss, 1860
HAGENOWELLA Cushman, 1933
PITYUSINA Rangheard & Colom, 1967
SABULINA Frieg & Price, 1982
GEROCHELLINAE subfam. nov.
Test with a trochospiral early stage with 4 chambers per whorl; an intermediate short uniserial uniserival stage with 2-3 chambers, and a uniserial adult stage.
GEROCHELLA Neagu, 1997
PERNERININAE Loeblich & Tappan, 1984
AGGLUTISOLENA Senowbari Daryan, 1984
ANATOLIELLA Sirel, 1988
COPROLITHINA Marie, 1941
CRENAVERNEUILINA Barnard & Banner, 1980
HAGENOWINA Loeblich & Tappan, 1961
KAEVERIA Senowbari-Daryan, 1984
OPERTUM Voloshina, 1972
ORBIGNYNA von Hagenow, 1842
PERNERINA Cushman, 1933
VOLOSHINOIDES Barnard & Banner, 1980
VOLOSHINOVELLA Loeblich & Tappan, 1964
GLOBOTEXTULARIIIDAE Cushman, 1927
GLOBOTEXTULARINAE Cushman, 1927
CRIIBROTURRETOIDES D.J. Smith, 1949
GLOBOTEXTULARIA Eimer & Pickert, 1899
GRAVELLINA Brönnimann, 1953
RHUMBLERELLA Brönnimann, 1981
TETRATAXIELLA Seiglie, 1964
VERNEUILLINA Saidova, 1975
VARSOVIELLinAE Gawor-Biedova, 1987
VARSOVIELLA Gawor-Biedova, 1987
LIEBUSELLINAE Saidova, 1981
CUBANINA Palmer, 1936
JARVESELLA Brönnimann, 1953
LIEBUSELLA Cushman, 1933
REMESELLA Vasicek, 1947
RUAKITURIA Kennett, 1967
TEXTULARIELLIDAE Gröhagen & Luterbacher, 1966
ALVEOVALVULINA Brönnimann, 1951
ALVEOVALVULINELLA Brönnimann, 1953
CUNEOLINELLA Cushman & Bermúdez, 1941
GUPPYELLA Brönnimann, 1951
HAGENOWINOIDES Saidova, 1975
TEXTULARIELLA Cushman, 1927
MONTSALEVIIIDAE Zaninetti, Salvini-Bonnard, Charollais, & Decrouez, 1987
MONTSALEVIEA Zaninetti, Salvini-Bonnard, Charollais & Decrouez, 1987
CUNEOLINIDAE Saidova, 1981

80 Here removed from the synonymy of Guppyella.
81 The description of the family is here emended to include genera such as Histerolina and Scythiolina which have a planispirally coiled initial stage.

CUNEOLININAE Saidova, 1981
CUNEOLINA d’Orbigny, 1839
PALKAEOLITONELLA Berzzi-Makk, 1981
PSEUDOTEXTULARIELLA Barnard, 1953
VERCORSSELLA Arnaud-Vanneau, 1980
SCYTHIOLININAE Neagu. subfam. nov.
Test free, flattened, flabelliform to elongated. Initial stage coiled in a very short planispir e of 3-4 chambers. Interior of chambers subdivided by vertical radial partitions. Aperture an interiomarginal slit, becoming crenulated. HISTEROLINA Neagu, 2000
SCYTHIOLINA Neagu, 2000
SABAUDINAE Brönnimann, Decrouez & Zaninetti, 1983
SABAUDA Charollais & Brönnimann, 1965
DICYCLINIDAE Loeblich & Tappan, 1964
DICYCLINA Munier-Chalmas, 1887
DICTYOPSELLIDAE Brönnimann, Zaninetti & Whittaker, 1983
ANDAMOOKIA Ludbrook, 1966
CONORBINELLA Poroshina, 1976
DICTYOPSELLA Munier-Chalmas, 1900
DICTYOPSELLOIDAE Loeblich & Tappan, 1985

ORBITolinina subord. nov.
Test trochospiral or conical, later stage may have reduced number of chambers per whorl, or may become uniserial and rectilinear; chamber interior of advanced taxa subdivided by vertical or horizontal exoskeletal partitions or both, by radial or transverse partitions, or with interseptal pillars.
PFEnderinacea Smout & Sudgen, 1962
PFEnderININAE Smout & Sudgen, 1962
PfeDERININAE Septfontaine, 1983
PSEUDOPfenderininae Septfontaine, 1988
SIPHOVALVULINA Septfontaine, 1988
PALEOPFENDERININAE Septfontaine, 1988
CONICOPfenderINa Septfontaine in Kaminski, 2000
CHABLAISIA Septfontaine, 1978
PALEOPfenderINa Septfontaine in Kaminski, 2000
PSEUDOEgGERELLA Septfontaine, 1988
SATORINA Fourcade & Chorowicz, 1980
SANDERELLA Redmond, 1964
STEINEKELLA Redmond, 1964
PFEnderININAE Smout & Sudgen, 1962
DOBROGELINA Neagu, 1979
DREVENNIA Arnaud-Vanneau, 1980
PFNDERELLA Redmond, 1964
PfenderININAE Henson, 1948
KURNUBINAE Redmond, 1964
CONICOKURNUBIA Septfontaine, 1988
GYROCONULINA Schroeder & Darmoan, 1977
KURNUBIA Henson, 1948
PRAEKURNUBIA Redmond, 1964
HAURANIINAE Septfontaine, 1988
HAURANIINAE Septfontaine, 1988
CYMBRIEELLA Fugagnoli, 1999

82 Originally placed by Neagu (2000) in the Cuneolinidae.
83 Elevated to superfamily rank by Brönnimann & Whittaker (1988), regarded as a subfamily and removed from the Trochaminacea by Brönnimann & Whittaker (1990).
84 Not included in the Pfenderiniidae by Septfontaine (1988).
PARACOSKINOLINA Moullade, 1965
PRAECICTORYBITOLINA Schroeder, 1990
ORBITOLININAE Martin, 1890
ALPILLINA Foury, 1968
CONICORBITOLINA Schroeder, 1973
EOPALORBITOLINA Schroeder, 1968
EYGalERINA Foury, 1968
Mesorbitolina Schroeder, 1962
NUAPLIELLA Decrouez & Moullade, 1974
NEORIRAQA Danilova, 1963
NEORBITOLINOPSIS Schroeder, 1964
ORBITOLINA d’Orbigny, 1850
PALORBITOLINA Schroeder, 1963
PALORBITOLINOIDES Cherchi & Schroeder, 1980
PRAEBITOLITOLINA Schroeder, 1965
RECTDICICTYOCONUS Schroeder, 1964
VALSERINA Schroeder & Conrad, 1968

TEXTULARIIDA Delage & Herouard, 1896 [emended]\(^{19}\)
Test trochospiral, planispiral, triserial, biserial, or uniserial in early stages; later may be biserial, uniserial, or bifurcate; wall agglutinated, with low-Mg calcite cement, canaliculate. Mesozoic forms may be protocanaliculate, or develop canaliculae late in ontogeny.

TEXTULARINA Delage & Herouard, 1896
EGGERELLACEA Cushman, 1937
EGGERELLIDAE Cushman, 1937
DOROTHINAE Balakhmatova, 1972
ARENOSARIA Finlay, 1939
BANNERELLA Loeblich & Tappan, 1985
DOROTHIA Plummer, 1931
MATANZIA Palmer, 1936\(^{16}\)
MARSSONELLA Cushman, 1933
PSEUDOMORULAEPELECTA Neagu & Neagu, 1995
MINOUXINAE Loeblich & Tappan, 1986
ANDERSENDIA Neagu, 1968
MINOUXIA Marie, 1954
TETRAMINOUXIA Gendrot, 1963
EGGERELLINAE Cushman, 1937
EGGERELLA Cushman, 1935
EGGERINA Toulmin, 1941
KARRERIELLA Cushman, 1933
MARTINOTTIELLA Cushman, 1933
MEIDAMONELLA Loeblich & Tappan, 1986
MULTIFIDELLA Loeblich & Tappan, 1961
RUDIGAUDRYINA Cushman & McCulloch, 1939
COLOMINELLINAE Popescu, 1998
COLOMINELLA Popescu, 1998
COLOMINELLA Popescu, 1998
COLOMINELLA Popescu, 1998
COLOMINTA Gonzalez-Dosonos, 1968\(^{27}\)
TRITAXILINAE Loeblich & Tappan, 1986
TRITAXILINA Cushman, 1911
PSEUDOGAUDRYINIDAE Loeblich & Tappan, 1985

\(^{19}\) Includes perforate uniserial genera such as *Thomasinella* and forms that have a small initial spiral portion such as *Kaniokesia* and *Spirorutilus*.

\(^{16}\) Transferred to the Textulariaceae by Cicha et al., (1998) because the type species is canaliculate.

\(^{27}\) Transferred from the Septotextulariinae by Popescu (2000).
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PSEUDOCLAUDRYINAE Loeblich & Tappan, 1985
CLAVULINOIDES Cushman, 1936
CLAVULINOPSIS Banner & Desai, 1985
CONNEMARELLA Loeblich & Tappan, 1989
HEMLEBENIA Loeblich & Tappan, 1989
MIGROS Finlay, 1939
PARAGAUDRYINELLA Popescu, 1998
PSEUDOCCLAVULINA Cushman, 1936
PSEUDOCLAUDRYINA Cushman, 1936
VALVORESSSUELLA Hofker, 1957
SIPHONIFEROIDINAE Loeblich & Tappan, 1985
PLOTNIKOVINA Mikhailovich, 1981
SIPHONIFEROIDES Saidova, 1981
VALVULAMMINIDAE Loeblich & Tappan, 1986
ARENAGULA Bourdon & Lys, 1955
DISCORINOPSIS Cole, 1941
VALVULAMMINA Cushman, 1933
VALVULINIDAE Bert helin, 1880*
VALVULININAE Bert helin, 1880
CLAVULINA d’O rbigny, 1826
CRI BroBULIMINA Cushman, 1927
CRI BROGOESELLA Cushman, 1935
CYLINDRO CLAVULINA Bermúdez & Key, 1952
GOESEL LA Cushman, 1933
GY ROVAULVULINA Loeblich & Tappan, 1985
MAKARSKIANA van Soest, 1942
NEOCLAVULINA Puri, 1957
VALVULINA d’O rbigny, 1826
SIPHOBIGENERININAE Loeblich & Tappan, 1986
SIPHOBIGENERININA Cushman, 1979
TEXTULARIACEA Ehrenberg, 1838*
THOMASINELLIDAE Loeblich & Tappan, 1984*
AXICOLUMELLA Hera cogová, 1988
PROTOSCHISTA Eimer & Fickert, 1899
THOMASINELLA Schlumberger, 1893
KAMINSKIIIDAE Neagu, 1999*
KAMINSKIA Neagu, 1999
SPIRORUTILIS Hottinger, Halicz & Reiss, 1990*
TEXTULARIDAE Ehrenberg, 1838
TEXTULARIIIDAE Ehrenberg, 1838
BIGNERINA d’O rbigny, 1826
HAUSLERELLA Parr, 1935
PARAVULVULINA Cicha & Zapletalová, 1965
SAHULIA Loeblich & Tappan, 1985
SEMIVULVULINA Finlay, 1939
TETRAGONOSTOMINA Mikhailovich, 1975
TEXTULARIA Defrance, 1824

SIPHOTEXTULARINAE Loeblich & Tappan, 1985
KARREROTEXTULARIA Le Calvez, de Klas & Brun, 1974
PLECANIUM Reuss, 1862
SIPHOSCUTULARIA Loeblich & Tappan, 1985
SIPHOTEXTULARIA Finlay, 1939
TEXTULINA Saidova, 1975
PLANCTOSTOMATICAE Loeblich & Tappan, 1984
CRIBROBIGINERINA Andersen, 1961
OLSSONINA Bermúdez, 1949
PLANCTOSTOMA Loeblich & Tappan, 1955
PORTEXTULARIA Loeblich & Tappan, 1952
TAWITAWINA Loeblich & Tappan, 1961
TAWITAWIA Loeblich, 1952
TEXTULARIOIDINAE Loeblich & Tappan, 1984
TEXTULARIOIDES Cushman, 1911
SEPTOTEXTULARINAE Loeblich & Tappan, 1985
SEPTOTEXTULARIA Cheng & Zheng, 1978
CHRYSA LIDINACEAE Neagu, 1968*
CHRYSA LIDINIDAE Neagu, 1968*
ACCORDIELLA Garinacci, 1962
CHRYSA LIDINA d’O rbigny, 1839
DUKHANIA Henson, 1948
PFENDERICONUS Hottinger & Drohne, 1980
PRAECHRYSA LIDINA Lupertz Gini, 1979
PSEUDOCRYSALIDINA Cole, 1941
VACUOVALVULINA Hofker, 1966
PARAVULVULINAE Banner, Simmons & Whittaker, 1991*
PARAVULVULINAE Banner, Simmons & Whittaker, 1991
INDOMARSSONELLA Mand wal & Singh, 1993
KILIANINA Pfender, 1933*
PARAVULVULINA Septfontaine, 1988
PSEUDOMARSSONELLA Redmond, 1965
REDMONDOIDES Banner, Simmons & Whittaker, 1991
RIYADOIDES Banner, Simmons & Whittaker, 1991
PSEUDODICTYOPSISSELA Septfontaine & De Matos, 1998
PSEUDODICTYOPSISSELA Septfontaine & De Matos, 1998

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88 Septfontaine & De Matos (1998) proposed emending the Valvulinidae to include Pseudodictyopsella, a Middle Jurassic genus that has an imperforate wall with hypodermic radial partitions. This view is not followed herein, and only Cenozoic taxa are included in the group.
89 Here understood as containing predominantly biserial forms that may have either a small initial planispiral whorl or an adventitious chamber.
90 Transferred from the Hormosinacea because of its perforate wall, a fact that was already noted by Loeblich & Tappan (1987).
91 Originally regarded as a subfamily by Neagu (1999), the presence of a planispiral part is sufficiently different to justify elevation to family status.
92 Authorship is credited to Hottinger et al. (1990), as the original name of Hofker (1976) is here regarded as nomen nudum.
93 Nom.transl. ex Chrysalidinaceae Neagu, 1968.
94 Loeblich & Tappan (1992) did not subdivide the Chrysalidinidae. The families Chrysalidinidae and Paravalvulinae are based on the reclassification of the chrysalidinids by Banner et al. (1991), who emended the family and established two subfamilies (here elevated to family status). The chrysalidinids include Jurassic protocamalculiform forms (Paravalvulininae) that have very little in common with the Textulariacea, and is here only tentatively retained in the Textulariina.
95 Nom.transl ex Paravalvulinae. Includes low trochosphoral forms with subepidermal vertical partitions (Pseudodictyopsellinae).
96 Placed in the Valvulininae by Septfontaine (1988). Loeblich & Tappan (1992) excluded the Jurassic noncamuliform forms from this group.
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Mikhalevich, V.I. (this volume). On the heterogeneity of the former Textularina (Foraminifera).


