The Year 2000 Classification of the Agglutinated Foraminifera

MICHAEL A. KAMINSKI

Department of Earth Sciences, University College London, Gower Street, London WCIE 6BT, U.K.;
and KLFR, 3 Boyne Avenue, Hendon, London, NW4 2JL, U.K. [m.kaminski@ucl.ac.uk]

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 & Mikhalevich), five suborders (the Verneuilinina Mikhalevich & Kaminski, Nezzazatina, Loftusiina Kaminski & Mikhalevich, Biokovinina, and Orbitolinina), two families (the Syrianidae and the Debarinidae) and five subfamilies (the Polychasmininae, Praesphaeramminiinae Kaminski & Mikhalevich, Flatschkofeliinae, Gerochellinae and the Scythiolininae 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 Mikhalevich (1995) suprageneric scheme for the Astrorhizida (3) transfer of the Ammodiscacea to the Astrorhizida (4) restriction of the Lituolida to forms with simple wall structure (5) supression of the order Trochamminida, and (6) inclusion of the Carterinida within the Trochamminacea (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 Astrorhizida), calcareous and canaliculate (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; Mikhalevich & Debenay, 2001; Mikhalevich, 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.

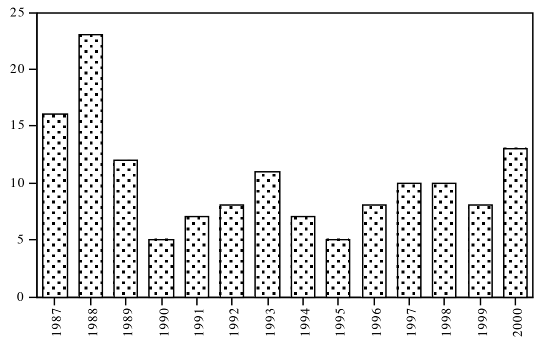

Figure 1. Annual number of new taxa (genera and higher taxa) described since the publication of Loeblich & Tappan (1987).

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

In: Bubík, M. & Kaminski, M.A. (eds), 2004. Proceedings of the Sixth International Workshop on Agglutinated Foraminifera. *Grzybowski Foundation Special Publication*, **8**, 237-255.

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 Trochamminacea is based on the work of Brönnimann & Whittaker (1988, 1990). The taxonomy of the Jurassic lituolid 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 (= Granuloreticulosa 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 Granuloreticulosa/ 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. Suprisingly, in their 1992 classification, these authors did not make full use of the systematical 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 Foraminiferea can now be defined at the rank of a subclass. The actual number of subclasses within the Foraminiferea would then become eight (Allogromiia, Textulariia, Fusulinia, Milioliia, Silicoloculinia, Spirillinia, Rotaliia, and Robertinia). The discussion of the whole class Foraminiferea 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, porcellanous, or arenaceous; and thus we have the families Gromida, 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 porcellanous 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 "Textulariicea" (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 occuping 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 Astrorhizina Jírovic, 1953 was understood to have organic cement in the form of strands, the Trochamminina 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 canaliculate 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 Haplophragmiina 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*, *Rhabdammina*, *Thurammina*, *Miliammina*, *Ammodiscus*, *Reophax*, *Cribrostomoides*, *Ammoscalaria*, *Eggerelloides*, *Paratrochammina*, and *Tritaxis*). 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 unneccessary 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 Foraminiferea were recognised as a class, following the ranking of Lee (1990) published in the "Handbook of Protoctista" (Margulis *et al.*, 1990). In their newly revised scheme, the various foraminiferal suborders were elevated to the rank of orders, and the three orders of organically-cemented agglutinated foraminifera (Astrorhizida, Lituolida, and Trochamminida) were simply described as having "*a firmly cemented test consisting of foreign particles cemented to an organic matrix*". The order Lituolida was substituted for the suborder Haplophragmiina 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 Astrorhizida 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 Lituolida contained mostly the chambered families, (but without further explanation also included the superfamily 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 athalamids 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 apertural characteristics (e.g., Gu‰iç, 1977, Haynes, 1981, Mikhalevich, 1992, 1998, 2000, this volume; Vdovenko, 1993; Mikhalevich & 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 Textulariia, four main groups emerge that are here regarded at the level of an order. These groups are here defined based a combination of test morphology 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 institutes 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 Mikhalevich (1995), with some important differences mainly involving the rank of categories above the level of the family. In the Mikhalevich scheme, the group was assigned the rank of a class (the Astrorhizata Saidova, 1981, emend. Mikhalevich, 1995), containing five orders (the Astrorhizida, Dendrophryida, Saccamminida, Parathurammida, and Hippocrepinida). Mikhalevich described a total of 12 new families and subfamilies, and her scheme constitutes a major reclassification of the group. Mikhalevich 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 Mikhalevich 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 parathuramminids, paratikhinellids, *Pilammina*, *Rectopilammina*, and the Paulbronnimanninae 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 Mikhalevich scheme in some details. For example, the current classification recognises the Komokiacea as a separate superfamily within the Astrorhizina, rather than as families dispersed within the group of dendrophryids. The presence of abundant stercomata within the test and its loosely cemented wall is sufficient reason to regard the group as a separate superfamily. 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 superfamily 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 superfamily Ammodiscacea Reuss, 1862), but in later classifications had included the group within the lituolids (Loeblich & Tappan, 1992, 1994). This superfamily possesses an undivided tubular second chamber similar in mode of growth to the Hippocrepinacea, 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 Glaessner (1945) and Pokorny (1958) in ranking the Ammodiscacea among the Astrorhizida.

2. The Order Lituolida

The Lituolida are here understood to comprise all the noncanaliculate 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 Lituolida, cement composition (organic vs. calcareous) is regarded to have less importance than the presence of a bilamellar wall with alveolae, internal rafters and pillars, pseudopores or canaliculae, which is used to distinguish the Loftusiida 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 *Eomarssonella* & *Protomarssonella*). The occurrence of calcitic cement is probably a feature that evolved independently in various lineages (Desai & Banner, 1987; Mikhalevich, 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 miliolids. 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 *Miliammina*.

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 Mikhalevich (1995) who listed pseudochambered forms such as *Caudammina* within the Astrorhizida. 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, Haplophragmiacea, Recurvoidacea, and Nezzazatacea which include forms with both organic and microgranular calcite cement. The new superfamily Lituotubacea likely represent an evolutionary transition from the Ammodiscacea. The Lituotubidae 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 Hormosinacea. The streptospiral genera with simple walls are here placed in the new superfamily Recurvoidacea, whereas the genera with alveolar walls are removed to the Loftusiida. Finally, the microgranular forms are placed within the new superfamily 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 *Haplophragmoides* 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 Verneuilinina 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 Loftusiida 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 Loftusiina, Biokovina, Cyclolinina, Ataxophragmiina, and the Orbitolinina. These suborders are differentiated by morphology and on the type of inner structure. The former (Loftusiina) has an alveolar wall, and includes the Haplophragmiacea, 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 Ataxophragmiina and Orbitolinina possess internal partitions and interseptal pillars.

4. The Order Textulariida

The presence of calcitic cement with canaliculi or pseudopores 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 *Glaucoammina*. 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 *Protomarssonella - Marssonella* 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 *Kaminskia*, 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 trochospiral or triserial Eggerellacea, the mostly biserial Textulariacea (including the Kaminskiidae); and the trochospiral Chrysalinacea. 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 Chrysalinacea (=Chrysalinidae as emended by Banner *et al.*, 1991) consist of Mesozoic high trochospiral (triserial, quadriserial and quinqueserial) forms that have solid, protocanaliculate or canaliculate microgranular walls. In some genera, such as the Jurassic paravalvulinids, canaliculae 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 Chrysalinacea within the Textulariida, 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 rotaliids. Interestingly, the two canaliculate agglutinated genera studied (*Bigenerina* and *Textularia*) form a separate subcluster within the multichambered agglutinated-rotaliid 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 FORAMINIFEREA d'Orbigny, 1826

Subclass Textulariia 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 labyrinthic structures or inner protrusions partially subdividing the chamber, cement organic.

ASTRORHIZINA Lankester, 1885

ASTRORHIZACEA Brady, 1881

ASTRORHIZIDAE Brady, 1881[1]

ASTRORHIZA Sandahl, 1858

ASTRORHIZOIDES Shchedrina, 1969

CLADOS Schröder, Medioli & Scott, 1989

CYSTINGARHIZA Bell, 1996

CYLINDRAMMINA Bell, 1996

GLOBODENDRINA Plewes, Palmer & Haynes, 1993

[1] The genus *Pelosina* Brady, 1879 was removed to the Xenophyophoria by Mikhalevich & Voronova (1999).

RADICULA Christiansen, 1958
VANHOEFFENELLIDAE Saidova, 1981[2]
INAURIS J.E. Conkin, B.M. Conkin & Thurman, 1979
VANHOEFFENELLA Rhumbler, 1905
RHABDAMMINIDAE Brady, 1884
RHABDAMMININAE Brady, 1884
LINEA Schröder, Medioli & Scott, 1989
MARSIPELLA Norman, 1878
RHABDAMMINA M. Sars in Carpenter, 1869[3]
BATHYSIPHONINAE Avnimelech, 1952
BAHIANOTUBUS Brönnimann, Zaninetti, & Moura, 1979[4]
BATHYSIPHON Sars, 1872
BOGDANOWICZIA Pishvanova & Vyalov, 1967
NOTHIA Pflaumann, 1964
PSAMMOSIPHONELLA Avnimelich, 1952
RHABDAMMINELLA de Folin, 1887
HIPPOCREPINELLIDAE Loeblich & Tappan, 1984 emend. Mikhalevich, 1995
AMPHITREMOIDA Eisenack, 1938[5]
ASTRORHIZINULLA Saidova, 1975[6]
CRESPINITELLA Rauser & Reitlinger, 1993[4]
CRONEISELLA Dunn, 1942[5]
HIPPOCREPINELLA Heron-Allen & Earland, 1932
DENDROPHRYIDAE Haeckel, 1894[7]
DENDROPHRYA Wright, 1861
PSAMMATODENDRON Norman, 1881
SACCODENDRON Rhumbler, 1935[8]
SPICULIDENDRON Rützler & Richardson, 1996
NOTODENDRODIDAE Delaca, Lipps & Hessler, 1980
NOTODENDRODES Delaca, Lipps & Hessler, 1980
ARBORAMMINIDAE Shires, Gooday & Jones, 1994
ARBORAMMINA Shires, Gooday & Jones, 1994
DRYORHIZOPSIDAE Loeblich & Tappan, 1984
DRYORHIZOPSIS Henbest, 1963
SAGENINA Chapman, 1900
SCHIZAMMINIDAE Nørvang, 1961
JULLIENELLA Schlumberger, 1890
SCHIZAMMINA Heron-Allen & Earland, 1929
HALYPHYSEMIDAE Loeblich & Tappan, 1984[9]
HALYPHYSEMA Bowerbank, 1862
DENDRONINA Heron-Allen & Earland, 1922
DIFFUSILINIDAE Loeblich & Tappan, 1961
ATELIKAMARA McClellan, 1973[10]
DIFFUSILINA Heron-Allen & Earland, 1924
KERIONAMMINA Moreman, 1933

KOMOKIACEA Tendal & Hessler, 1977[11]
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
NORMANINIDAE Mikhalevich, 1995
NORMANINA Cushman, 1928
SEPTUMA Tendal & Hessler, 1977
RHIZAMMINIDAE Wieser, 1931
RHIZAMMINA Brady, 1879[12]
TESTULORHIZA Avnimelech, 1952[13]
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

SACCAMMININA Lankester, 1885
SACCAMMINACEA Brady, 1884[14]
STEGNAMMINIDAE Moreman, 1930[15]
AMPHIFENESTRELLINAE Mikhalevich, 1995
AMPHIFENESTRELLA Rhumbler, 1935[16]
BLASTAMMINA Eisenack, 1932
STEGNAMMININAE Moreman, 1930
ANICTOSPHAERA McClellan, 1973[17]
BYKOVAEINA Suleymanov, 1969[17]
CERATAMMINA Ireland, 1939
GASTROAMMINA Dunn, 1942[18]
LUEKATIELLA Zhigulina, 1999
PSEUDASTRORHIZA Eisenack, 1932[17]
RAIBOSAMMINA Moreman, 1930
SPICULOSIPHON Christiansen, 1964[17]
STEGNAMMINA Moreman, 1930
STORTHOSPHAERA Schulze, 1875[17]
THEKAMMINA Dunn, 1942
THURAMMINOIDES Plummer, 1945[17]
HEMISPHAERAMMININAE Loeblich & Tappan, 1961, emend Mikhalevich, 1995[19]
HEMISPHAERAMMINA Loeblich & Tappan, 1957
FAIRLIELLA Summerson, 1958
SOROSPHAERELLA Conkin, Conkin & Thurman, 1979
SACCAMMINIDAE Brady, 1884
CAUSIINAE Mikhalevich, 1995
CAUSIA Rhumbler, 1938[20]

---

[2] Raised to the status of a family by Mikhalevich (1995).
[3] Includes the genus *Oculosiphon* Avnimelech, 1952.
[4] Transferred from the Allogromiida by Brönnimann et al. 1992.
[5] Transferred from the Saccammininae by Mikhalevich (1995).
[6] Transferred from the Bathysiphonidae by Mikhalevich (1995) because of the constricted apertures
[7] Mikhalevich (1995) regarded the group to be of family rank.
[8] Transferred from the Astrorhizidae by Mikhalevich (1995) because of its long slender, branching arms.
[9] Mikhalevich (1995) regarded the group to be of family rank.
[10] Transferred from the Hemmisphaerammininae by Mikhalevich (1995).
[11] Retained here in the Foraminiferida despite Kamenskaya's (1992, 2000) views that they constitute a separate order within Rhizopoda, *incertae sedis*. Mikhalevich (1995) placed the komokiid families within her order Dendrophryida, considered here to be within the Astrorhizacea.
[12] Transferred to the Komokiacea in accordance with findings of Gooday & Cook (1984). The subfamily Rhizamminidae is therefore reinstated herein.
[13] Placed by Mikhalevich (1995) in the subfamily Rhizammininae, but its affiliation to the Komokiacea has not been verified.
[14] Regarded by Mikhalevich (1995) to comprise a suborder, this group of single forms is here assigned superfamily rank.
[15] Elevated in rank from subfamily by Mikhalevich (1995). Includes all free-living forms without a distinct aperture.
[16] Transferred from the Vanhoefenellinae by Mikhalevich (1995) because of its circular (not tubular) test.
[17] Transferred from the Psammosphaerinae by Mikhalevich (1995).
[18] Transferred from the Thuramminae by Mikhalevich (1995) because it lacks apertures on its protuberances.
[19] Lowered in rank from a family by Mikhalevich (1995)
[20] Transferred from the Vanhoefenellinae by Mikhalevich (1995).

SACCAMMININAE Brady, 1884
BRACHYSIPHON Chapman, 1906
CRIBROTHALAMMINA Goldstein & Barker, 1988
HYPERAMMINITA Crespin, 1958
LAGENAMMINA Rhumbler, 1911
MARSUPULINOIDES Brönnimann, 1988
OVAMMINA Dahlgren, 1962
PILULINELLA Saidova, 1975
PLACENTAMMINA Thalmann, 1947
PSAMMOPHAGA Arnold, 1982
PSEUDOSACCULINELLA Yassini & Jones, 1995
SACCAMMINA Carpenter, 1869
SACCAMMINELLA Brönnimann, Whittaker & Zaninetti, 1992
SACCULINELLA Crespin, 1958
STOMASPHAERA Mound, 1961
TECHNITELLA Norman, 1878
TITANOTHEKA Gaucher & Sprechmann, 1999
PILULININAE Brady, 1884
PILULINA Carpenter, 1870
THURAMMININAE Miklukho-Maklay, 1963
ASTRAMMINA Rhumbler, 1931
BAHIANOFUSUS Brönnimann, Zaninetti, & Moura, 1979[21]
ORBULINELLOIDES Saidova, 1975
ORDOVICINA Eisenack, 1938
PSEUDOTHURAMMINA Scott, Medioli & Williamson, 1981
THURAMMINA Brady, 1879
COLONAMMININAE Rauser-Chernousova & Reitlinger, 1993
COLONAMMINA Moreman, 1930
JASCOTTELLA Huddleston & Haman, 1982[22]
NUBECULARIELLA Averintsev, 1911[23]
THOLOSININAE Mikhalevich, 1995
IRIDIA Heron-Allen & Earland, 1914[22]
MESAMMINA Pichler, 1971[22]
SCYPHOCODON Kristan-Tollmann, 1971[22]
THOLOSINA Rhumbler, 1895[22]
CRITHIONINIDAE Hofker, 1972[24]
DAITRONINAE Mikhalevich, 1995
DAITRONA Loeblich & Tappan, 1961
NEPHROSPHAERA Kristan-Tollmann, 1971
CRITHIONININAE Hofker, 1972
CRITHIONINA Goes, 1894
PSEUDOWEBBINELLA Shchedrina, 1962
VERRUCINA Goes, 1896
ORYCTODERMINAE Saidova, 1981
DISCOBOTELLINA Collins, 1958
ORYCTODERMA Loeblich & Tappan, 1961
MASONELLA Brady, 1889[25]

PSAMMOSPHAERACEA Haeckel, 1894[26]
PSAMMOSPHAERIDAE Haeckel, 1894
PSAMMOSPHAERINAE Haeckel, 1894
CELLONINA Kristan-Tollmann, 1971
PSAMMOPHAX Rhumbler, 1931
PSAMMOSPHAERA Schulze, 1875
SOROSPHAERA Brady, 1879
THURAMMINOPSIS Haeusler, 1883
TELAMMINIDAE Loeblich & Tappan, 1985 emend, Mikhalevich, 1995[27]
METAMORPHINA Browne, 1963
ROPOSTRUM Jonasson & Schröder-Adams, 1996
TELAMMINA Gooday & Haynes, 1983
TUMIDOTUBUS Gooday & Haynes, 1983
POLYSACCAMMINIDAE Loeblich & Tappan, 1984[28]
POLYSACCAMMININAE Loeblich & Tappan, 1984
GOATAPITIGBA Narchi, 1962
POLYSACCAMMINA Scott, 1976
SACCAMMINOIDES Geroch, 1955[29]
SACCAMMINIDINAE Mikhalevich, 1995
SACCAMMINIS Ireland, 1960
AMPHICERVICINAE Mikhalevich, 1995
AMPHICERVICIS Mound, 1961
LACUSTRINELLIDAE Mikhalevich, 1995
AGGEROSTRAMEN Loeblich & Tappan, 1985[30]
AMMOPEMPHIX Loeblich, 1952[22]
LACUSTRINELLA Loeblich & Tappan, 1987
PATELLAMMINA Bell, 1996
SOROSTOMASPHAERA McClellan, 1966[17]
WEBBINELLOIDEA G.A. Stewart & Lampe, 1947[16]

HIPPOCREPININA Saidova, 1981
HIPPOCREPINACEA Rhumbler, 1895
HIPPOCREPINIDAE Rhumbler, 1895
HIPPOCREPININAE Rhumbler, 1895
GIRALIARELLA Crespin, 1958[31]
HIPPOCREPINA Parker, 1870
HYPERAMMINOIDES Cushman & Waters, 1928[31]
PSEUDOHYPERAMMINA Crespin, 1958[31]
JACULELLINAE Mikhalevich, 1995
ACICULELLA Vyalov, 1968[32]
ARENOSIPHON Grubbs, 1939[32]
JACULELLA Brady, 1879[32]
KECHENOTISKE Loeblich & Tappan, 1984[31]
SANSABAINA Loeblich & Tappan, 1984[31]
TASMANAMMINA Gutschick & Wuellner, 1983[31]
HYPERAMMINIDAE Eimer & Fickert, 1899[33]
HYPERAMMININAE Eimer & Fickert, 1899
ARENICONULUS Eisenack, 1969
HYPERAMMINA Brady, 1878
PLATYSOLENITES Eichwald, 1860[34]
SACCHARARENA Loeblich & Tappan, 1984[35]

---

[21] Transferred from the Allogromiida by Brönnimann *et al.* 1992.
[22] Transferred from the Hemisphaeramminae by Mikhalevich (1995).
[23] Transferred from the Halyphyseminae by Mikhalevich (1995) because of its saccamminid aperture.
[24] Elevated in rank from a subfamily by Mikhalevich (1995), who incorrectly cited the authorship as Goës (1894).
[25] Transferred from the Crithoninae by Mikhalevich (1995).
[26] Regarded by Mikhalevich (1995) to comprise a suborder, this group of pseudocolonial forms is here assigned superfamily rank.
[27] Transferred from the Hormosinacea by Mikhalevich (1995) because the group is colonial and lacks true chambers.
[28] Elevated in rank to a family and transferred from the Saccamminidae by Mikhalevich (1995).
[29] Here transferred from the Ammosphaeroidininae because of its pseudocolonial habitat.
[30] Transferred from the Telamminidae by Mikhalevich (1995).
[31] Transferred from the Hyperamminoididae by Mikhalevich (1995).
[32] Transferred from the Hippocrepininae by Mikhalevich (1995).
[33] Elevated in rank by Mikhalevich (1995).
[34] Transferred to the Hippocrepinacea by McIlroy *et al.* (2001), who found specimens with globular proloculi.
[35] Transferred from the Hyperamminoididae by Mikhalevich (1995).

SACCORHIZINAE Eimer & Fickert, 1899[36]
SACCARENA Chernykh, 1969
SACCORHIZA Eimer & Fickert, 1899
BOTELLINIDAE Chapman & Parr, 1936[37]
BOTELLINA Carpenter, Jeffreys & Thomson, 1870[38]
PROTOBOTELLINA Heron-Allen & Earland, 1929[32]
AMMOVOLUMMIDAE Chernykh, 1967[39]
AMMOVOLUMINA Chernykh, 1967
HYPERBATHOIDES Ireland, 1966
PSAMMONYX Döderlein, 1892
SERPENULINA Chernykh, 1967

AMMODISCINA Mikhalevich, 1980
AMMODISCACEA Reuss, 1862
AMMODISCIDAE Reuss, 1862
AMMODISCINAE Reuss, 1962
AGATHAMMINOIDES Vangerow, 1964
AMMODISCOIDES Cushman, 1909
AMMODISCUS Reuss, 1962
ARENOTURRISPIRILLINA Tairov, 1956
BIFURCAMMINA Ireland, 1939
HEMIDISCUS Schellwien, 1898
RECTOAMMODISCUS Reitlinger, 1993
SPIRILLINOIDES Rhumbler, 1938
SPIROSOLENITES Glaessner, 1979
TOLYPAMMININAE Cushman, 1928
AMMODISCELLA Ireland, 1956
AMMODISCELLITES Resig & Glenn, 1997
AMMOLAGENA Eimer & Fickert, 1899
AMMOVERTELLA Cushman, 1928
HEMIDISCELLA Bock, 1968
SATURNELLA Hedinger, 1993
SERPULOPSIS Girty, 1911
TOLYPAMMINA Rhumbler, 1895
AMMOVERTELLININAE Saidova, 1981[40]
AMMOVERTELLINA Suleymanov, 1959
ANNECTINA Suleymanov, 1963
ARENOMEANDROSPIRA Jones & Wonders, 2000
GLOMOSPIRELLA Plummer, 1945
PILAMMINELLA Salaj, 1978
RECTOGLOMOSPIRA Trifonova, 1978
VOSTOKOVELLA Pronina, 1972
USBEKISTANIINAE Vyalov, 1968
FLAGROSPIRA Vyalov, 1977
GLOMOSPIRA Rzehak, 1885[41]
REPMANINA Suleymanov, in Arapova & Suleymanov, 1966
TURRITELLELLA Rhumbler, 1905
USBEKISTANIA Suleymanov, 1960

[36] Regarded by Loeblich & Tappan to be in the synonymy of the Hippocrepinidae, reinstated by Mikhalevich (1995)
[37] Considered a synonym of the Hyperammininae by Loeblich & Tappan (1987), reinstated and raised in rank from a subfamily by Mikhalevich (1995). This family includes the pseudo-labyrinthic forms with sponge spicules protruding into the chamber lumen.
[38] Transferred from the Hyperaminինae by Mikhalevich (1995),
[39] These loosely coiled forms were transferred from the Ammodiscacea by Mikhalevich (1995), who regarded them to be transitional to the ammodiscids.
[40] The Triassic microgranular genera *Gandinella*, *Pilammina*, and *Rectopilammina* 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*.

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[42]
RZEHAKINACEA Cushman, 1933
RZEHAKINIDAE Cushman, 1933
RZEHAKININAE Cushman, 1933[43]
PSAMMINOPELTA Tappan, 1957
RZEHAKINA Cushman, 1927
SPIROLOCAMMINA Earland, 1934
MILIAMMININAE Saidova, 1981[44]
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 Mikhalevich, 1980[45]
HORMOSINELLACEA Rauser & Reitlinger, 1986
OXINOXISIDAE Vyalov, 1968[46]
OXINOXIS Gutschick, 1962[44]
HORMOSINELLIDAE Rauser & Reitlinger, 1986[47]
ARCHIMERISMUS Loeblich & Tappan, 1984
CAUDAMMINA Montanaro-Gallitelli, 1955[43]
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[48]
REOPHACIDAE Cushman, 1927
ADELUNGIA Suleymanov, 1966
HORMOSINOIDES Saidova, 1975
LEPTOHALYSIS Loeblich & Tappan, 1984
NODULINA Rhumbler, 1895
REOPHAX de Montfort, 1808
HORMOSINIDAE Haeckel, 1894

[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* (Bubík, 1997).
[45] Nom. transl. ex order Hormosinida Mikhalevich, 1980.
[46] Transferred from the Lituolacea, as its chamber arrangement is irregular, not coiled as reported by L&T'87. Gutschick (1962) originally regarded *Oxinoxis* as transitional between saccamminids and reophacids.
[47] This family was placed in the Astrorhizida by Mikhalevich (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.

CUNEATINAE Loeblich & Tappan, 1984[49]
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
HORMOSINA Brady, 1879
LOEBLICHOPSIS Hofker, 1967
PSEUDONODOSINELLA Saidova, 1970
SILICONODOSARINA Colom, 1963
NODOSININAE Saidova, 1981
CRIBRATINOIDES Saidova, 1975
NODOSINUM Hofker, 1930
KUNKLERINIDAE Rauser & Reitlinger, 1986
KUNKLERINA Rauser & Reitlinger, 1986
SCHEROCHORELLA Loeblich & Tappan, 1984
DUSENBURYINIDAE Loeblich & Tappan, 1984
DUSENBURYINA Bermúdez & Key, 1952
GLAUCOAMMINIDAE Saidova, 1981[50]
GLAUCOAMMINA Seiglie & Bermúdez, 1969
PSAMMOLINGULINA A. Silvestri, 1904[51]

LITUOLINA Lankester, 1885
LITUOTUBACEA Loeblich & Tappan, 1984[52]
LITUOTUBIDAE Loeblich & Tappan, 1984
LITUOTUBA Rhumbler, 1895
PARATROCHAMMINOIDES Soliman, 1972
PLAGIORAPHE Kristan-Tollmann, 1973
CONGLOPHRAGMIUM Bermúdez & Rivero, 1963[53]
TROCHAMMINOIDAE Haynes & Nwabufo-Ene, 1998[50]
SOKOTINA Haynes & Nwabufo-Ene, 1998
TROCHAMMINOIDES Cushman, 1910

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

[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 Textulariida because of its noncalcareous wall. *Glaucoammina* has a bilamellar wall with open intergranular spaces between the layers, not true canaliculae.
[51] Transferred from the Cuneatinae 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 nonseptate early portion.
[53] Placed in the synonymy of *Paratrochamminoides* by Loeblich & Tappan (1987), the genus is here reinstated for the fully chambered forms with basal apertures.

LABROSPIRA Höglund, 1947
TREMATOPHRAGMOIDES Brönnimann & Keij, 1986
TROCHAMMINITA Cushman & Brönnimann, 1948
UNITENDINA Alekseychik-Mitskevich, 1973
VELERONINOIDES Saidova, 1981
DISCAMMINIDAE Mikhalevich, 1980
AMMOSCALARIA Höglund, 1947
DISCAMMINA Lacroix, 1932
GLAPHYRAMMINA Loeblich & Tappan, 1984
STAROBOGATOVELLA Mikhalevich, 1994
SPHAERAMMINIDAE Cushman, 1933
SPHAERAMMININAE Cushman, 1933
AMMOSPHAERULINA Cushman, 1912
CANEPAIA Boltovskoy, 1961
SPHAERAMMINA Cushman, 1910
PRAESPHAERAMMININAE Kaminski & Mikhalevich, **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 Kristan-Tollmann, 1964
AMMOBACULITES Cushman, 1910
AMMOMARGINULINA Wiesner, 1931
AMMOTIUM Loeblich & Tappan, 1953
ERATIDUS Saidova, 1975
HAYMANELLA Sirel, 1999
KUTSEVELLA Dain, 1978
LAMINA Voloshina, 1972
OSTIOBACULITES Brönnimann, Whittaker & Zaninetti, 1992
SCULPTOBACULITES Loeblich & Tappan, 1984
SIMOBACULITES Loeblich & Tappan, 1984
FLABELLAMMININAE Podobina, 1978
AMMOPALMULA Lindenberg, 1966
FLABELLAMMINA Cushman, 1928
PTERAMMINA Hamaoui, 1965
TRIPLASIA Reuss, 1854
LITUOLINAE de Blainville, 1827
ATACTOLITUOLA Loeblich & Tappan, 1984
BULBOBUCCICRENATA Kerdany & Eissa, 1973
KOLCHIDINA Morozova, 1967
LITUOLA Lamarck, 1804
AMMOASTUTINAE Loeblich & Tappan, 1984
AMMOASTUTA Cushman & Brönnimann, 1948
PRAEAMMOASTUTA Bursch, 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
FLATSCHKOFELIINAE **subfam.nov.**

Test attached, chambers of early stage irregularly coiled, later biserial then rectilinear; wall agglutinated, solid.
FLATSCHKOFELIA Rettori, Senowbari-Daryan & Zühlke, 1996
ADHAERENTIINAE Loeblich & Tappan, 1986
ADHAERENTIA Plummer, 1938

RECURVOIDACEA Alekseychik-Mitskevich, 1973[54]
AMMOSPHAEROIDINIDAE Cushman, 1927
AMMOSPHAEROIDININAE Cushman, 1927
AMMOSPHAEROIDINA Cushman, 1910
CYSTAMMINA Neumayr, 1889
PRAECYSTAMMINA Krasheninnikov, 1973
RECURVOIDINAE Alekseychik-Mitskevich, 1973
BUDASHEVAELLA Loeblich & Tappan, 1964
CRIBROSTOMELLUS Saidova, 1970[55]
CRIBROSTOMOIDES Cushman, 1910[56]
RECURVOIDELLA Uchio, 1960
RECURVOIDES Earland, 1934
THALMANNAMMINA Pokorn˘, 1951
PLECTORECURVOIDIDAE Loeblich & Tappan, 1964[57]
PLECTORECURVOIDES Noth, 1952
POKORNYAMMINA Neagu & Platon, 1994
AMMOBACULINIDAE Saidova, 1981
AMMOBACULININAE Saidova, 1981
AMMOBACULINUS Saidova, 1975
BULBOBACULITES Maync, 1952
NAVARELLA Ciry & Rat, 1951
TELATYNELLINAE Gawor-Biedowa, 1987
TELATYNELLA Gawor-Biedowa, 1987
ACUPEINIDAE Brönnimann & Zaninetti, 1984
ACUPEINA Brönnimann & Zaninetti, 1984

SPIROPLECTAMMININA Mikhalevich, 1992[58]
SPIROPLECTAMMINACEA Cushman, 1927
SPIROPLECTAMMINIDAE Cushman, 1927
SPIROPLECTAMMININAE Cushman, 1927
AMMOBACULOIDES Plummer, 1932
BOLIVINOPSIS Yakovlev, 1891
HETERANTYX Loeblich & Tappan, 1982
ORECTOSTOMINA Seiglie, 1965
PALUSTRELLA Brönnimann, Whittaker & Zaninetti, 1992[59]
QUASISPIROPLECTAMMINA Loeblich & Tappan, 1982
SPIROPLECTAMMINA Cushman, 1927
SPIROPLECTELLA Earland, 1934
SPIROPLECTINELLA Kisel'man, 1972
VULVULININAE Saidova, 1981
AMMOSPIRATA Cushman, 1933
VULVULINA d'Orbigny, 1826
SPIROTEXTULARIINAE Saidova, 1975
SEPTIGERINA Keijzer, 1941
SPIROTEXTULARIA Saidova, 1975
NOVALESIINAE Loeblich & Tappan, 1984
NOVALESIA Magniez, 1974
MORULAEPLECTINAE Saidova, 1981
MORULAEPLECTA Höglund, 1947
DUQUEPSAMMINIIDAE Sieglie & Baker, 1987
DUQUEPSAMMINA Sieglie & Baker, 1987
TEXTULARIOPSIDAE Loeblich & Tappan, 1982[60]
AAPTOTOICHUS Loeblich & Tappan, 1982
BICAZAMMINA Neagu & Neagu, 1995
BIMONILINA Eicher, 1960
HAGHIMASHELLA Neagu & Neagu, 1995
HAIMASIELLA Loeblich & Tappan, 1982
MINYAICHME Loeblich & Tappan, 1982
MONOTALEA Brönnimann, Whittaker & Zaninetti, 1992
PLECTINELLA Marie, 1956
PLEUROSTOMELLOIDES Majzon, 1943
RASHNOVAMMINA Neagu & Neagu, 1995
TEXTULARIOPSIS 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

PAVONITINACEA Loeblich & Tappan, 1961
MARIEITIDAE Loeblich & Tappan, 1986
HENSONIA Marie, 1954
MARIEITA Loeblich & Tappan, 1964
PAVONITINIDAE Loeblich & Tappan, 1961
SPIROPSAMMIINAE Seiglie & Baker, 1984
SPIROPSAMMIA Seiglie & Baker, 1984
PAVONITININAE Loeblich & Tappan, 1961
PAVONITINA Schubert, 1914
PAVOPSAMMIA Seiglie & Baker, 1984
PSEUDOTRIPLASIA Ma∏ecki, 1954
ZOTHECULIFIDA Loeblich & Tappan, 1957

TROCHAMMININA Saidova, 1981
TROCHAMMINACEA Schwager, 1877
TROCHAMMINIDAE Schwager, 1877
TROCHAMMININAE Schwager, 1877
AMMOANITA Seiglie & Baker, 1987
CALYPTAMMINA Nagy & Basov, 1998
AMMOGLOBIGERINA Eimer & Fickert, 1899
ASAROTAMMINA Brönnimann, 1986
CAMURAMMINA Brönnimann & Keij, 1986
GLOBOTROCHAMMINOPSIS Brönnimann & Zaninetti, 1984
LEPIDOPARATROCHAMMINA Brönnimann & Whittaker, 1986
LINGULOTROCHAMMINA Hercogová, 1987
PARATROCHAMMINA Brönnimann, 1979
PATELLOVALVULINA Neagu, 1975

[54] Nom. transl. ex family Recurvoidinae Alekseychik-Mitskevich, 1973. This superfamily is here separated from the superfamily Haplophragmiacea (sensu Loeblich & Tappan, 1987) on account of its simple wall.
[55] Transferred from the Haplophragmoididae because of its reportedly streptospiral coiling.
[56] As above. Jones *et al*. (1993) demonstrated that the types pecies is streptospiral, especially in the early stage.
[57] Transferred from the Spiroplectamminacea, as the group is displays closer affinity to *Recurvoides*.
[58] Nom.transl. ex Spiroplectamminida Mikhalevich, 1992.
[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
ARENOPARRELLINAE Saidova, 1981
ARENOPARRELLA Andersen, 1951
TROCHAMMINULA Shchedrina, 1955
CARTERININAE Loeblich & Tappan, 1955[61]
CARTERINA Brady, 1884
JADAMMININAE Saidova, 1981
ENTZIA Daday, 1883
JADAMMINA Bartenstein & Brand, 1938
POLYSTOMAMMININAE Brönnimann & Beurlen, 1977
BALTICAMMINA Brönnimann, Lutze & Whittaker, 1989
DEUTERAMMINA Brönnimann, 1976
LEPIDODEUTERAMMINA Brönnimann & Whittaker, 1983
POLYSTOMAMMINA Seiglie, 1965
ROTALIAMMININAE Saidova, 1981
ROTALIAMMINA Cushman, 1924
SIPHOTROCHAMMINA Saunders, 1957
TIPHOTROCHA Saunders, 1957
TORETAMMININAE Brönnimann, 1986
TORETAMMINA Brönnimann, 1986
TROCHAMMINELLINAE Brönnimann, Zaninetti & Whittaker, 1983
ALTERAMMINA Brönnimann & Whittaker, 1988
ATLANTIELLA Saidova, 1981
EARLANDAMMINA Brönnimann & Whittaker, 1988
PSEUDOTROCHAMMINA Frerichs, 1969
RESUPINAMMINA Brönnimann & Whittaker, 1988
TROCHAMMINELLA Cushman, 1943
VIALOVIINAE Suleymanov, 1983
ARENONIONELLA Marks, 1951
VIALOVIA Suleymanov, 1966
ZAVODOVSKININAE Brönnimann & Whittaker, 1988
ZAVODOVSKINA Brönnimann & Whittaker, 1988
ADERCOTRYMIDAE Brönnimann & Whittaker, 1988 emend. Brönnimann & Whittaker, 1990
ADERCOTRYMINAE Brönnimann & Whittaker, 1987, emend. Brönnimann & Whittaker, 1990.
ADERCOTRYMA Loeblich & Tappan, 1952
INSCULPTARENULA Loeblich & Tappan, 1985
BYKOVIELLINAE Loeblich & Tappan, 1984[62]
BYKOVIELLA V. I. Korchagin, 1964
POLSKIAMMINA Brönnimann, Zaninetti & Whittaker, 1987
SEPETIBAELLA Brönnimann & Dias-Brito, 1982
REMANEICIDAE Loeblich & Tappan, 1964, emend. Brönnimann & Whittaker, 1990[63]
ASTEROTROCHAMMININAE Brönnimann, Zaninetti & Whittaker, 1983
ASTEROPARATROCHAMMINA Brönnimann & Zaninetti, 1984
ASTEROTROCHAMMINA Bermúdez & Seiglie, 1963
REMANEICINAE Loeblich & Tappan, 1964

[61] Brönnimann & Whittaker (1988, 1990) regarded it to be a subfamily within the Trochamminidae. Loeblich & Tappan (1992) regarded the Carterinina as a separate order.
[62] Placed in the Adercotrymidae by Brönnimann & Whittaker (1990)
[63] Elevated to superfamily rank by Brönnimann & Whittaker (1990); it is here regarded as a family of the Trochamminacea.

BRUNEICA Brönnimann, Keij & Zaninetti, 1983
REMANEICA Rhumbler, 1938
REMANEICELLA Brönnimann, Zaninetti, & Whittaker, 1983[64]
ZANINETTINAE Brönnimann & Whittaker, 1983
ABYSSOTHERMA Brönnimann, Van Dover & Whittaker, 1989
ZANINETTIA Brönnimann & Whittaker, 1983

VERNEUILININA Mikhalevich & Kaminski **subord. nov.**
Test high trochospiral 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
ARENOGAUDRYINA Podobina, 1975
CONVALLINA McNeil, 1997
DANUBINA Neagu, 1997
EGGERELLOIDES Haynes, 1973[65]
EOMARSSONELLA Levina, 1972
GEROCHAMMINA Neagu, 1990
KADRIAYINA Al-Najdi, 1975
KARRERULINA Finlay, 1940
MAGNESOINA 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
RIYADHELLA 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
FLOURENSINA Marie, 1938
GAUDRYINOPSIS Podobina, 1975
MOOREINELLA Cushman & Waters, 1928
PALEOGAUDRYINA Said & Barakat, 1958
PARAGAUDRYINA Suleymanov, 1958
TALIMUELLA Zeng & Li, 1982
VERNEUILINOIDES Loeblich & Tappan, 1949
VIALOVELLA Voloshina, 1972
REOPHACELLIDAE Mikhalevich & Kaminski, (this volume)
REOPHACELLIDAE Mikhalevich & Kaminski, (this volume)
REOPHACELLA Kaptarenko-Chernousova, 1956
FALSOGAUDRYINELLA Bartenstein, 1977
UVIGERINAMMINA Majzon, 1943

[64] *Septotrochammina* Zheng, 1979 is here tentatively regarded as a synonym (see discussion by Brönnimann & Whittaker, 1990, p. 124).
[65] Here transferred from the Eggerellinae because of its compact, noncalcareous wall.

PSEUDOREOPHAXINAE Mikhalevich & Kaminski, (this volume)
PSEUDOREOPHAX Geroch, 1961
CARONIINAE Brönnimann, Whittaker & Zaninetti, 1992[66]
CARONIA Brönnimann, Whittaker & Zaninetti, 1992
SPIROPLECTINATINAE Cushman, 1928
BELORUSSIELLA Akimets, 1958
GAUDRYINOIDES Geodakchan, 1969
SPIROPLECTINA Schubert, 1902
SPIROPLECTINATA Cushman, 1927
VERNEUILININAE Cushman, 1911
GAUDRYINA d'Orbigny, 1839
GAUDRYINELLA Plummer, 1931
LATENTOVERNEUILINA Loeblich & Tappan, 1985
PARAMIGROS Adb-Elsahfy & Ibrahim, 1990
PSEUDOGAUDRYINELLA Cushman, 1936
SIPHOGAUDRYINA Cushman, 1935
VERNEUILINA d'Orbigny, 1839
BARBOURINELLINAE Saidova, 1981
BARBOURINELLA Bermúdez, 1940
BERMUDEZINA Cushman, 1937
HETEROSTOMELLA Reuss, 1866
PIALLINIDAE Rettori & Zaninetti, 1993
PIALLINA Rettori & Zaninetti, 1993

NEZZAZATINA subord.nov.[67]
Test free, low trochospiral to planispiral with a simple non-lamellar, microgranular wall. May possess internal plates or simple partitions and/or multiple apertures.
NEZZAZATACEA Hamaoui & Saint-Marc, 1970[68]
NAUTILOCULINIDAE Loeblich & Tappan, 1985
MURGEINA Bilotte & Decrouez, 1979
NAUTILOCULINA Mohler, 1930
MAYNCINIDAE Loeblich & Tappan, 1985
BICONCAVA Hamaoui, 1965
CARASUELLA Neagu, 2000
COMALIAMMA Loeblich & Tappan, 1985
DAXIA Cuvillier & Szakall, 1949
DEUTEROSPIRA Hamaoui, 1965
FLABELLOCYCLOLINA Gendrot, 1964
FREIXIALINA Ramalho, 1969
GENDROTELLA Maync, 1972
HINOGAMMINA Neagu, 2000
MAYNCINA Neumann, 1965
NONIONAMMINA Neagu, 2000
PHENACOPHRAGMA Applin, Loeblich & Tappan, 1950
STOMATOSTOECHA 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[69]
NEZZAZATIDAE Hamaoui & Saint-Marc, 1970
NEZZAZATINAE Hamaoui & Saint-Marc, 1970
BIPLANATA Hamaoui & Saint-Marc, 1970

[66] Nom. transl. ex Caroniidae
[67] Nom. transl. ex Nezzazatidae.
[68] Nom. transl. ex Nezzazatidae.
[69] Transferred from the Haplophragmoididae because of its micrgranular wall.

LUPERTOSINNIA Farinacci, 1996
MERLINGINA Hamaoui, 1965
NEZZAZATA Omara, 1956
NEZZAZATINELLA Darmoian, 1976
PYRENINA Peybernes, 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

LOFTUSIIDA Kaminski & Mikhalevich, **ord.nov.**
Test free or attached, multilocular, coiled in early stage, later may uncoil; wall agglutinated with organic, microgranular, or calcitic 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.

LOFTUSIINA Kaminski & Mikhalevich, **subord.nov.**
Test free or attached, multilocular, coiled or uncoiling, with an alveolar wall.
HAPLOPHRAGMIACEA Eimer & Fickert, 1899 [emended][70]
Test streptospirally enrolled, later uncoiling, or wholly uniserial. Wall alveolar or subdivided by radial exoskeletal partitions. Aperture terminal, single or multiple.
CRIBRATINIDAE Loeblich & Tappan, 1964[71]
CRIBRATINA Sample, 1932
HAPLOPHRAGMIIDAE Eimer & Fickert, 1899
HAPLOPHRAGMIUM Reuss, 1860
LABYRINTHIDOMATIDAE Loeblich & Tappan, 1987
BULBOPHRAGMIUM Maync, 1952
LABYRINTHIDOMA Adams, Knight & Hodgkinson, 1973

LOFTUSIACEA Brady, 1884
MESOENDOTHYRIDAE Voloshinova, 1958
MESOENDOTHYRINAE Banner, 1966[72]
AUDIENUSINA Bernier, 1985
MESOENDOTHYRA Dain, 1958
PLANISEPTINAE Septfontaine, 1988 nom. nudum
PLANISEPTA Septfontaine *in* Kaminski, 2000
PALEOMAYNCINA Septfontaine *in* Kaminski, 2000
ORBITOPSELLINAE Hottinger & Caus, 1982[73]
CYCLORBITOPSELLA Cherchi, Schroeder & Zhang, 1984
ORBITAMMINA Berthelin, 1893
ORBITOPSELLA Munier-Chalmas, 1902

[70] The superfamily is here restricted to Mesozoic families that possess complex inner structure (alveolae, septal plates, or traverse partitions, and includes wholly uniserial forms such as *Cribratina*. The genera with simple walls are here removed to the Recurvoidacea.
[71] Here transferred from the Hormosinacea because of its alveolar wall.
[72] Reinstated by Septfontaine (1988), but the authorship is Banner, 1966, not Voloshinova, 1958.
[73] Removed from the Cyclolinidae by Loeblich & Tappan (1992), who transferred the subfamilies Orbitopsellinae & Labyrinthininae to the Mesoendothyridae.

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[74]
RECTOCYCLAMMINA Hottinger, 1967
CYCLAMMINIDAE Marie, 1941
BUCCICRENATINAE Loeblich & Tappan, 1985
BUCCICRENATA Loeblich & Tappan, 1949
ALVEOLOPHRAGMIINAE Saidova, 1981
ALVEOLOPHRAGMIUM Shchedrina, 1936
POPOVIA Suleymanov, 1965
QUASICYCLAMMINA Belford, 1977
RETICULOPHRAGMOIDES Gradstein & Kaminski, 1989
RETICULOPHRAGMIUM Maync, 1955
SABELLOVOLUTA Loeblich & Tappan, 1985
HEMICYCLAMMININAE Banner, 1966
ALVEOCYCLAMMINA Hillebrandt, 1971
FLABELLAMMINOPSIS Ma∏ecki, 1954
HEMICYCLAMMINA Maync, 1953
CHOFFATELLINAE Maync, 1958
ABUHAMMADINA Abd-Elsahfy & Ibrahim, 1990
BRAMKAMPELLA Redmond, 1964
CHOFFATELLA Schlumberger, 1905
PARACYCLAMMINA Yabe, 1946
TORINOSUELLA Maync, 1959
PSEUDOCHOFFATELLINAE Loeblich & Tappan, 1985
BALKHANIA Mamontova, 1966
BROECKINELLA Henson, 1948
DHRUMELLA Redmond, 1965
MONTSECHIANA Aubert, Coustau & Gendrot, 1963
PSEUDOCHOFFATELLA Deloffre, 1961
TORREMIROELLA Brun & Canerot, 1979
CYCLAMMININAE Marie, 1941
CYCLAMMINA Brady, 1879
ECOUGELLIDAE Loeblich & Tappan, 1985
ECOUGELLA 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
PRAERETICULINELLA Deloffre & Hamaoui, 1970
RETICULINELLA 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.

COSCINOPHRAGMATACEA Thalmann, 1951
HADDONIIDAE Saidova, 1981
HADDONIA Chapman, 1898
STYLOLINA Karrer, 1877[75]
COSCINOPHRAGMATIDAE Thalmann, 1951
ALPINOPHRAGMIUM Flugel, 1967
AMMOTROCHOIDES Janin, 1984
BDELLOIDINA Carter, 1877
GOELLIPORA Senowbari-Daryan & Zankl, 2000
COSCINOPHRAGMA Thalmann, 1951

BIOKOVINACEA Gu‰iç, 1977
CHARENTIIDAE Loeblich & Tappan, 1985
CHARENTIA Neumann, 1965
ISMAILIA El-Dakkak, 1974
KARAISELLA Kurbatov, 1971
MELATHROKERION Brönnimann & Conrad, 1967
MONCHARMONTIA De Castro, 1967
PRAEKARAISELLA Kurbatov, 1972
PRAEPENEROPLIS Hofker, 1952
LITUOLIPORIDAE Gu‰iç & Veliç, 1978
LITUOLIPORA Gu‰iç & Veliç, 1970[76]
BIOKOVINIDAE Gu‰iç, 1977
BIOKOVINA Gu‰iç, 1977[77]
BOSNIELLA Gu‰iç 1977
TROCHAMIJIELLA Athersuch, Banner & Simmons, 1992[78]

CYCLOLININA Mikhalevich, 1992[79]
CYCLOLINACEA Loeblich & Tappan, 1964
CYCLOLINIDAE Loeblich & Tappan, 1964
CYCLOLININAE Loeblich & Tappan, 1964
AMMOCYCLOLOCULINA Maync, 1958
CYCLOLINA d'Orbigny, 1846
CYCLOPSINELLINAE Loeblich & Tappan, 1984
CYCLOPSINELLA Galloway, 1933
MANGASHTIA Henson, 1948
ILERDORBINAE Hottinger & Caus, 1982
DOHAIA Henson, 1948
ECLUSIA Septfontaine, 1971
ILERDORBIS Hottinger & Caus, 1982

[74] Includes *Feurtillia* Maync, 1958, considered a junior synonym of *Everticyclammina* by Septfontaine (1988)

[75] Originally regarded as a synonym of *Lituola* by Loeblich & Tappan (1987); reinstated by Cicha *et al*., (1998), and transferred to the Hadoniidae by Popescu (2000).

[76] Regarded by Septfontaine (1988) to be closely related to, if not synonymous with *Paleomayncina* and belonging in the Planiseptinae.

[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 Mesoendothyrinae.

[78] Original suprageneric assignment by Athersuch *et al*. (1992).

[79] Nom.transl. ex order Cyclolinida Mikhalevich, 1992.

ATAXOPHRAGMIINA Fursenko, 1958
ATAXOPHRAGMIACEA Schwager, 1877
ATAXOPHRAGMIIDAE Schwager, 1877
ATAXOPHRAGMIINAE Schwager, 1877
ARENOBULIMINA 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 irregularly uniserial 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
GLOBOTEXTULARIIDAE Cushman, 1927
GLOBOTEXTULARIINAE Cushman, 1927
CRIBROTURRETOIDES D.J. Smith, 1949
GLOBOTEXTULARIA Eimer & Fickert, 1899
GRAVELLINA Brönnimann, 1953
RHUMBLERELLA Brönnimann, 1981
TETRATAXIELLA Seiglie, 1964
VERNEUILINULLA Saidova, 1975
VARSOVIELLINAE Gawor-Biedova, 1987
VARSOVIELLA Gawor-Biedova, 1987
LIEBUSELLINAE Saidova, 1981
CUBANINA Palmer, 1936
JARVISELLA Brönnimann, 1953
LIEBUSELLA Cushman, 1933
REMESELLA Vasicek, 1947
RUAKITURIA Kennett, 1967
TEXTULARIELLIDAE Grönhagen & Luterbacher, 1966
ALVEOVALVULINA Brönnimann, 1951
ALVEOVALVULINELLA Brönnimann, 1953[80]
CUNEOLINELLA Cushman & Bermúdez, 1941
GUPPYELLA Brönnimann, 1951
HAGENOWINOIDES Saidova, 1975
TEXTULARIELLA Cushman, 1927
MONTSALEVIIDAE Zaninetti, Salvini-Bonnard, Charollais, & Decrouez, 1987
MONTSALEVIA Zaninetti, Salvini-Bonnard, Charollais & Decrouez, 1987
CUNEOLINIDAE Saidova, 1981[81]
CUNEOLININAE Saidova, 1981
CUNEOLINA d'Orbigny, 1839
PALAEOLITUONELLA Berczi-Makk, 1981
PSEUDOTEXTULARIELLA Barnard, 1953
VERCORSELLA Arnaud-Vanneau, 1980
SCYTHIOLININAE Neagu, **subfam.nov.**
Test free, flattened, flabelliform to elongated. Initial stage coiled in a very short planispire of 3-4 chambers. Interior of chambers subdivided by vertical radial partitions. Aperture an interiomarginal slit, becoming crenulated.
HISTEROLINA Neagu, 2000[82]
SCYTHIOLINA Neagu, 2000
SABAUDIINAE Brönnimann, Decrouez & Zaninetti, 1983
SABAUDIA Charollais & Brönnimann, 1965
DICYCLINIDAE Loeblich & Tappan, 1964
DICYCLINA Munier-Chalmas, 1887
DICTYOPSELLIDAE Brönnimann, Zaninetti & Whittaker, 1983[83]
ANDAMOOKIA Ludbrook, 1966
CONORBINELLA Poroshina, 1976
DICTYOPSELLA Munier-Chalmas, 1900
DICTYOPSELLOIDES 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.
PFENDERINACAE Smout & Sugden, 1962
PFENDERINIDAE Smout & Sugden, 1962
PSEUDOPFENDERININAE Septfontaine, 1988
PSEUDOPFENDERINA Hottinger, 1967
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 & Sugden, 1962
DOBROGELINA Neagu, 1979
DREVENNIA Arnaud-Vanneau, 1980
PFENDERELLA Redmond, 1964
PFENDERINA Henson, 1948
KURNUBIINAE Redmond, 1964
CONICOKURNUBIA Septfontaine, 1988
GYROCONULINA Schroeder & Darmoian, 1977[84]
KURNUBIA Henson, 1948
PRAEKURNUBIA Redmond, 1964
HAURANIIDAE Septfontaine, 1988
HAURANIINAE Septfontaine, 1988
CYMBRIAELLA Fugagnoli, 1999

[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.

[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 Trochamminacea by Brönnimann & Whittaker (1990).
[84] Not included in the Pfenderinidae by Septfontaine (1988)

GUTNICELLA Moullade, Haman & Huddleston, 1981
HAURANIA Henson, 1948
MEYENDORFFINA Aurouze & Bizon, 1958
PLATYHAURANIA Bassoullet & Boutakiout, 1996
SOCOTRAINA Banner, Whittaker, Boudagher-Fadel & Samuel, 1997
TIMIDONELLA Bassoullet, Chabrier & Fourcade, 1974
AMIJELLINAE Septfontaine, 1988
ALVEOSEPTA Hottinger, 1967
ALZONELLA Bernier & Neumann, 1970
AMIJIELLA Loeblich & Tappan, 1985
ANCHISPIROCYCLINA Jordan & Applin, 1952
BOSTIA Bassoullet, 1998
IJDRANELLA Bassoullet, Boutakiout & Echarfaoui, 1999
KASTAMONINA Sirel, 1993
PALAEOCYCLAMMINA Bassoullet, Boutakiout & Echarfaoui, 1999
PSEUDOCYCLAMMINA Yabe & Hanzawa, 1926
REDMONDELLINA Banner & Whittaker, 1991
SPIRALOCONULUS Allemann & Schroeder, 1980
PARURGONINIDAE Septfontaine, 1988
PARURGONINA Cuvillier, Foury & Pignatti Morano, 1968

COSKINOLINACAE Moullade, 1965
COSKINOLINIDAE Moullade, 1965
COLEICONUS Hottinger & Drobne, 1980
COSKINOLINA Stache, 1875
COSKINON Hottinger & Drobne, 1980
LITUONELLOIDES Henson, 1948
PSEUDOLITUONELLA Marie, 1955

ORBITOLINACEA Martin, 1890
ORBITOLINIDAE Martin, 1980
DICTYOCONINAE Moullade, 1965
ABRARDIA Neumann & Damotte, 1960
CALVEZICONUS Caus & Cornella, 1982
CAMPANELLULA De Castro, 1964
CARINOCONUS Cherchi & Schroeder, 1982
COSKINOLINOIDES Keijzer, 1942
CRIBELLOPSIS Arnaud-Vanneau, 1980
CUSHMANIA Silvestri, 1925
DAVIESICONUS Hottinger & Drobne, 1980
DICTYOCONELLA Henson, 1948
DICTYOCONUS Blanckenhorn, 1900
FALLOTELLA Mangin, 1954
FALSURGONINA Arnaud-Vanneau & Argot, 1973
HETEROCOSKINOLINA Saint-Marc, 1978
IRAQIA Henson, 1948
KARSELLA Sirel, 1997
ORBITOLINELLA Henson, 1948
ORBITOLINOPSIS Henson, 1948
PALEODICTYOCONUS Moullade, 1965
PSEUDORBITOLINA H. Douville, 1910
SIMPLORBITOLINA Ciry & Rat, 1953
URGONINA Foury & Moullade, 1966
VALDANCHELLA Canerot & Moullade, 1971
VERSEYELLA Robinson, 1977
PRAEDICTYORBITOLININAE Schroeder, 1990
DICTYORBITOLINA Cherchi & Schroeder, 1976
PARACOSKINOLINA Moullade, 1965
PRAEDICTYORBITOLINA Schroeder, 1990
ORBITOLININAE Martin, 1890
ALPILLINA Foury, 1968
CONICORBITOLINA Schroeder, 1973
EOPALORBITOLINA Schroeder, 1968
EYGALIERINA Foury, 1968
MESORBITOLINA Schroeder, 1962
NAUPLIELLA Decrouez & Moullade, 1974
NEOIRAQIA Danilova, 1963
NEORBITOLINOPSIS Schroeder, 1964
ORBITOLINA d'Orbigny, 1850
PALORBITOLINA Schroeder, 1963
PALORBITOLINOIDES Cherchi & Schroeder, 1980
PRAEORBITOLINA Schroeder, 1965
RECTODICTYOCONUS Schroeder, 1964
VALSERINA Schroeder & Conrad, 1968

TEXTULARIIDA Delage & Herouard, 1896
[emended][85]
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.

TEXTULARIINA Delage & Herouard, 1896
EGGERELLACEA Cushman, 1937
EGGERELLIDAE Cushman, 1937
DOROTHIINAE Balakhmatova, 1972
ARENODOSARIA Finlay, 1939
BANNERELLA Loeblich & Tappan, 1985
DOROTHIA Plummer, 1931
MATANZIA Palmer, 1936[86]
MARSSONELLA Cushman, 1933
PSEUDOMORULAEPLECTA Neagu & Neagu, 1995
MINOUXIINAE Loeblich & Tappan, 1986
ANDERSENIA 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
COLOMITA Gonzalez-Donoso, 1968[87]
TRITAXILININAE Loeblich & Tappan, 1986
TRITAXILINA Cushman, 1911
PSEUDOGAUDRYINIDAE Loeblich & Tappan, 1985

[85] Includes perforate uniserial genera such as *Thomasinella* and forms that have a small initial spiral portion such as *Kaminskia* and *Spirorutilus*.
[86] Transferred to the Textulariacea by Cicha *et al.*, (1998) because the type species is canaliculate.
[87] Transferred from the Septotextulariinae by Popescu (2000).

PSEUDOGAUDRYINAE Loeblich & Tappan, 1985
CLAVULINOIDES Cushman, 1936
CLAVULINOPSIS Banner & Desai, 1985
CONNEMARELLA Loeblich & Tappan, 1989
HEMLEBENIA Loeblich & Tappan, 1989
MIGROS Finlay, 1939
PARAGAUDRYINELLA Popescu, 1998
PSEUDOCLAVULINA Cushman, 1936
PSEUDOGAUDRYINA Cushman, 1936
VALVOREUSSELLA Hofker, 1957
SIPHONIFEROIDINAE Loeblich & Tappan, 1985
PLOTNIKOVINA Mikhalevich, 1981
SIPHONIFEROIDES Saidova, 1981
VALVULAMMINIDAE Loeblich & Tappan, 1986
ARENAGULA Bourdon & Lys, 1955
DISCORINOPSIS Cole, 1941
VALVULAMMINA Cushman, 1933
VALVULINIDAE Berthelin, 1880[88]
VALVULININAE Berthelin, 1880
CLAVULINA d'Orbigny, 1826
CRIBROBULIMINA Cushman, 1927
CRIBROGOESELLA Cushman, 1935
CYLINDROCLAVULINA Bermúdez & Key, 1952
GOESELLA Cushman, 1933
GYROVALVULINA Loeblich & Tappan, 1985
MAKARSKIANA van Soest, 1942
NEOCLAVULINA Puri, 1957
VALVULINA d'Orbigny, 1826
SIPHOBIGENERININAE Loeblich & Tappan, 1986
SIPHOBIGENERINA Zheng, 1979

TEXTULARIACEA Ehrenberg, 1838[89]
THOMASINELLIDAE Loeblich & Tappan, 1984[90]
AXICOLUMELLA Hercogová, 1988
PROTOSCHISTA Eimer & Fickert, 1899
THOMASINELLA Schlumberger, 1893
KAMINSKIIDAE Neagu, 1999[91]
KAMINSKIA Neagu, 1999
SPIRORUTILUS Hottinger, Halicz & Reiss, 1990[92]
TEXTULARIIDAE Ehrenberg, 1838
TEXTULARIINAE Ehrenberg, 1838
BIGENERINA d'Orbigny, 1826
HAEUSLERELLA Parr, 1935
PARAVULVULINA Cicha & Zapletalová, 1965
SAHULIA Loeblich & Tappan, 1985
SEMIVULVULINA Finlay, 1939
TETRAGONOSTOMINA Mikhalevich, 1975
TEXTULARIA Defrance, 1824

SIPHOTEXTULARIINAE Loeblich & Tappan, 1985
KARREROTEXTULARIA Le Calvez, de Klasz & Brun, 1974
PLECANIUM Reuss, 1862
SIPHOSCUTULA Loeblich & Tappan, 1985
SIPHOTEXTULARIA Finlay, 1939
TEXTULINA Saidova, 1975
PLANCTOSTOMATINAE Loeblich & Tappan, 1984
CRIBROBIGENERINA Andersen, 1961
OLSSONINA Bermúdez, 1949
PLANCTOSTOMA Loeblich & Tappan, 1955
PORITEXTULARIA Loeblich & Tappan, 1952
TAWITAWIINAE Loeblich & Tappan, 1961
TAWITAWIA Loeblich, 1952
TEXTULARIOIDINAE Loeblich & Tappan, 1984
TEXTULARIOIDES Cushman, 1911
SEPTOTEXTULARIINAE Loeblich & Tappan, 1985
SEPTOTEXTULARIA Cheng & Zheng, 1978

CHRYSALIDINACEA Neagu, 1968[93]
CHRYSALIDINIDAE Neagu, 1968[94]
ACCORDIELLA Farinacci, 1962
CHRYSALIDINA d'Orbigny, 1839
DUKHANIA Henson, 1948
PFENDERICONUS Hottinger & Drobne, 1980
PRAECHRYSALIDINA Luperto Sinni, 1979
PSEUDOCHRYSALIDINA Cole, 1941
VACUOVALVULINA Hofker, 1966
PARAVALVULINIDAE Banner, Simmons & Whittaker, 1991[95]
PARAVALVULININAE Banner, Simmons & Whittaker, 1991
INDOMARSSONELLA Mandwal & Singh, 1993
KILIANINA Pfender, 1933[96]
PARAVALVULINA Septfontaine, 1988
PSEUDOMARSSONELLA Redmond, 1965
REDMONDOIDES Banner, Simmons & Whittaker, 1991
RIYADHOIDES Banner, Simmons & Whittaker, 1991
PSEUDODICTYOPSELLINAE Septfontaine & De Matos, 1998
PSEUDODICTYOPSELLA Septfontaine & De Matos, 1998

ACKNOWLEDGEMENTS
I wish to thank my wife Danuta for convincing me to take a summer beach holiday in France, during which the initial version of this manuscript was compiled. I also thank Marialsira González (PDVSA) for giving me her MS WORD file with the original Loeblich & Tappan (1987) classification. The new classification adopted herein benefitted greatly from discussions with Valeria Mikhalevich, John Whittaker, and other colleagues who

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 Chrysalidinae Neagu, 1968.
94 Loeblich & Tappan (1992) did not subdivide the Chrysalidinidae. The families Chrysalidinidae and Paravalvulinidae 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 protocanaliculate forms (Paravalvulininae) that have very little in common with the Textulariacea, and is here only tentatively retained in the Textulariina.
95 Nom.transl ex Paravalvulininae. Includes low trochospiral forms with subepidermal vertical partitions (Pseudodictyopsellinae).
96 Placed in the Valvulininae by Septfontaine (1988). Loeblich & Tappan (1992) excluded the Jurassic noncanuliculate forms from this group.

attended the IWAF-6 in Prague, and from an ad-hoc workshop with Valeria Mikhalevich and Theodor Neagu held in Bucharest in May, 2002. Theodor Neagu kindly provided the description of Scythiolininae. Funding for this project is provided by the KLFR. I am grateful to Theodor Neagu, Valeria Mikhalevich, Roberto Rettori, and John Whittaker for reviewing the manuscript. This is contribution nr. 68 of the Deep-Water Agglutinated Foraminiferal Project.

REFERENCES

Alimov, A.F. (ed.), *Protisty: Rukovodstvo po Zoologii,* pt. 1. Nauka Publishers, St. Petersburg, 679 pp.

Athersuch, J., Banner, F.T. & Simmons, M.D. 1992. On *Trochamijiella gollesstanehi* gen.nov et sp.nov. (Foraminiferida, Loftusiacea), an index for the Middle Eastern marine late Bathonian. *Journal of Micropalaeontology,* **11,** 7-12.

Banner, F.T. & Desai, D. 1985. The genus *Clavulinoides* Cushman emended and the new Cretaceous genus *Clavulinopsis*. *Journal of Foraminiferal Research,* **15**, 79-90.

Banner, F.T., Simmons, M.D. & Whittaker, J.E. 1991. The Mesozoic Chrysalinidae (Foraminifera, Textulariacea) of the Middle East: the Redmond (Aramco) taxa and their relatives. *Bulletin of the British Museum (Natural History), Geology Series,* **42** (2), 101-152.

Bender, H. 1989. Gehäuseaufbau, Gehäusegenese, und Biologie agglutinierter Foraminiferen (Sarcodina, Textulariina). *Jahrbuch der Geologischen Bundesanstalt, Wien,* **133**, 259-347.

Bender, H. 1995. Test structure and classification in agglutinated foraminifera. *In:* Kaminski, M.A., Geroch, S. & Gasinski, M.A. (eds), Proceedings of the Fourth International Workshop on Agglutinated Foraminifera. *Grzybowski Foundation Special Publication*, **3**, 27-70.

Bender, H. & Hemleben, C. 1988. Constructional aspects in test formation of some agglutinated foraminifera. *Abhandlungen der Geologischen Bundesanstalt,* **41**, 13-12.

Brady, H.B. 1884. Report on the foraminifera dredged by H.M.S. Challenger during the years 1873-1876. *Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873-1876, Zoology,* **9**, 1-814.

Brönnimann, P. & Whittaker, J.E. 1988. *The Trochamminacea of the Discovery Reports.* British Museum (Natural History), London, 152 pp.

Brönnimann, P. & Whittaker, J.E. 1990. Revision of the Trochaminacea and Remaneicacea of the Plymouth District, SW England, described by Heron-Allen and Earland (1930). *In:* Hemleben, C., Kaminski, M.A., Kuhnt, W. & Scott, D.B. (eds), *Paleoecology, Biostratigraphy, Paleoceanography and Taxonomy of Agglutinated Foraminifera.* NATO ASI Series C, 327, pp. 105-137.

Brönnimann, P., Whittaker, J.E. & Zaninetti, L. 1992. Brackish water foraminifera from mangrove sediments of southwestern Viti Levu, Fiji Islands, southwest Pacific. *Revue de Paléobiologie,* **11,** 13-65.

Bubík, M. 1997. What is *Rothina silesica*? A taxonomic revision of the genus *Rothina* (Foraminiferida). *Annales Societatis Geologorum Poloniae,* **67**, 175-182.

Carpenter, W.B. 1862. *Introduction to the study of the Foraminifera.* Ray Society, London, 319 pp + 22 pls.

Cavalier-Smith, T. 1993. Kingdom Protozoa and its 18 phyla. *Microbiological Reviews,* **57**, 953-994.

Cavalier-Smith, T. 1998. A revised six-kingdom system of life. *Biological Reviews,* **73**, 203-266.

Cicha, I., Rögl, F., Rupp, C. & Cytroka, J. (eds), Oligocene – Miocene foraminifera of the Central Paratethys. *Abhandlungen der senckenbergischen naturforschenden Gesellschaft,* **549**, 69-325.

Culver, S. 1991. Early Cambrian Foraminifera from West Africa. *Science*, **254**, 689-691.

Cushman, J.A. 1927. An outline of the re-classification of the Foraminifera. *Contributions from the Cushman Laboratory for Foraminiferal Research,* **3**, 1-105.

Cushman, J.A. 1948. *Foraminifera, their classification and economic use* (fourth edition). Harvard University Press, 603 pp.

Delage, Y. & Hérouard, E. 1896. *Traité de Zoologie Concrète,* Vol. 1, *La Cellule et les Protozoaires.* Paris: Schleicher Fréres.

Desai, D. & Banner, F.T. 1987. The evolution of Early Cretaceous Dorothiinae (Foraminiferida). *Journal of Micropaleontology,* **6**, 13-27.

Gaucher, C. & Sprechmann, P. 1999. Upper Vendian skeletal fauna of the Arroyo de Soldado Group, Uruguay. *Beringeria*, **23**, 55-91.

Glaessner, M.F. 1945. *Principles of Micropalaeontology.* Melbourne University Press, 296 pp.

Gooday, A. & Cook, P.L. 1984. An association between komokiacean foraminifers (Protozoa) and Paludicelline Ctenostomes (Bryozoa) from the abyssal northeast Atlantic. *Journal of Natural History,* **18**, 765-784.

Gu‰iç, I. 1977. A new foraminiferal family, Biokovinidae, from the Jurassic of the Dinarids and its phylogenetic relationships. *Palaeontologia Jugoslavica,* **18**, 7-31 + 15 pls.

Gutschick, R.C. 1962. Arenaceous foraminifera from oncolites in the Mississippian Sappington Formation of Montana. *Journal of Paleontology,* **36,** 1291-1304.

Haynes, J.R. 1981. Foraminifera. John Wiley & Sons, New York, 433 pp.

Haynes, J.R. 1990. The classification of the foraminifera - a review of historical and philosophical perspectives. *Palaeontology*, **33,** 503-528.

Hemleben, C. & Kaminski, M.A. 1990. Agglutinated foraminifera – an introduction. *In:* Hemleben, C; Kaminski, MA; Kuhnt, W; Scott, DB (eds), *Paleoecology, Biostratigraphy, Paleoceanography and Taxonomy of Agglutinated Foraminifera.* NATO ASI Series C, **327**, pp. 1-13.

Jones, T.R. 1876. Remarks on the Foraminifera, with special reference to their variability of form, illustrated by the Cristellarians. *Monthly Microscopal Journal,* **15**, 61-62.

Jones, R.W., Bender, H., Charnock, M.A., Kaminski, M.A. & Whittaker, J.E. 1993. Emendation of the foraminiferal genus *Cribrostomoides* Cushman, 1910, and its taxonomic implications. *Journal of Micropalaeontology,* **12** (2), 181-193.

Kamenskaya, O.E. 2000. Otryad Komokiida Kamenskaya, 1992. *In:* Alimov, A.F. (ed.), *Protisty: Rukovodstvo po Zoologii,* pt. 1. Nauka Publishers, St. Petersburg, pp. 524-528.

Kaminski, M.A. 2000. The new and reinstated genera of agglutinated foraminifera published between 1986 and 1996. *In:* Hart, M.B., Kaminski, M.A. & Smart, C.B., (eds), *Proceedings of the Fifth International Workshop on Agglutinated Foraminifera.* Grzybowski Foundation Special Publication, **7**, 185-219.

Kaminski, M.A. (this volume). The new and reinstated genera of agglutinated foraminifera published between 1986 and 2000.

Lee, J.J. 1990. Phylum Granuloreticulosa (Foraminifera). *In:* Margulis, L., Corliss, J.O., Melkonian, M., Chapman, D.J. (eds), 1990. *Handbook of Protoctista.* Jones & Bartlett, Boston, 524-548.

Lee, J.J., Pawlowski, J., Debenay, J.P., Whittaker, J.E., Banner, F.T., Gooday, A.J., Tendal, O., Haynes, J. & Faber, W.W. 2000. Class Foraminifera. *In:* Lee, J.J., Leedale, G.F. & Bradbury, P. (eds), *An Illustrated Guide to the Protozoa, second edition.* Society of Protozoologists (Allen Press, Lawrence Kansas), pp. 877-951.

Loeblich, A.R. & Tappan, H. 1964. *Part C. Protista 2. Chiefly "Thecamoebians" and Foraminiferida. In:* Moore, R.C. (Ed.), Treatise on Invertebrate Paleontology. The Geological Society of America and the University of Kansas. Lawrence Kansas, 900 pp.

Loeblich, A.R. & Tappan, H. 1974. Recent advances in the Classification of the Foraminiferida. *In:* Hedley, R.H. & Adams, C.G. (eds), *Foraminifera*, vol. 1. Academic Press, London, pp. 1-53.

Loeblich, A.R. & Tappan, H. 1987. *Foraminiferal Genera and their Classification.* Van Nostrand Reinhold. 970 pp + 847 pl.

Loeblich, A.R. & Tappan, H. 1988. Foraminiferal evolution, diversification, and extinction. *Journal of Paleontology,* **62,** 695-714.

Loeblich, A.R. & Tappan, H. 1989. Implications of wall composition and structure in agglutinated Foraminifera. *Journal of Paleontology*, **36**, 769-777.

Loeblich, A.R. & Tappan, H. 1992. Present status of Foraminiferal Classification. *In:* Takayanagi, Y. & Saito, T (eds), *Studies in Benthic Foraminifera.* Tokai University Press, 93-102.

Loeblich, A.R. & Tappan, H. 1994. Foraminifera of the Sahul Shelf and Timor Sea. *Cushman Foundation for Foraminiferal Research Special Publication,* **31**, 661 pp.

Margulis, L. 1974. Five-kingdom classification and the origin of evolution in cells. *Evolutionary Biology,* **7**, 45-78.

Margulis, L. & Schwartz, K. 1988. Five Kingdoms: An illustrated guide to the Phyla of life on Earth. (second edition), W.H. Freeman & Co., New York, 376 pp.

Margulis, L., Corliss, J.O., Melkonian, M. & Chapman, D.J. (eds), 1990. *Handbook of Protoctista.* Jones & Bartlett, Boston.

Mikhalevich, V.I. 1980. Sistematika i evolyutsiya foraminifer v svete novykh dannykh po ikh tsitologii i ul'trastrukture. *Trudy Zoologicheskogo Instituta Akademii Nauk SSSR,* **94**, 42-61.

Mikhalevich, V.I. 1995. A new classification of the class Astrorhizata. *Zoosystematica Rossica,* **3** (2), 161-174.

Mikhalevich, V.I. 1998. Makrosystema Foraminifer. *Izvestiya Akademii Nauk, Seriya Biologicheskaya,* **1998** (2), 266-271.

Mikhalevich, V.I. 2000. Typ Foraminifera d'Orbigny, 1826. *In:* Alimov, A.F. (ed.), *Protisty: Rukovodstvo po Zoologii,* pt. 1. Nauka Publishers, St. Petersburg, pp. 533-623.

Mikhalevich, V.I. (this volume). On the heterogeneity of the former Textulariina (Foraminifera).

Mikhalevich, V.I. & Debenay, J.P. 2001. The main morphological trends in the development of the foraminiferal aperture and their taxonomic significance. *Journal of Micropalaeontology,* **20**, 13-28.

Mikhalevich, V.I. & Voronova, M.N. 1999. O sistematicheskom polozhenii roda *Pelosina* (Xenophyophoria, Protista, Inc. Sedis). *Zoologicheskii Zhurnal,* **78** (2), 133-141.

McIlroy, D., Green, O.R. & Brasier, M.D. 2001. Paleobiology and evolution of the earliest agglutinated foraminifera: *Platysolenites*, *Spirosolenites* and related forms. *Lethaia*, **34**, 13-29

Neagu, T. 1999. Kaminskiinae n.subfam. and *Kaminskia* n.gen., a new Early Cretaceous calcareous agglutinated foraminifera from southern Dobrogea, Romania. *Annales Societatis Geologorum Poloniae,* **69** (3-4), 173-188.

Neagu, T. 2000. Lower Cretaceous calcareous agglutinated Foraminifera from Southern Dobrogea, Romania. Part ll. Early Cretaceous Cuneolinidae. *In:* Hart, M.B., Kaminski, MA. & Smart, C.W. (eds), *Proceedings of the Fifth International Workshop on Agglutinated Foraminifera.* Grzybowski Foundation Special Publication, **7**, 363-386.

Pokorn˘, V. 1958. *Grundzüge der Zoologischen Mikropaläontologie,* Bd. 1. VEB Deutscher Verlag der Wissenschaften.

Popescu, G. 2000. Lower and Middle Miocene agglutinated foraminifera from the Carpathian area. *Acta Palaeontologica Romaniae,* **2**, 407-425.

Roberts, S. & Murray, J.W. 1995. Characterization of cement mineralogy in agglutinated foraminifera (Protista) by Raman spectroscopy. *Journal of the Geological Society, London,* 152, 7-9.

Saidova, Kh.M. 1981, *O sovremennom sostoyanii sistemy nadvidovykh taksonov Kaynozoyskikh bentosnykh foraminifer* [On an up-to-date system of supraspecific taxonomy of Cenozoic benthonic foraminifera]. Institut Okeanologi P.P. Shirshova, Akademiya Nauk SSSR, Moscow, 73 pp.

Schwager, C. 1877. Quadro del proposto sistema di clasificazione dei foraminiferi con guscio, *Bolletino R. Comitato Geologico d'Italia,* **8**, 18-27.

Septfontaine, M. 1988. Towards an evolutionary classification of Jurassic lituolids (Foraminifera) in carbonate platform environment. *Revue de Paléobiologie Special Volume,* **2**, 229-256.

Septfontaine, M. & De Matos, J.E. 1998. *Pseudodictyopsella jurassica* n.gen., n.sp., a new foraminifera from the early Middle Jurassic of the Musandam Peninsula, N. Oman Mountains; sedimentological and stratigraphical context. *Revue de Micropaleontologie,* **41**, 71-87.

Vdovenko, M.V., Rauzer-Chernousova, D.M., Reitlinger, E.A., & Sabirov, A.A. 1993. *Spravochnik po sistematike melkikh foraminifer Paleozoya (za isklyucheniem endotiroidey I permskikh mnogokamernykh lagenoidey.* [A reference-book on the systematics of Paleozoic Foraminifera (excluding endothyrids and Permian multichambered lagenids)] "Nauka" Publishers, Moscow, 1-125.