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THE NEW SYSTEM OF THE SUPERFAMILY QUINQUELOCULINOIDEA CUSHMAN, 1917 (FORAMINIFERA)

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Abstract. The composition of the superfamily Quinqueloculinoidea Cushman, 1917 up to the generic level and the emended diagnosis of all the suprageneric taxa including 11 families and 38 subfamilies are given herein. Five subfamilies (Orthellinae, Parahauerinoidinae, Danubiellinae, Hechtininae, Flintinellinae) are new.

Keywords: Systematics, Foraminifera, Miliolids, New taxa.

INTRODUCTION

The system of the superfamily Quinqueloculinoidea Cushman, 1917 is elaborated here proceeding from the new concepts of the foraminiferal macrosystem published earlier (Mikhalevich, 1988, 2000, 2004). This new classification stresses the significance of a morphological approach, and also takes in consideration the wall structure and composition. The latter is characteristic for subclasses within the classes, thus having subordinate importance. The Quinqueloculinoidea with its porcellaneous wall enters the subclass Miliolana of the class Miliolata which has also a second subclass – the Miliamminana which includes representatives with an agglutinated wall.

The morphologic similarity between both subclasses, the similar tendencies of their onthogenetic and phylogenetic development, and also the presence of intermediate forms with a wall partly agglutinated and partly porcellaneous (Mikhalevich, 2000, 2004, Mikhalevich *et al.*, 1986) serves as evidence of their unity within the same class. The volume and structure of the Quinqueloculinoidea given in the present article differ significantly from that of Loeblich & Tappan (1987, 1992) where the composition of many taxa, especially the Hauerininae and Miliolinellinae, is too wide, including forms with quite different shell structure and apertures. In the classification presented here, the structure of the test and the type of coiling are used as the basic features separating the families; the peculiarities of their apertures – as features of the subfamily level. Such an approach permits us to separate the taxa more precisely and to compose key tables.

Overviewing the wide range of the quinqueloculinoidean genera one notices that each of the characteristic shell types (quinqueloculine, spiroloculine, biloculine, triloculine, sigmoiline, hauerine) have different apertural structures (simple aperture without a tooth, aperture with a flap, simple or complex tooth, or trematophore) – as if they tried to use all possible variants in their evolution. This regularity can be expressed and demonstrated in a table with nearly mathematical accuracy (Mikhalevich, 2000, p. 581, fig. 549) and such a table could have prognostic value.

To show more clearly the position of this superfamily within the subclass - the closest higher taxa are also briefly given. According to the rules of the ICZN the endings of the names of the superfamilies are changed to –oidea; the diagnostic features of the taxa present in the diagnoses of their higher taxa are not repeated in the lower ones. The generic composition embracing 97 genera and the emended diagnoses of the 11 quinqueloculinoidean families and 38 subfamilies (including five new subfamilies Orthellinae, Parahauerinoidinae, Danubiellinae, Hechtininae, Flintinellinae) are given below.

SYSTEMATIC DESCRIPTIONS

PHYLUM **FORAMINIFERA** d'Orbigny, 1826
CLASS **MILIOLATA** Saidova, 1981
Shells may be pseudo-two-chambered, pseudo-multichambered, but mostly multichambered, or very seldom unicellular, the predominant type of coiling – irregular - or regular glomerate, planispiral more often combined with one of the glomerate (streptospiral) modes, trochospiral only as an exception; shells of the higher representatives may be cyclical and fusulinoid in form; the presence of a flexostyle is typical of the majority of the group; chambers predominantly tubular, usually two per whorl (only in Soritida, broad and more numerous), in higher representatives chamber number increases to several thousands; chamber lumen may be subdivided by septa (sometimes by the primary and the secondary ones), by pillars, advanced forms may have integrative systems (stolons, tunnels), inner apertural systems not developed, canal system absent; shell wall - monofontinal, agglutinated in the lower forms (subclass Miliammiinana), porcellaneous in the higher ones (subclass Miliolana), with irregular pseudopores between irregular randomly oriented needles of crystal units; chamber growth occurs by the gradual addition of the wall part by part, organic and secreted elements are laid simultaneously; aperture terminal in position, simple in the most primitive forms, in more

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complex ones with an outer (flap) or inner tooth of a special structure, sometimes the aperture is secondarily multiple, additional apertures not developed (except as an exception); nuclear apparatus heterokariotic in higher secreted forms, sometimes with polymerization of the somatic nuclei (*Sorites*); in *Triloculina* gametes are known as biflagellated (and having an axostyle?); benthic forms, mostly free living, more rarely attached.

Carboniferous - Holocene.

Subclasses Miliammiinana Mikhalevich, 1992 and Miliolana Saidova, 1981.

SUBCLASS **MILIOLANA** Saidova, 1981
Tests with porcellaneous wall.

SUPERORDER **S Q U A M U L I N O I D A** Mikhalevich, 1988
Test unilocular, free living or attached. Upper Cretaceous – Holocene.

ORDER **SQUAMULINIDA** Mikhalevich, 1988

SUPERORDER **C O R N U S P I R O I D A** Jirovec, 1953
Test free or attached, pseudo-two-chambered, with a globular proloculus followed by a long tubular second chamber, coiling planispiral, glomerate, zigzagged, meandering or irregular, finally may become uncoiled and rectilinear; flexostyle absent; wall simple; aperture a simple terminal opening. Carboniferous – Holocene.

ORDER **CORNUSPIRIDA** Jirovec, 1953
Order Cornuspirida Mikhalevich, 1980 (part), suborder Cyclogyrina Saidova, 1981

SUPERORDER **C O S T I F E R O I D A** Mikhalevich, 1988
Test free, with chambers in a single row, straight or curved, flexostyle absent; aperture simple. Middle Triassic – Holocene.

ORDER **COSTIFERIDA** Mikhalevich, 1988

SUPERORDER **M I L I O L O I D A** Jones, 1896
Test multichambered, with flexostyle; chambers initially tubular, two (more rarely 2 ½ to 3) chambers per whorl, at least in the initial coils. Middle Triassic – Holocene.

ORDER **NUBECULARIIDA** Jones, 1875
(=order Cornuspirida Mikhalevich, 1980 (part), suborder Nubeculariina Saidova, 1981)
Test free or attached, planispiral, evolute, chambers initially tubular, two or more rarely three per whorl, may become cyclical in advanced forms, in attached forms may become irregular in form and disposition; wall simple or with inner incomplete septa; aperture simple, may be with a neck or a lip. Middle Triassic - Holocene.
Remarks. In some forms a slightly noticed tooth may occur (Nubeculariinae Jones, 1875).

ORDER **MILIOLIDA** Delage & Herouard, 1896
Test predominantly free; coiling initially streptospiral, of one of the miliolid types (quinqeloculine, cryptoquinqueloculine, rarely irregularly streptospiral, schlumbergerine, triloculine, biloculine) with a secondary transition to a planispiral coiling in some genera; in advanced forms (Alveolinids) of one of the fusulinoid types, whorls predominantly involute, often with one to two last chambers involute or embracing, more rarely with evolute coiling; chambers tubular at least initially, later may be more wide but usually preserving some features of the tubular character; aperture simple only in the minor group of more primitive forms, in the rest more complex – with an external flap or more often with inner tooth of variable complexity, either cribrate or having a trematophore; additional apertures known only as an exception; in advanced supermultichambered forms (Alveolinids) stolons and tunnels may present; wall simple or complex, may be pitted externally or with deposits of skeletal matter at the bottom of the chambers; may have inner incomplete septa or a complex system of inner septa fully subdividing the chamber into chamberlets, rarely alveolar. Lower Cretaceous – Holocene.

Suborder MILIOLINA Delage & Herouard, 1896
Test mostly having one of the miliolid types, chambers initially tubular and more often bearing some features of the tubular character in the wider chambers of later volutions; chamber wall may be simple (smooth or sometimes pitted) or complex (with subepidermal reticulum or alveolar); chambers undivided or may have incomplete septa.

Superfamily QUINQUELOCULINOIDEA Cushman, 1917
Test with a simple wall; chamber lumen is not subdivided.
Remarks.The family Zoyaellidae Saidova, 1981 is transferred to the superorder Soritidoida as the representatives of the genus *Zoyaella* Loeblich & Tappan, 1962 have planispiral coiling with broad multiple (up to twelve) chambers in their volutions, only the initial tubular chamber is coiled streptospirally. The entirely planispiral Fisherinidae Millett, 1899 and trochospiral Fisherinellidae Saidova, 1981 are also transferred to the Soritidoida.

Family **Miliolechinidae** Zaninetti, Ciarapica, Cirilli & Cadet, 1985
Test quinqueloculine in the early stage, later chambers semisphaerical, each with one or more empty needles; aperture unknown.
Miliolechina Zaninetti, Ciarapica, Cirilli & Cadet, 1985.

Family **Glomulinidae** Saidova, 1981, emend.
Test with irregular or streptospiral coiling at least initially, chambers elongated; aperture simple, without a tooth.
Remarks.The composition of the family is here widened with the inclusion of the new subfamily.

Subfamily G l o m u l i n i n a e Saidova, 1981.
Test entirely irregularly streptospiral.
Glomulina Rhumbler, 1936.

Subfamily O r t h e l l i n a e subfam. nov.
Test streptospiral initially, later part rectilinear, chambers formed by outer constrictions of the wall and the inner thickenings.
Remarks. Transferred from the Hemigordiopsinae as having true chambers according to Azbel in Subbotina *et al.*, (1981) though its chambers are rather primitive, tests may be free or attached.
Orthella E. V. Bykova, 1956.

Family **Spiroloculinidae** Wiesner, 1920
Test (?secondary) planispiral entirely, evolute; aperture may be simple, with inner tooth of varying complexity or with a trematophore.
Remarks. The slightest sigmoid curve of the very first chambers in some specimens of different species of this family gives grounds to suppose the origin of the spiroloculinids from initially streptospiral or quinqueloculine ancestors.

Subfamily S p i r o l o c u l i n i n a e Wiesner, 1920
Test entirely planispiral in the adult stage, with chambers half a coil in length; aperture usually at the end of an elongated neck, with a simple or complicated inner tooth.
Spiroloculina d'Orbigny, 1826, *Bidentina* Mikhalevich, 1988, *Elazigella* Sirel, 1999, *Flintia* Schubert, 1911.

Subfamily S t e l l a r t i c u l i n i n a e Mikhalevich, 1988
Test free, with a well developed uniserial portion, early part formed by the proloculus and by one coil of the tubular chamber; aperture with small multiple teeth.
Stellarticulina Papp & Schmid, 1976, *Nubeculina* Cushman, 1924.

Subfamily C r i b r o s p i r o l o c u l i n i n a e Mikhalevich, 1988
Test like in *Spiroloculina*; aperture complex, multiple – a trematophore; additional apertures absent.
Cribrospiroloculina McCulloch, 1977.

Subfamily P a r a h a u e r i n o i d i n a e subfam. nov.
Test with planispiral coiling throughout; chambers of tubular character both in the initial and later whorls, two chambers per whorl in the earlier part, in the final whorl may be two and a half, with wider but still elongated tubular chambers; main aperture is a trematophore; chambers of the final whorls with delicate additional sutural apertures.
Remarks. The type genus is transferred from the Polysegmentininae (Hauerinidae). The new subfamily differs from the latter in its planispiral rather than streptospiral initial part, less number of chambers in their last volutions preserving the tubular character. It differs from the subfamily Miliolinellinae (where it was placed by Loeblich & Tappan, 1987) in the structure of the aperture and the presence of additional apertures. The latter feature well distinguishes it also from all the other spiroloculinid subfamilies.
Parahauerinoides McCulloch, 1977.

Family **Planispiroidinidae** Saidova, 1981
Test free, triloculine or pseudotriloculine externally in both generations, the early part of the microsphaeric generation is planispiral; aperture with a wide external flap.
Remarks. Initial planispiral whorls are very small and embraced fully or partially by the later ones, the initial planispiral tube of the microsphaeric form is very thin and equal in diameter, like a long flexostyle.
Planispirinoides Parr, 1950, *Pippinia* McCulloch, 1977.

Family **Quinqueloculinidae** Cushman, 1917
Test free, quinqueloculine entirely; aperture simple without a tooth, with an external flap, with an inner tooth of varying complexity, or cribrate (multiple).
Remarks. This family is here reinstated from the synonymy of the family Hauerinidae where it was placed by Loeblich & Tappan, 1987.

Subfamily L a b a l i n i n i n a e Mikhalevich, 1988
Test of quinqueloculine type; aperture simple, without a tooth.
Labalina Azbel, 1988, *Pseudosigmoilina* Bartenstein, 1965, *Triloculinopsis* Popescu, 1975, *Moesiloculina* Neagu, 1984 (the aperture has a crenulated margin as was demonstrated by Neagu, 1984, 1985, 1986, but not a trematophore as described earlier by Loeblich & Tappan, 1987).

Subfamily Q u i n q u e l o c u l i n i n a e Cushman, 1917
Test of quinqueloculine type with whorls in five (rarely more) planes; aperture with an inner straight or bifid tooth.
Quinqueloculina d'Orbigny, 1826, *Adelosina* d'Orbigny, 1826 (one coil of the tubular chamber is insufficient to regard it as planispiral coiling), *Axiopolina* Neagu, 1984 (only slightly differing from the *Quinqueloculina*), *Cycloforina* Luczkowska, 1972, *Lachlanella* Vella, 1957, ??*Paleoquinqueloculina* Ma Van Lac, 1981, *Pseudoschlumbergerina* Cherif, 1970.

Subfamily C r i b r o l i n o i d i n a e Haynes, 1981
Test of the quinqueloculine type; aperture with a complex inner tooth: additional lateral teeth or a circular tooth.
Cribrolinoides Cushman & LeRoy, 1939, *Podolia* Serova, 1981.

Subfamily S c u t u l o r i n a e Mikhalevich, 1987
Test of the quinqueloculine or cryptoquinqueloculine type; aperture with a flap of simple form or may be dentate or goffered.
Triloculinella Riccio, 1950 (= *Scutuloris* Loeblich & Tappan, 1953), *Crenatella* Luczkowska, 1972, *Scythiloculina* Neagu, 1984, *Cribromiliolinella* Saidova, 1981, *Miliammelus* Saidova & Burmistrova, 1978 (previously placed by Loeblich & Tappan,1987, to Silicoloculinidae Resig *et al.*, 1980)).

Family **Tubinellidae** Rhumbler, 1906
Test free or attached, with an initial quinqueloculine part which may be strongly reduced and a second uncoiled part; aperture of varying structure: simple without tooth, with inner tooth or aperture multiple.
Remarks. Without Pavoninoidinae transferred to Miliolidae (Milioloidea) as having a pitted wall.

Subfamily T u b i n e l l i n a e Rhumbler, 1906
Test with an early quinqueloculine part, which may be distinct or strongly reduced and with an uncoiled terminal part; aperture without a tooth, may have a collar.
Remarks. The heterogenous *Nodophthalmidium* needs to be revised concerning both the structure of its initial part and the aperture. Only forms without any tooth are included here in the genus *Articulina*. In our material (Mikhalevich, 1983, p. 139) in the three Recent species of *Articulina* the tooth was also absent.
Tubinella Rhumbler, 1906, *Articulina* d'Orbigny, 1826, *Nodophthalmidium* (part) Macfadyen, 1939 (= *Sarmatiella* Bogdanovich, 1952) (Azbel in Subbotina *et al.*, 1981 includes it in the synonymy of *Articulina* following Bogdanovich, 1952 and regarding the initial part as a strongly reduced quinqueloculine stage in the both the A1 and A2 generations), *Parrina* Cushman, 1931, ?*Ishamella* Buzas & Severin, 1982 (uncoiled part is not described in the picture).

Subfamily A r t i c u l a r i i n a e Mikhalevich, 1987
Test with an initial quinqueloculine or cryptoquinqueloculine chamber arrangement and later uncoiled; aperture with a flap, at least in the early stage.
Articularia Luczkowska, 1974.

Subfamily P o r o a r t i c u l i n i n a e Saidova, 1981
Test with an initial quinqueloculine part and later uncoiled; aperture complex – cribrate or labyrinthic.
Remarks. The genus *Dogielina* needs additional study,as the "spongy" character of its wall supposedly is restricted to the outer chamber wall.
Poroarticulina Cushman, 1944, *Dogielina* Bogdanovich & Voloshinova, 1949.

Family **Triloculinidae** Bogdanovich, 1981
Test free, with chambers of the adult stage in a triloculine or cryptotriloculine arrangement; aperture may be with a flap, with an inner tooth or multiple, with a complex tooth.

Subfamily T r i l o c u l i n i n a e Bogdanovich, 1981
Test with chambers of the adult stage in a triloculine or cryptotriloculine arrangement; aperture with an inner tooth.
Triloculina d'Orbigny, 1826 (= *Sinuloculina* Łuczkowska, 1972), *Affinetrina* Łuczkowska, 1972, *Pseudotriloculina* Cherif, 1970.

Subfamily T r i l o c u l i n o i d i n a e Mikhalevich, 1988
Test as in *Triloculina*; aperture with a complex tooth resulting in a multiple aperture.
Triloculinoides Stschedrina, 1964.

Subfamily T r i l o c u l i n e l l i n a e Mikhalevich, 1988
Test of triloculine or pseudotriloculine arrangement; aperture with an external flap forming an arcuate slit or a more complex outline like in *Cruciloculina*.
Triloculinellus Saidova, 1975, *Varidentella* Łuczkowska, 1972, *Cruciloculina* d'Orbigny, 1839.

Subfamily I n v o l v o h a u e r i n i n a e Mikhalevich, 1986
Test triloculine in at least one of the initial stages, globular; aperture cribrate.
Remarks. The genus *Nurdanella* has a subsphaerical test, quinqueloculine in microsphaeric and triloculine in megalosphaeric generations initially, later planispiral in both, with two to three chambers in the last coil. Placed by the author of the genus first into Hauerininae. The genus is transferred here into the Involvohauerininae due to its having less than three chambers per whorl, a subsphaerical test and a cribrate aperture rather than the more numerous chambers, flattened test and trematophore of the hauerinins. The subfamily is closer to the family Pyrgoidae, the occasional specimens of *Involvohauerina* having only two chambers in the last whorl are difficult to distinguish from *Crybropyrgo*.
Involvohauerina Loeblich & Tappan, 1955, *Nurdanella* Özgen, 2000, p. 80.

Family **Sigmoilinitidae** Łuczkowska, 1974
Test free, with a clearly sigmoiline chamber arrangement, chambers half a coil in length;

aperture may be simple without a tooth, with a flap, with one or multiple inner teeth.

Subfamily M e s o s i g m o i l i n i n a e Mikhalevich, 1988
Test sigmoiline; aperture without a tooth.
Mesosigmoilina S. Y. Zheng, 1981; *Subedentostomina* McCulloch, 1981.

Subfamily S i g m o i l i n i t i n a e Łuczkowska, 1972
Test sigmoiline; aperture with an inner tooth.
Sigmoilina Schlumberger, 1887, *Sigmella* Azbel & Mikhalevich, 1983, *Spirosigmoilina* Parr, 1942, *Sigmoilinella* S.Y. Zheng, 1979, *Sigmoilinita* Seiglie, 1965 (non *Spiroglutina* Mikhalevich, 1983 with a very thin agglutinated wall).

Subfamily S i g m o i n e l l i n a e Mikhalevich, 1987
Test sigmoiline; aperture with a flap.
Sigmoinella Saidova, 1975 (obviously part of the species placed earlier into the genus *Sigmoilina* but having an apertural flap instead of an inner tooth).

Subfamily L o n g i a p e r t i n i n a e Mikhalevich, 1987
Test sigmoiline; aperture complex, multiple.
Longiapertina Seiglie, 1979.

Family **Pyrgoidae** Mikhalevich, 1983
Test free, involute, entirely biloculine in megalosphaeric forms, in microsphaeric forms biloculine in the adult stage with the earlier part being quinqueloculine, then triloculine, may be sigmoiline; aperture may be with a flap, with an inner tooth, or be complex and multiple.
Remarks. In the microsphaeric form of *Nummulopyrgo* (Biloculinellinae) the flexostyle forms more than one volution.

Subfamily P y r g o i n a e Mikhalevich, 1983
Test with final biloculine volutions; aperture with an inner tooth.
Pyrgo Defrance, 1824, *Praelacazina* Hofker, 1959 [the ultrastructure of the wall of the Cretaceous type species *P. (Biloculina) fragilis* Hofker, 1927 needs further investigation as it is not clear whether the outer wall is agglutinated or recrystallized. If the first case is true, the genus ought to be moved into the subclass Miliamminana], *Pseudopyrgo* Rasheed, 1971 (the plan of compression of the test is opposite to the compression in *Pyrgo*).

Subfamily B i l o c u l i n e l l i n a e Mikhalevich, 1983
Test with the final volutions of a biloculine character; aperture with a flap.
Biloculinella Wiesner, 1931, *Nummulopyrgo* Hofker, 1983, (in the microsphaeric form the flexostyle has more than one volution), *Istriloculina* Neagu, 1984, *Sigmopyrgo* Hofker, 1983.

Subfamily C r i b r o p y r g o i n a e Mikhalevich, 1986
Test with final biloculine volutions; aperture multiple at least in adults.
Cribropyrgo Cushman & Bermudez, 1946, *Pyrgoella* Cushman & E.M. White, 1936.

Subfamily I d a l i n i n a e Mikhalevich, 1988
Test with the last chamber enveloping all the previous whorls, in earlier stages chambers arranged in quinqueloculine, triloculine and biloculine types in succession; aperture multiple.
Idalina Schlumberger & Munier-Chalmas, 1884, *Nevillina* Sidebottom, 1905.

Family **Massilinidae** Thalmann, 1941
Test quinqueloculine, more rarely triloculine in the early stage, then planispiral. The initial part constitutes a significant part, and often the bulk of the test; the number of chambers in the planispiral part also two (sometimes two and a half) per whorl, the form of the chambers of the initial and later part is the same, the terminal part may be uncoiled; aperture of different structure: simple, with a flap, with inner tooth, or multiple.
Remarks. This family is reinstated herein from the synonymy of the family Hauerinidae where it was placed by Loeblich & Tappan (1987).

Subfamily P s e u d o m a s s i l i n i n a e Mikhalevich, 1988
Test entirely coiled; aperture without a tooth.
Pseudomassilina Lacroix, 1938, *Tschokrakella* Bogdanovich, 1969, *Sissonia* Cushman & White, 1936.

Subfamily R e c t o m a s s i l i n i n a e Mikhalevich, 1988
Test with the earlier part of the massiline type, finally uncoiled; aperture without a tooth.
Rectomassilina Seiglie, 1964.

Subfamily M a s s i l i n i n a e Thalmann, 1941
Test coiled entirely in a massiline arrangement; aperture with a simple tooth.
Massilina Schlumberger, 1893 (= *Decussoloculina* Neagu, 1984), *Proemassilina* Lacroix, 1938 (the initial quinqueloculine part is small), *Neopateoris* Bermudez & Seiglie, 1963 (only slightly distinguished from *Mesopateoris* McCulloch, 1977 which I regard as its synonym as both have similar structure of the test with two and a half chambers per whorl in the last volutions, the striate shell wall of *Mesopateoris* is a feature of specific value).

Subfamily F l i n t i n i n a e Saidova, 1981
Test initially quinqueloculine or triloculine, with up to three chambers in the last whorls, usually only the chambers of the last whorl are visible from the

outside; aperture with an inner tooth which may be complex.
Flintina Cushman, 1921, *Ptychomiliola* (*Pseudoflintina* is here transferred into the subclass Miliamminana as having an agglutinated wall).

Subfamily M i l i o l i n e l l i n a e Vella, 1957
Test coiled entirely in a massiline arrangement; aperture with a flap.
Miliolinella Wiesner, 1931 (= *Steigerina* McCulloch, 1977) (the structure of the aperture is not clear both from the diagnosis or from the figure given in Loeblich & Tappan, 1987. If it has an external triangular flap, it is a synonym of *Miliolinella*; if there is an inner tooth – a synonym of *Massilina*; the striate wall of the type species *Stegnerina bubnanensis* McCulloch, 1977 is regarded here as a feature of specific level), ?*Mandorovella* de Klasz, Y. Le Calvez & Rerat, 1969 (up to three chambers in the last whorl but chambers strongly overlapping, masking the initial whorls), *Wellmanellinella* Cherif, 1970 (the striate character of the wall could not be considered as a feature at the generic level, only such characteristics as the biconvex character of the shell and its occasional attachment questionably permit me to preserve this genus as valid).

Subfamily T o r t o n e l l i n a e Mikhalevich, 1988
Test coiled entirely in a massiline arrangement; aperture multiple (complex tooth or trematophore).
Tortonella Didkovsky, 1957, *Heterillina* Munier-Chalmas & Schlumberger, 1905, *Massilinoides* McCulloch, 1977, *Anchihauerina* McCulloch, 1977.

Family **Hauerinidae** Schwager, 1876
Test free, usually flattened, broadly oval or subcircular in outline; the initial part small, sometimes barely visible, with one of streptospiral miliolid types of coiling (quinqueloculine, indistinctly triloculine, indistinctly sigmoiline with two tubular chambers per whorl) or irregular, last whorls planispiral, evolute, more rarely involute, with three to six chambers per whorl; chambers of the planispiral part usually wide, flattened, strongly differ from the narrow tubular chambers of the earlier part; aperture simple or with a flap or inner tooth, may also be cribrate; in some genera (Polysegmentininae) additional sutural apertures are present.
Remarks. This family differs from the family Massilinidae in its less developed earlier streptospiral part, strongly developed flattened planispiral part with more multiple flattened chambers, wide in form rather than in massilinids where chambers of the planispiral part usually preserve their elongated character.

Subfamily L o r e t t a o i d i n a e Mikhalevich, 1988
Test with the last whorls evolute or involute, with three to six chambers per whorl; aperture is an elongated vertical or horizontal (in *Flintinoides)* slit, without a tooth.
Lorettaoides McCulloch, 1977 (from Miliolinellinae), *Derventina* Neagu, 1968 (the genus is transferred from the Hauerininae as having a simple aperture though with a crenulate margin, not a trematophore. In spite of the fact hat the type species has two or two and a half chambers in the last planispiral volutions, the number of chambers of the last volutions in some other species of the genus (*D. bicarinata, D. scutuli*) described by the author of the genus later (Neagu, 1986) often reaches three), *Wellmanella* Finlay, 1947, ?*Flintinoides* Cherif, 1970 (*Sissonia* is transferred to the subfamily Pseudomassilininae, family Massilinidae as it usually has three chambers in the planispiral whorl which are more tubular in character than in the majority of the hauerinids. The genus could be regarded as an intermediate form between the hauerinids and massilinids. Its type specimen looks like an occasionally irregular form, but the supposition of the presence of chamberlets seems doubtful).

Subfamily D a n u b i e l l i n a e subfam. nov.
Test with the early part quinqueloculine, later planispiral with broad chambers up to five in the last whorl, masking the initial part, the latest part uncoiled; aperture without a tooth, usually as a slit.
Remarks. The subfamily differs from the Lorettaoidinae in its uncoiled part, from the Rectomassilininae in the structure of the coiled part having broad chambers, four to five in number in planispiral whorls and being subcircular in outline rather than two tubular chambers half coil in length and elongated in outline. In the later species of Neagu, 1985, (p. 218) *D. gracillima,* the number of chambers of the last planispiral whorl reaches six. In the sections of the microsphaeric forms of the same work the secondary depositions of the shell at the bottom of the chambers of the coiled part in the apertural area are clearly seen.
Danubiella Neagu, 1968.

Subfamily H e c h t i n i n a e subfam. nov.
Test with the early part irregularly then streptospirally coiled, finally planispiral, with 3 to 6 chambers per whorl, occasionally attached specimens tending to uncoil; early chambers of the irregular and streptospiral part are elongated, chambers of the planispiral part are wider and may be flattened; aperture without a tooth.
Remarks. Tests may be occasionally attached as in some other miliolid genera, Azbel, 1981 in Subbotina *et al.*, 1981 (p. 50, pl. XVII, 15) showed the slight tendency of *Hechtina* to uncoil. The subfamily differs from the Danubiellinae and from all the other hauerinid subfamilies in its irregular initial coiling, from the Flintinellinae, Nummoloculininae, Hauerininae and Polysegmentininae also in its more simple aperture.

Hechtina Bartenstein & Brand, 1949 (The genus is transferred here from the Nubeculariidae where it was placed by Neagu, 1970, Azbel (in Subbotina *et al.*, 1981) and Loeblich & Tappan, 1987, because its initial part displays irregular streptospiral coiling instead of the initial planispiral coiling of nubeculariids which is regarded here as their diagnostic feature. In a perfect series of specimens, Neagu (1970) showed all the developmental stages of the genus describing for the first time the clearly planispiral stage of adults, as well as cross sections. He also showed how it differs from the genus *Wellmanella*. Neagu's data permits to give this new diagnosis of the genus.)

Subfamily F l i n t i n e l l i n a e subfam. nov.
Test with the early stage in a quinqueloculine arrangement, the last whorls evolute or partially involute, with up to 5 broad flattened chambers; aperture an elongate opening with an elongate simple tooth.
Remarks. This subfamily differs from the other subfamilies of the family Hauerinidae (from Lorettaoidinae, Danubiellinae, Nummoloculininae, Hauerinae, Polysegmentininae) in the nature of its aperture having an inner tooth, from the Polysegmentininae also in the absence of the additional apertures. It differs from the subfamily Flintininae (Massilinidae) in the form of the test (subcircular rather than elongated), in the greater number of the chambers in the planispiral whorls and their wide rather then elongated form.
F*lintinella* Didkovsky, 1960, *Planomiliola* de Klasz, Y. Le Calvez & Rerat, 1964 (the genus could be regarded as an intermediate to the family Massilinidae, the subfamily Massilininae having more elongated and inflated chambers, more characteristic for this subfamily and even for the Pyrgoinae, but the number of the chambers in the last planispiral whorl (up to five) makes it closer to Flintinellinae as the representative of the Hauerinidae).

Subfamily N u m m o l o c u l i n i n a e Saidova, 1981
Test with up to six broad chambers in the last whorls, evolute or pseudoevolute; aperture with a flap.
Nummoloculina Steinmann, 1881.

Subfamily H a u e r i n i n a e Schwager, 1976
Test with up to 4 broad chambers in the planispiral whorl, evolute; aperture with a trematophore.
Hauerina d'Orbigny, 1839, *Dervieuxina* Popescu, 2001 (the shell is much thicker and the chambers of the last whorl are broader and more multiple though also bearing some tubular features), *Sigmohauerina* S. Y. Zheng, 1979.

Subfamily P o l y s e g m e n t i n i n a e Mikhalevich, 1988
Test with the last whorls evolute or partially involute and containing five to seven broad chambers; aperture cribrate, in the chambers of planispiral whorls additional sutural apertures are present.
Remarks. This is the very rare case of the presence of additional apertures among the Miliolana. The genus *Parahauerinoides* is transferred to Spiroloculinidae, as it has planispiral rather than streptospiral initial coiling.
Polysegmentina Cushman, 1946, *Parahauerina* McCulloch, 1977.

Superfamily MILIOLOIDEA Ehrenberg, 1839
Test of one of the miliolide types with the complex wall having multiple pseudopores on its surface; chamber lumen is not subdivided.
Superfamily RIVEROINOIDEA Saidova, 1981
[(= Reverooininea Saidova, 1981, p. 32 (nom. incorr.)]
Test of one of miliolide types with the chambers partly subdivided by incomplete septa.

Superfamily AUSTROTRILLINOIDEA Mikhalevich, 1986
Test of one of the miliolide types with complex wall (with a subepidermal reticulum or alveolar).

Suborder ALVEOLININA Mikhalevich, 1980

SUPERORDER **SORITIOIDA** Schultze, 1854

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