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# MILIOLIDAE (FORAMINIFERIDA) FROM MIOCENE OF POLAND PART I. REVISION OF THE CLASSIFICATION

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*Abstract.* — On the basis of an examination of the internal structure and aperture shape, the revision of some genera of Miliolidae is made. The genus *Massilina* is considered to be an ontogenetical stage of the genus *Quinqueloculina*. Five new genera are established: *Cycloforina*, *Varidentella*, *Sinuloculina*, *Affinetrina* and *Crenatella*. A new species, *Crenatella mira*, is described. Considering the quinqueloculine or kryptoquinqueloculine internal structure of particular genera, the emending of their diagnosis and subfamilies classification is proposed. The basic material to the presented study was derived from the Miocene of Poland and from Recent seas.

## INTRODUCTION

The most exhaustive classification of Miliolidae based on morphological data as well as internal structure of the test is that of Loeblich & Tappan

(1964). However, it is not consequently applied, using in some cases heterogeneous characteristics in distinguishing homogeneous taxonomic units. In determining families, these authors take into consideration the internal structure, chamber arrangement and shape of the aperture. In the description of subfamilies they take into account in Quinqueloculininae, Miliolinellinae and Miliolinae the aperture shape only, neglecting their internal structure, whereas in the last two subfamilies, Fabulariinae and Tubinellinae, the authors consider the internal structure. At the same time there are in other families of Miliolacea also subfamilies which join forms with all kinds of the aperture, with simple, flap-like or cribrate tooth (e.g. family Nubeculariidae, subfamily Spiroloculininae).

Thereby within three subfamilies Quinqueloculininae, Miliolinellinae and Miliolinae forms with nearly identical development characteristics were distributed; some of them are closely related to each other, but placed into different subfamilies only on the basis of the shape of the tooth, which may be simple, flap-like or cribrate. As a result, the subfamily Quinqueloculininae also contains genera with non-quinqueloculine chamber arrangement, even in their juvenile stage (e.g. *Ptychomiliola*, *Flintina*, *Sigmoilina*, *Wellmanella*), whereas subfamilies Miliolinellinae and Miliolinae may have with quinqueloculine arrangement, at least in the early portion (e.g. *Scutuloris*, *Miliola*, *Dogielina*, *Hauerina*, *Heterillina*, *Involvohauerina*).

The shape of the aperture has been hitherto taken into consideration in distinguishing various species and sporadically also in distinguishing genera among species with identical chamber arrangement. E.g. Wiesner (1931) described the genus *Miliolinella*, differing from *Triloculina* in having the flap-like tooth only; Leoblich & Tappan (1953) created the genus *Scutuloris*, differing from *Quinqueloculina* in possessing also the flap-like tooth; *Podolia* (Serova, 1961a) differs from *Quinqueloculina* in lyre-shaped aperture; *Cruciloculina* (d'Orbigny, 1839) differs from *Triloculina* in developing of cruciform aperture in the adult; *Biloculinella* (Wiesner, 1931) differs from *Pyrgo* in having a broad flap in the aperture; *Miliola* (Lamarck, 1804, in Catalogue, 1940) differs from *Quinqueloculina* in its cribrate aperture etc. Following this way Vella (1957) went as far as to divide the genus *Quinqueloculina* into three subgenera and to separate a new subgenus *Lachlanella*, which differs from *Quinqueloculina* in having elongate aperture and a long, simple tooth.

There is no doubt that the shape of aperture and tooth may be of basic importance in distinguishing genera but it cannot be considered as sufficient feature for the higher-rank taxons, unless internal structure of the genera indicates their ralationships. It is true that the taxonomy of Miliolidae is not a simple one because of their different internal structure in forms with similar morphology. But if one of morphological features only,

e.g. character of the aperture, is taken into consideration in classifying some subfamilies in Loeblich & Tappan's classification, and not adopted in others, it is clear that this feature is not useful enough for taxons higher than the genus.

It is herein suggested to consider the criteria of internal and external features of Miliolidae adopted in Treatise classification (p. C153) in some emended order, paying more attention to the shape of the aperture in distinguishing genera and to the internal structure in higher rank taxons. It is therefore suggested to use the basic data in the following way: 1) wall composition and microstructure of test as of primary importance for classifying suborders and superfamilies; 2) internal structure, e.g. mode of chamber and septal addition and also mode of living — as of secondary importance for classifying families; 3) internal structure in detail, e.g. chamber arrangement in the ontogeny, subdivision of chambers or reduction of some stages — as third in importance in classifying subfamilies; 4) external structure, the chamber forms and arrangement, the apertural characters and their modifications as fourth in importance in defining genera. The reclassification proposed on this basis is given below.

The present paper is based on the author's many years' experience in the study of Miocene Miliolidae from Tortonian and Sarmatian deposits of Southern Poland, compared with Recent collections from the Mediterranean and other seas. In order to study the morphological variability of species, over 400 cross-sections were made and the internal structure was examined. The results concerning emendation of some diagnosis of subfamilies and genera, as well as descriptions of new genera, are enclosed in propositions presented herewith in Part I, the monograph of about 90 species of Miocene Miliolidae will appear separately in Part II.

## REMARKS ON THE GENERA *QUINQUELOCULINA* AND *MASSILINA*

### *Contradictions in the uniform conception of the genus Quinqueloculina*

As mentioned above, the shape of the aperture and tooth have been mainly used in distinguishing various species of *Quinqueloculina* by most authors. This found its expression in disagreements in the taxonomy of the genus in different classifications. E.g. Loeblich & Tappan (1964) describe the genus with the aperture "rounded with a simple or bifid tooth", but neither of the two illustrated species has a rounded aperture. Cushman (1948), Glaessner (1948) and Pokorny (1958) describe in *Quinqueloculina* also aperture "rounded with a simple tooth", but Galloway (1933) mentions aperture "flush with the surface or with neck, round or elongate, with plate-like or bifid tooth; Sigal (1952) includes in the genus also forms with different shape of aperture and tooth, Bogdanowich and Voloshinova (1959)

describe the aperture "rounded, ovate or slit-like, with simple or flap-like tooth".

Most of the above authors mention the rounded aperture in a description of the genus but include in the genus various species with rounded, oval or slitlike apertures and with different shape of the tooth. Even if we consider the fact that these features are of great variability in some species, the problem is not solved. It is particularly striking that the neotype of *Quinqueloculina seminulum* (Linné), the type species of the genus, figured by Loeblich & Tappan (1964, Fig. 349 1) has not a rounded but

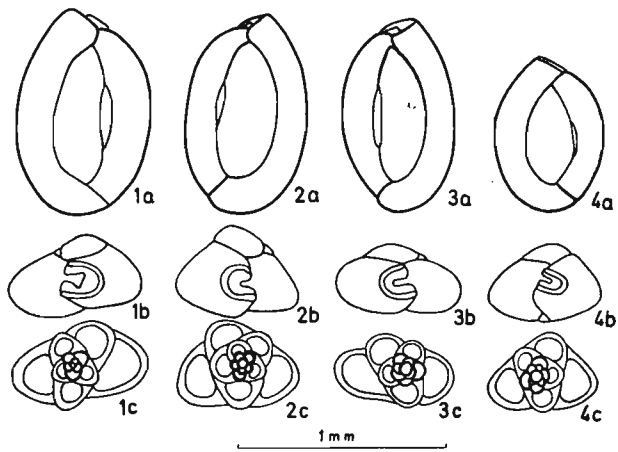


Fig. 1. — Morphological variability of *Quinqueloculina seminulum* (Linné), Recent, Black Sea, Bosphorus; *1, 3* — flattened forms, *2, 4* — typical forms; *1* — microspheric generation, *2-4* — mega I generation; *a* — side view, *b* — apertural view, *c* — transverse section showing the internal structure.

ovate aperture. This shape of the aperture of *Quinqueloculina seminulum* is in accordance with drawings of *Q. seminulum* by other authors, e.g. Brady (1884, Pl. 5), Williamson, Parker & Jones (in Brady, 1884, p. 159), Hofker (1960, Fig. 41), Cushman (1929, Pl. 9, Fig. 18), Cushman and Valentine (1930, Pl. 1, Fig. 8). The presence of the ovate aperture in *Q. seminulum* from the Adriatic and Black Sea was also observed by the present author (Text-fig. 1; Pl. XII, Figs. 1, 2).

It is therefore evident that ovate, elongate aperture and a simple tooth, as in *Q. seminulum*, should be regarded as proper to the genus *Quinqueloculina*. Consequently, forms with a different morphology of aperture should be recognized as separate taxons, different from the true *Quinqueloculina*.

### *Differentiation of the aperture shape*

Vella (1957) distinguished three groups of *Quinqueloculina*: 1) subgenus *Quinqueloculina* (*Quinqueloculina*) d'Orbigny, with the type species

*Q. seminulum* (Linné), characterized by smooth shells and apertures with a rim and a small bifid tooth, in end view broadly Y-shaped; 2) subgenus *Quinqueloculina* (*Lachlanella*) Vella, with the type species *Q. (L.) cooki* Vella, characterized by subquadrate chambers, elongate aperture with subparallel sides and typically reflexed lip and a tooth consisting of a long slender septum and a small V-shaped platform; 3) *Quinqueloculina* sensu lato, including all species not enclosed in the two previous subgenera. Vella expressed the opinion that the genus *Quinqueloculina* needs revision and must be eventually subdivided into further groups both subgeneric and generic rank. Unfortunately he only announced the problem and did not even suggest what features he regarded useful for the subdivision he proposed.

Studies of different species of fossil *Quinqueloculina* from the Miocene of Poland permit to distinguish four distinct groups of aperture shape: 1) an open, elongate-oval aperture and a long simple or Y-shaped tooth; 2) a high, narrow aperture with parallel sides and a long tooth; 3) a closed, round aperture, usually on the prolonged end of the last chamber and with a short V-shaped tooth; 4) an open, semicircular, transverse aperture and a broad quadrangular or reduced tooth. A study of the literature and investigations of other collections of fossil *Quinqueloculina* of both older and younger age from Poland and the neighboring countries, as well as some Recent assemblages show that the mentioned differentiation of the aperture is commonly recognizable. It cannot be considered as infraspecific variability of the shape because it is observed in certain species only, occurring in different areas and in sediments of different age.

The four mentioned groups of aperture shape were taken into consideration as separate units and were carefully studied.

**Elongate-oval aperture and a long tooth.** *"Quinqueloculine" and "massiline" chamber arrangement.* The aperture belonging to this group

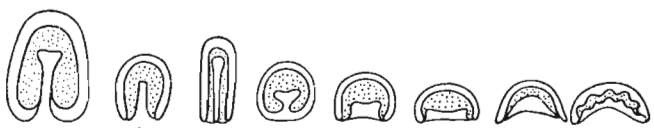


Fig. 2. — Shapes of apertural openings and teeth; *a, b* — *Quinqueloculina*, *c* — *Lachlanella, Affinetrina*, *d* — *Sinuloculina, Cycloforina, Triloculina*, *e, f* — *Varidentella*, *g* — *Miliolinella*, *h* — *Crenatella.*

is oval, flush with the surface, usually with bordered lip in young specimens; in mature stage it is more elongate, parallel or oblique to the plane of coiling (Text-fig. 2 a, b). The tooth consists of a long simple or bifid at the end septum, fixed to the preceding chamber wall by a thin platform.

As mentioned, this shape of the aperture is proper to the type species of the genus *Quinqueloculina*, e.g. *Q. seminulum*. But at the same time

similar elongate-oval aperture is also present in the genus *Massilina* (the type species *Quinqueloculina secans* d'Orbigny), separated by Schlumberger in 1893 for specimens of *Quinqueloculina* with last chambers placed on alternate sides in a single plan as in *Spiroloculina*. A problem therefore arises, whether the true quinqueloculinas can be distinguished from those of the juvenile stage of massilinas? In fact, the massiline forms are rather rare in recent and fossil populations; more abundant are specimens of *Quinqueloculina*, representing *Massilina*'s juvenile stage, which in the case of the lack of mature stage of *Massilina* in a given population are not to be defined as *Massilina*. There are situations where individuals with a similar morphology of the test and with a similar oval, open aperture are to be considered as belonging to two genera: *Quinqueloculina* and *Massilina*. On the other hand, *Quinqueloculina seminulum* may grow as large flat forms in the adult, approaching the "massiline" morphology in their flat shape (Text-fig. 1; Pl. XII, Fig. 2).

The criteria of "massiline" arrangement of chambers lose therefore in some cases their generic significance and express the ontogenetic stage not only in *Quinqueloculina* but also in other genera as *Palaeomiliolina, Spirosigmoilina, Ammomassilina, Heterillina*. The term "spiroloculine" arrangement indicates also last chambers placed on alternate sides in a single plane. "Sigmoiline" arrangement, the word used by some authors (e.g. Bogdanowich, 1952) to define a slight deviation from the single plane of "massiline" arrangement, is also unequivocal because, according to Barker (1960), the genus *Sigmoilina* has become invalid. In general, the names *Spiroloculina, Massilina* and *Sigmoilina* are in many cases regarded as synonymous and the same species often appear classified under these three genera; and inversely, species belonging to different genera are joined under the same generic name. Forms placed with the genus *Massilina* in Catalogue (1941) of Ellis and Messina are a sufficient example.

*Internal structure.* — In order to investigate the juvenile stage and ontogeny, an examination of the internal structure on about 300 cross-sections of Miocene *Quinqueloculina* and *Massilina* has been made. It was stated furthermore, that nearly all of the sectioned specimens of *Quinqueloculina* of this group have chambers with floor at the contact with the preceding chamber walls in the mature stage. The same character of chamber building have the sectioned specimens of *Massilina*. This feature was previously noted by Cushman (1917) and Serova (1961) and was interpreted analogically by both the authors: the chambers with floor are proper to the genus *Massilina*, those without floor, to the genus *Quinqueloculina* (in the former conception of the genus). The above authors did not pay attention to a connection of the observed characteristics with the shape of the aperture.

The group of investigated *Quinqueloculina* with an oval aperture and

a prominent feature to build the chamber floor show in most cases the simultaneous ability to form the "massiline" stage in the adult. This stage is sometimes represented by big, flat individuals with a few last chambers added in a single plane (usually with "sigmoiline" deviation), but in many cases the flat stage is not reached and there exist large, flattened *Quinqueloculine* forms with at least one or two last chambers added in planes of coiling approaching to 180°. It is not possible to separate them morphologically as two distinct genera, as the transitional forms between quinqueloculine and massiline stages exist.

The internal structure of quinqueloculine and massiline forms belonging to this group is rarely as regular as given in the systematic descriptions of the genera. The angles of chamber addition are inconstant and the planes of coiling vary from 120° to 160° apart in quinqueloculine stage, whereas in massiline stage they increase gradually to 160°—180° apart. The angles 140°, 146°, 152°, are the most frequent (Text-fig. 3), showing

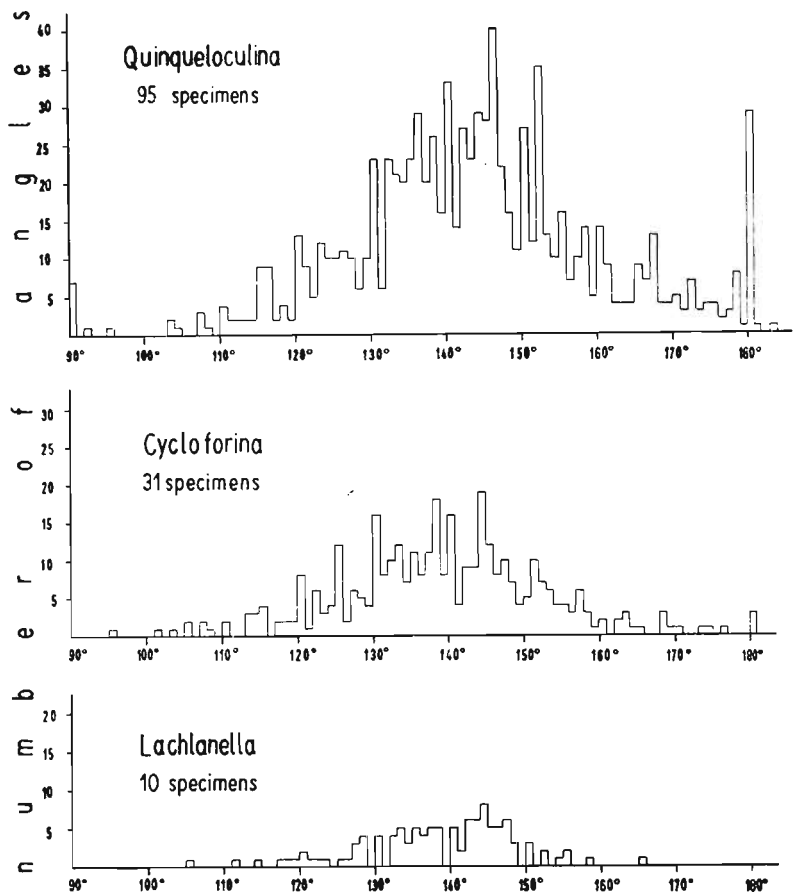


Fig. 3. — Histograms showing angles of chamber addition of *Quinqueloculina*, *Lachlanella* and *Cycloforina*.

evidently that the rule of chamber addition 144° apart in *Quinqueloculina* is not exactly proper to this group.

The specific feature connected with this group of Foraminifera is the production of three proloculus sizes: microspheric and two megalospheric, I and II [1]. There proloculus sizes, observed earlier by many authors (e.g. Schlumberger, 1893; Cushman, 1917; Bogdanowich, 1952), have been described by Hofker (1925, 1931) as connected with trimorphism. As Loeblich & Tappan (1961) stated, later examinations have shown that these three generations do not occur regularly and are never present in some species. Le Calvez (1938, in Loeblich & Tappan, 1964, p. C106) gave additional information available from culturing and concluded that the size of proloculus is defined at schizogony and depends exclusively on the ratio of volume of maternal protoplasm to number of daughter nuclei and does not control any morphological differentiation. He observed that the microspheric and megalospheric generations cannot be even determined solely by size of the proloculus in some species. Thus the term trimorphism does not indicate three generations but only test morphology, where it is occasionally recognizable (*ibidem*, p. C107).

The observations of fossil quinqueloculinas of this group do not reveal any morphological dimorphism or trimorphism of the test but only proloculus differentiation which can be distinguished even within the same species. This differentiation is so prominent that it cannot be neglected, although the size of proloculus is not recognizable in test morphology. The proloculus size differentiation in micro generation is of 20—50 μ in diameter, in mega I generation is of 70—120 μ in diameter, in mega II generation of 150—300 μ in diameter.

There is no rule in the production of micro and mega generations. As Loeblich & Tappan (1964) stated, the microspheric generation is much rarer in dead populations of fossil assemblages than in living populations

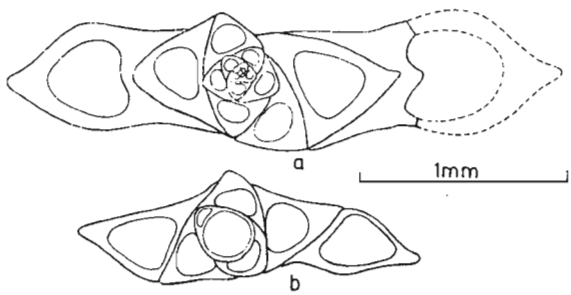


Fig. 4. — Diagrammatic sections showing the internal structure with chamber floor of "massiline" stage of *Quinqueloculina anagallis* n. sp., Korytnica, Miocene; *a* — micro generation, section 241, *b* — mega II generation, section 9.

[1] To simplify the terminology, it is suggested to reduce the terms microspheric, megalospheric I and megalospheric II to "micro", "mega I" and "mega II" proloculus sizes.

(p. C106). This observation cannot be confirmed in *Quinqueloculina* studied. In most cases big massiline forms are of micro generation (Text-fig. 4a) and rarely of mega II generation with a very large, spherical proloculus (Text-fig. 4b). Big quinqueloculine forms are also of micro or mega II generations (Text-fig. 5 a, c), whereas small quinqueloculine forms are

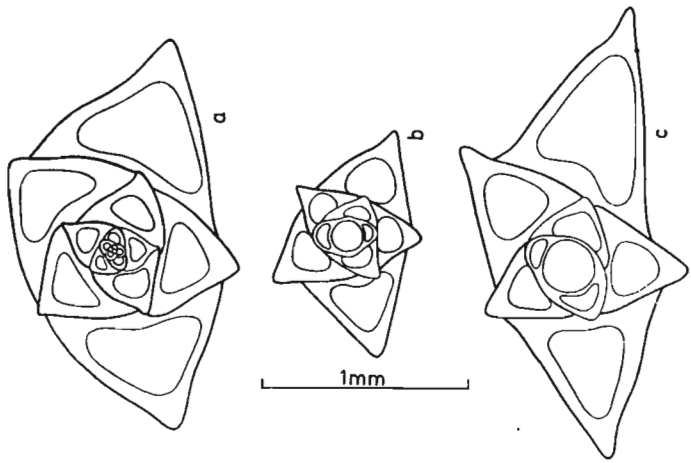


Fig. 5. — Diagrammatic sections showing the internal structure with chamber floor of "quinqueloculine" stage of *Quinqueloculina buchiana* d'Orbigny, Korytnica, Miocene; *a* — micro generation section 214, *b* — mega I generation, section 210, *c* — mega II generation, section 211.

mostly of mega I generation (Text-fig. 5b) and single specimens only are micro.

The number of massiline forms produced in particular species in fossil and recent populations is not constant and very likely depends on the biological and physical factors. There occur fossil populations with a predominance of quinqueloculine forms (e.g. *Quinqueloculina buchiana* d'Orbigny, *Q. akneriana* d'Orbigny. *Q. triangularis* d'Orbigny, *Q. spondiungeriana* (Serova)) as well as assemblages with a predominance of massiline forms and a small number or even no quinqueloculine forms (e.g. *Quinqueloculina peregrina* d'Orbigny, *Q. haidingerii* d'Orbigny, *Q. anagallis* n.sp. or in the recent populations of *Q. secans* d'Orbigny). The size of quinqueloculine-massiline forms is closely related to the stage in the adult: quinqueloculine forms are small if the flat massiline stage is produced and they are big if they do not attain the flat stage.

The periphery of chambers is as a rule angular or sharply keeled, at least in juvenile stage. In flat massiline forms it may be also rounded.

*Relations between Quinqueloculina and Massilina.* — As stated above, the morphological relations between *Q. seminulum*, the type species of the genus *Quinqueloculina*, and *Q. secans*, the type species of the genus *Massilina*, are clearly seen in their similar aperture shape. There also

exist the internal structure relations manifested in a similar mode of chamber production with floor, at least in microspheric generation in mature stage. Although some authors do not show any chamber floor in sections of *Q. seminulum* (e.g. Cuhsman, 1929; Brady, 1884; Martinotti, 1921), illustrations of others show a distinct floor (Schlumberger, 1893, p. 67, Fig. 16) like in *Q. secans* (*l.c.*, p. 77, Fig. 33, 34).

Of particular importance is, in the paper of Le Calvez (1969), the photography of the section of *Q. seminulum* from Schlumberger's collection Nr. V 1193, where the floor of the two last chambers is distinctly seen. If we add the author's observation that *Q. seminulum* reveals the ability to create flattened forms in the adult (Pl. I, Fig. 2), there is only one step to a conclusion that *Q. seminulum* and *Q. secans* belong to the same taxonomic group, as d'Orbigny classified them at first. The difference between them, observed by Schlumberger (1893), is rather based on a greater flattening of the test by *Q. secans* and on its more distinct tendency to build the massiline stage. The author believes that further investigations of a greater amount of material available will permit to find definite massiline forms of *Q. seminulum*.

*Conclusions.* — The following facts are to be noted by now:

1) The genus *Quinqueloculina* represents forms with elongate oval aperture and a simple tooth and possesses the ability to build chambers with floor.

2) There are species of *Quinqueloculina* which may produce the massiline stage in the adult. This stage is usually regarded as typical for the genus *Massilina*.

3) In the light of observations mentioned above, the genus *Massilina* becomes the younger synonym of the genus *Quinqueloculina*, like in earlier classifications of Brady (1884), Wiesner (1931), Bogdanowich (1952), Bogdanowich and Voloshinova (1959) and others. Considering, however, the fact that the existence of massiline forms should be marked in some way in the taxonomy, the following suggestions are made: a) to use the term "massiline" form to define the ontogenetic stage of *Quinqueloculina*, b) to supply if necessary the names of the species of *Quinqueloculina* with the symbol MS (massiline stage) or QS (quinqueloculine stage).

4) The quinqueloculine forms with elongate aperture with parallel sides and a long tooth, which do not build chamber floor and have no massiline stage in the adult, may remain classified as the genus *Lachlanella* sensu Vella (1957).

5) The other quinqueloculine forms with no elongate aperture and chamber floor should be excluded from this group.

6) It is feasible that massiline forms representing the adult or senile stage of ontogeny of some *Quinqueloculina*, only in certain cases may get developed. As they are certainly connected with reproductive cycle, they

may express a particular stage only which may have occured in special conditions. While building the chambers of the flat stage, they may add the chamber material also inside the preceding chambers of the early stage in order to obtain a greater consolidation of the test. This may be the reason why in some species of *Quinqueloculina* with massiline stage very rarely produced, the chamber floor in quinqueloculine stage is often absent. It is not possible to solve this problem on fossil materials; only biological investigations of recent populations may answer the question which factors should exist to give rise to the creation of massiline forms in ontogeny.

7) The ability to produce the chamber floor is also observed in the genus *Adelosina*, which should belong to the family Nubeculariidae, subfamily Spiroloculininae, because of its cornuspira-like juvenile stage. Thus this confirms to some extent the concept of Serova (1961) that *Massilina* (i.e. *Quinqueloculina* MS in the conception adopted herein) represents the transitional form between two branches: the group of *Spiroloculina* with chamber-floor building ability and the group of *Quinqueloculina* without chamber floor (i.e. the other genera of quinqueloculine forms as understood in the present paper).

**Elongate-narrow aperture with parallel sides and a long tooth.** The group of forms with elongate aperture with parallel sides was separated by Vella (1957) as subgenus *Quinqueloculina* (*Lachlanella*). It is to certain degree related to the preceding group in having similar aperture (Text-fig. 2c): the elongate opening filled with tooth, consisting of a long, slender septum and a small, V-shaped platform. The morphological difference consists in more elongated and narrower shape of the aperture opening and in its nearly parallel sides in *Lachlanella*. On the other hand, there is no chamber floor in this group and this is the feature approaching it to the next group characterized by the lack of the chamber floor.

In Vella's description of the subgenus, the subquadrate chambers are recorded. This shape of chambers is also observed in other genera (e.g. *Spiroloculina, Cycloforina* n.gen.) and is connected with the chamber ornamentation rather than with their generic attribute. In the fossil collections studied at present a great number of typical *Lachlanella* with subquadrate chambers have been found. The chambers are regularly coiled and no tendency to build the massiline stage has been observed. The sectioned specimens represent probably micro generation with proloculus diameter of 30—50 μ (Text-fig. 6a). The planes of chamber addition oscillate between 127—150° apart, the most frequent angles being those of 142—147° apart, which indicates a greater stability in ontogeny in comparison with the genus *Quinqueloculina*. (Text-fig. 3).

It seems that the mentioned features are sufficient for considering *Lachlanella* as a genus, not a subgenus of *Quinqueloculina*.

**Circular aperture and a short bifid tooth.** This shape of the aperture was usually attributed to the genus *Quinqueloculina*, presumably because of the frequency of its occurrence in most fossil and living populations. It is easy to distinguish from the aperture characteristic in the previous

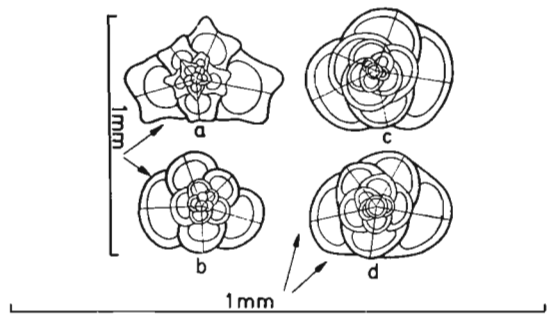


Fig. 6. — Diagrammatic sections showing the internal structure without chamber floor of *Lachlanella, Cycloforina* and *Varidentella: a — Lachlanella undosa* (Karrer), Węglinek, Miocene, section 165; *b — Cycloforina gracilis* (Karrer), Gliwice St., Miocene, section 171; *c, d — Varidentella reussi* (Bogdanowich), Zrecze 3, depth 101,9 m, Upper Miocene, *c* — kryptoquinqueloculine chamber arrangement, turn of the coiling axis visible, section 274, *d* — quinqueloculine chamber arrangement, section 277.

groups because its shape is circular, closed and it is usually placed at the somewhat extended end of the chamber (Text-fig. 2d). If the chamber end is flush with the surface, the shape of the aperture becomes slightly semicircular and there are transitional forms between them.

The short form of the tooth is connected with the round aperture shape; it may be simple or bifid, sometimes enlarged and square-shaped. The internal structure of the test shows more regular chamber coiling than in other genera of Quinqueloculinae. The alternating chambers are added in planes of coiling varying between 120° and 157° apart, like in *Quinqueloculina*; in the mature stage the planes decrease to 130—144° apart (Text-fig. 3). All specimens examined are probably of micro and mega I generations, with proloculus size diameters of 20—50—80 μ (Text-fig. 6b) and are hardly distinguishable one from another. This feature is in concordance with observations of Le Calvez (1938, in Loeblich & Tappan, 1964, p. C106), that the two generations cannot be determined by the size of proloculus in some species.

The chamber floor is absent altogether, which causes the weak chamber conjunction. The chamber shape is usually tubular, sometimes angular or quadrangular.

The specimens with circular aperture and a short tooth were assigned to the new genus *Cycloforina*.

**Open, transverse-semicircular aperture and a broad, quadrangular or reduced tooth.** This interesting group of Quinqueloculininae represents forms with broad, semicircular or transverse-slitlike aperture and a marked

tooth shape. It is quadrangular, low and broad, with two angular corners which are modifications of bifid tooth of *Cycloforina* (Text-fig. 2e). The quadrangular tooth is sometimes transformed into a narrow tape (Text-fig. 2f) or even entirely reduced, leaving the opening of the aperture empty. A modification of the tooth is sometimes recorded, which occurs in the shape of two corners at two outer ends of the aperture originating from the bending of the chamber walls inside the aperture. The joining of these two corners by the transverse tape creates then the quadrangular tooth.

The internal structure is mainly of quinqueloculine type but with a characteristic feature to turn the coiling axis about 90° in juvenile stage. This change may occur once or twice, just after a few chambers of juvenile stage have been built. The mature specimens are of quinqueloculine morphology but they may have also four or three outer chambers visible, having then kryptoquinqueloculine internal structure (Text-fig. 6c). This term was first used by Bogdanowich (1969), after Martinotti (1921) and Prell-Müssig (1965) observations, for determining the outer triloculine chamber arrangement, but with two previous internal chambers completing the last three in the quinqueloculine arrangement. The forms with typical quinqueloculine internal structure are also present (Text-fig. 6d).

All sectioned specimens show the proloculus variation of 10—30—60 μ and no micro or mega generations can be distinguished. The most frequent angles between planes of chamber addition vary between 120° and 147°, showing no dominant angle within this range. Of particular interest are

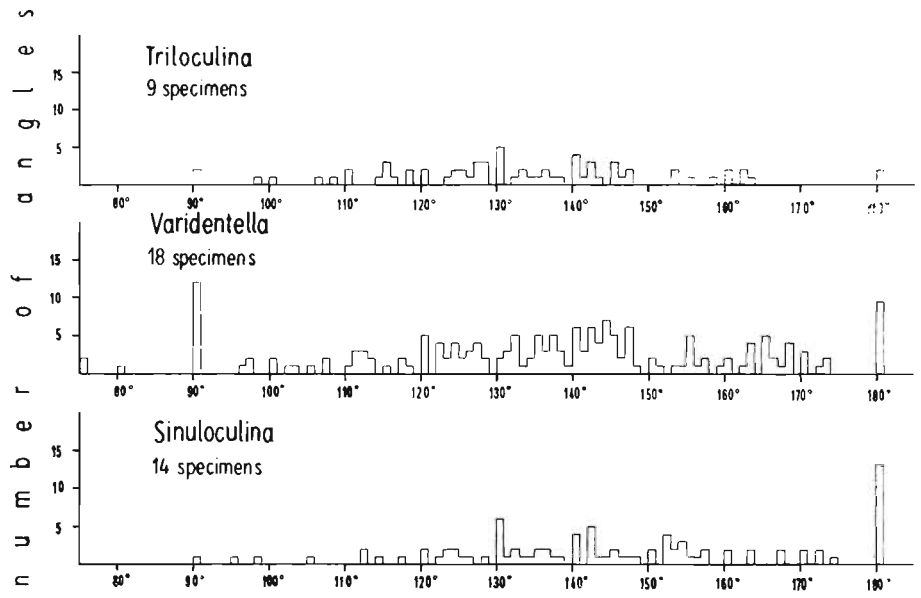


Fig. 7. — Histograms showing angles of chamber addition of *Triloculina*, *Varidentella* and *Sinuloculina*.

angles of 90° and 180°, distinctly separated from previous group of angles, illustrating the change of coiling axis in the ontogeny (Text-fig. 7).

The chamber floor is absent. The chamber shape is usually tubular. The variability of morphological features and internal structure approaches this group to *Miliolinella*, in which the change of coiling axis is also observed (Bogdanowich, 1969). It differs, however, in its shape of the aperture and tooth but undoubtedly is closely related to *Miliolinella* and represents transitional stage between *Cycloforina* and *Miliolinella*.

Considering the marked internal structure and morphology of specimens described as different from the other *Quinqueloculina* forms, they are determined as belonging to the new genus *Varidentella*.

## *"Adelosine" internal structure*

To the genus *Adelosina* d'Orbigny assigned in 1826 forms, whose juvenile stage consists of proloculus and the cornuspiroid second chamber with neck, which encircles the proloculus forming characteristic lenticular test. There was no consensus of opinion among other authors on the taxonomic value of the genus *Adelosina*. Some of them joined *Adelosina* with the genus *Quinqueloculina* and considered it as juvenile stage of megalospheric forms of *Quinqueloculina* (Bogdanowich, 1958; Bogdanowich & Voloshinova, 1959; Loeblich & Tappan, 1964 *et al.*), others supported the independence of the genus according to d'Orbigny's description (Schlumberger, 1886; Mangin, 1956; Bogdanowich, 1965).

The present author agrees with the argumentation of Mangin (1956) and Bogdanowich (1965) and considers the following criteria as fundamental to support the existence of the genus:

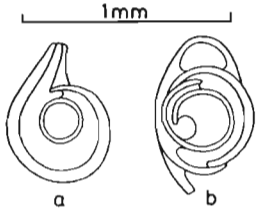


Fig. 8. — Diagrammatic sections showing the internal structure of juvenile stage of *Adelosina* (*a*) section 333, and *Quinqueloculina* (*b*) section 332, both of mega II generation.

1) The cornuspiroid juvenile stage, which is the feature connected with Spiroloculininae (Loeblich & Tappan, 1964). None of *Quinqueloculina* species create cornuspiroid juvenile stage, even in mega II generation (Text-fig. 8 a, b).

2) The building of chamber floor, like *Spiroloculina*. It is true that this characteristic is also observed in *Quinqueloculina* but this genus have no circular aperture with a short tooth at the end of the neck, like *Adelosina*. Similar round aperture exists only in the genus *Cycloforina* n.gen., which has no cornuspirine juvenile stage in the ontogeny and does not produce the chamber floor.

3) The tendency to uncoil last chambers in mature specimens, which is sporadically observed in the genus *Quinqueloculina* and other genera (Bogdanowich, 1958), but does not appear in *Cycloforina*, to which *Adelosina* might have been possibly ascribed, considering its similar morphology.

As a result, the author's suggestion is to transfer the genus *Adelosina* together with its synonymies to the family Nubeculariidae, subfamily Spiroloculininae.

## REMARKS ON THE GENUS *TRILOCULINA*

### *Systematics*

The conception of the genus *Triloculina* was very simply formulated by d'Orbigny in 1826 and was then applied in all classifications in a constant form: chambers arranged initially as in *Quinqueloculina*, then in three planes of coiling 120° apart, 3 chambers visible externally. According to this definition, all forms with three chambers visible were placed in the genus, without regard to the internal structure or to the aperture shape. Only one genus *Miliolinella* was separated from the genus *Triloculina*, on the basis of the aperture with a flap-like tooth (Wiesner, 1931). The most controversial were forms whose external appearance cannot be precisely defined, because of their 3, 4 or 5 outer chambers visible within one species. As a result, an attempt was made by Williamson (1868) to solve the problem by fusing genera *Triloculina* and *Quinqueloculina* in one genus *Miliolina*. Apparently, it was not the proper way and the old definitions of mentioned two genera were revived (e.g. Bogdanowich & Voloshinova, 1959; Loeblich & Tappan, 1964).

It is not easy to clear the problem, considering the variations of the test morphology in some species and the existence of transitional forms between the two genera mentioned. There is only one group of "classic" *Triloculina* which are morphologically recognizable. These are specimens with triangular cross-section and with last chambers arranged in three planes of coiling about 120° apart, according to the "classic" definition of the genus and the appearance of the type species *Triloculina trigonula* Lamarck. Defining other *Triloculina* is more questionable.

In order to investigate the problem forms with three chambers visible were examined, with respect to their internal structure and the shape of the aperture.

*Internal structure*

Studies of cross-sections of triloculine forms of Miocene Miliolidae permitted to state that "classic" individuals represent as a rule the mega II generation (Text-fig. 9a), being triloculine throughout. Most of "classic" forms of mega I and micro generations have kryptoquinqueloculine, not

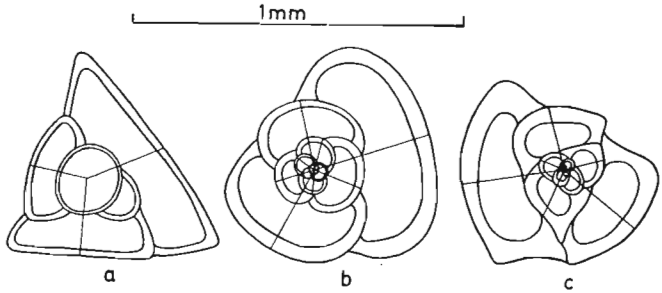


Fig. 9. — Diagrammatic sections showing the internal structure of "classic" *Triloculina: a* — *T. neudorfensis*, Toula, Wieliczka, Miocene, mega II generation with regular internal structure, section 189; *b* — *T. gubkini* Bogdanowich, Węglinek, Miocene, micro generation with pseudotriloculine chamber arrangement, section 205; *c* — *T. intermedia* Karrer, Karsy, Miocene, micro generation with kryptoquinqueloculine initial part and pseudotriloculine in mature stage, section 197.

quinqueloculine initial part and only a few last chambers are arranged in three planes of coiling, which are usually irregular (Text-fig. 9 b, c). Sporadically they remain kryptoquinqueloculine in the mature stage.

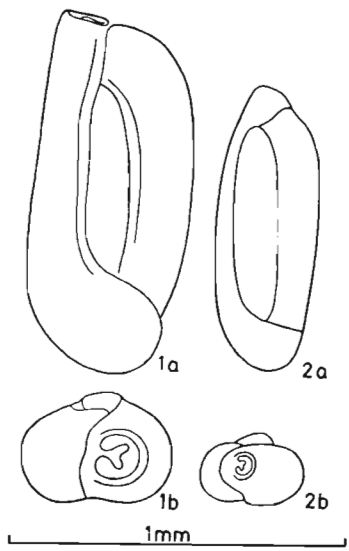


Fig. 10. *Sinuloculina microdon* (Reuss) and its juvenile stage, usually qualified as *Triloculina consorbina* d'Orbigny; *1 a, b "Triloculina" microdon* Reuss, Gliwice Stare, Miocene, *2 a, b* — *"Triloculina" consorbina* d'Orbigny, from inside of the mature specimen.

It was stated furthermore that specimens with no triangular, "classic" outline and internal structure show a tendency to flatten the test. Having the initial part kryptoquinqueloculine, as *Triloculina*, their internal structure omits the triloculine stage, remaining in the mature stage kryptoquinqueloculine or passing into flattened biloculine development. This form differs, however, from *Pyrgo* in its flattening in the opposite direction than *Pyrgo*; the side walls of chambers are laterally compressed, instead of receding from the axis.

The juvenile stage of those flattened "*Triloculine*" is usually more slender than the mature individuals and the aperture is placed sporadically at the protruding end of the last chamber. Such specimens were obviously qualified as separate species and a definition of their genus affords a lot of difficulties, e.g. *Triloculina* or *Quinqueloculina oblonga* Montagu, *T.* or *Q. consobrina* d'Orbigny, *T.* or *Q. nitens* Reuss and others. A good example is "*Triloculina*" *microdon* (Reuss), which has the slender form resembling *Triloculina consorbina* d'Orbigny inside the test (Text-fig. 10 a, b).

*Differentiation of the aperture shape*

The aperture shape in triloculine Miliolidae is less differentiated than in quinqueloculine forms, giving only two modifications: the rounded aperture of very frequent occurrence and the very rare one with the slitlike opening and a long, narrow tooth.

**Rounded aperture and a short bifid tooth.** *Triangular section.* — This group embodies "classic" triloculine forms with triangular transverse section and with internal structure kryptoquinqueloculine in the initial part, at least in microspheric or mega I generations, and triloculine or irregular triloculine in the mature stage of micro, mega I and mega II generations (Text-fig. 9 a—c). Thie mode of irregular triloculine chamber addition is named "pseudotriloculine" and is represented by two angles $> 130°$ and one angle $< 90°$, measured between three last chambers of the last whorl. The planes of coiling deviate sporadically from "classic" 120° by $\pm 20°$ or even in mature kryptoquinqueloculine forms up to $\pm 40°$. Thus the angles of chamber addition show maximum of 130°, but may also vary between 115° and 145° (Text-fig. 7). The proloculus sizes are 20 μ in micro generation, 70—120 μ in mega I generation, about 200 μ in mega II generation. The aperture is rounded, usually with a rim and with a short, bifid tooth (Text-fig. 2d); sometimes the base of the aperture is slightly contracted.

It seems advisable to consider only the species with the features presented as proper to the genus *Triloculina* s.s.

*Rounded or oval section.* — Species belonging to this group differ from *Triloculina* s.s. not only in the lack of triangular transverse section but

mainly because of their internal structure. The initial part is kryptoquinqueloculine or even quinqueloculine and irregular chamber addition (the deviation of angles between five last chambers is ± 20° from 72° of regular quinqueloculine arrangement) in micro generation (Text-fig. 11a), but both

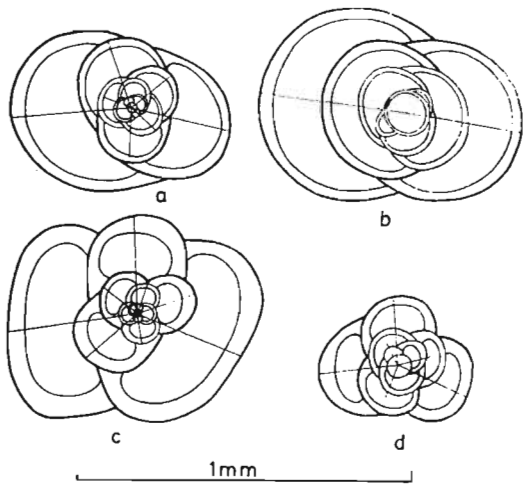


Fig. 11. — Diagrammatic sections showing the internal structure of *Sinuloculina* and *Affinetrina: a* — *Sinuloculina cyclostoma* (Reuss), Węglinek, Miocene, micro generation with regular kryptoquinqueloculine chamber addition, section 203; *b* — mega II generation, with angles of chamber addition increasing to 180° in mature stage section 199; *c* — *Affinetrina planciana* d'Orbigny, Gliwice St., Miocene, micro generation with kryptoquinqueloculine initial part and pseudotriloculine mature stage, section 206; *d* — mega I generation with pseudotriloculine chamber arrangement, section 209.

mega I and mega II generations as a rule become flattened, with angles of chamber addition increasing gradually to 180° (Text-fig. 11b). The couples of alternating chambers are arranged in sinusoid curve but each chamber broadly overlaps the wall of the preceding chamber only, without lateral extensions covering all the preceding chambers, as in *Sigmoilina.*

The angles of chamber addition are in the range of 120° to 157°, with maximum value of 130° in this range, with distinct domination of angle 180° indicating the "biloculine" stage of the test (Text-fig. 7). The proloculus sizes are 20—50 μ in micro generation and 120—150 μ in mega I and mega II generations, which are hardly distinguishable. The aperture is usually large, rounded, with a lip and a thick tooth, bifid and protruding over the apertural rim (Text-fig. 2d). The tooth is composed of a thick bifid at the end septum and a thin platform partially supporting the outer end of the tooth, so that the initial part of the platform beneath the tooth is open. Sporadically it resembles the tooth of *Cycloforina* or *Flintina.*

This group is distinguished here as belonging to the new genus *Sinuloculina.*

**Elongate slit-like aperture and a long tooth.** This group of triloculine forms is easy to distinguish due to their aperture shape. It is like a high narrow slit nearly filled with a long, simple tooth (Text-fig. 2c). The aperture of mature specimens may become slightly enlarged and the tooth may become bifid at the end, like in *Lachlanella*. The internal structure is initially kryptoquinqueloculine, then pseudotriloculine (Text-fig. 11c), sporadically the kryptoquinjuveloculine stage may be omitted (Text-fig. 11d). The proloculus size variation is of 30—50 μ and other distinct generations cannot be defined.

Triloculine forms with high slit-like aperture and a long tooth have been recognized as a new genus *Affinetrina*.

## REMARKS ON THE GENUS *MILIOLINELLA*

### *Systematics*

The type species of the genus *Miliolinella* Wiesner (1931), was not precisely defined by the author. The genus was distinguished for specimens with a broad aperture and a flap-like tooth and included initially two series of forms: the first one was represented by the type species *Miliolinella lamellidens* (Reuss), with a slender, quinqueloculine test and contained also *Miliolinella cryptella* (d'Orbigny) and *M. sphaera* (d'Orbigny) with large, biloculine tests. The second series was represented by the type species *Miliolinella subrotunda* (Montagu) and joined triloculine forms with more or less developed or no apertural flap. The first group was later assigned to two genera: *Miliolinella lamellidens* was included in the genus *Scutuloris* Loeblich & Tappan, 1964, the other two species — in the genus *Pyrgoella* Cushman & White, 1936. Thus the second group was consequently regarded by the later investigators as representative of the genus *Miliolinella*, the type species of which remains *Vermiculum subrotundum* Montagu, 1803 (in Catalogue, Ellis and Messina).

It is not known whether the recent material from English coast, from which *Miliolinella subrotunda* was defined by Montagu, was at Wiesner's disposal as well while distinguishing the genus. The Montagu's illustration of the species is not clear and due to this fact Rhumbler (1936, in Catalogue, 1941) renamed the type species of the genus *Miliolinella* as *M. wiesneriana*. He stated that the species *Vermiculum subrotundum* Montagu includes forms without tooth or with a simple long tooth, not with the transverse one; thus the species with a flap-like tooth, defined by Wiesner as the type species, had to be given a new name.

Studying the recent Miliolidae from the English coast, the present author found specimens of *M. subrotunda* altogether corresponding to

Montagu's illustration and description (Text-fig. 12 a—c). Even specimens without tooth were found among them besides those with the distinct flap-like tooth. On the other hand, the author found in Wiesner's collection from the Adriatic (Punta Grossa near Triest) specimens of *Miliolinella sub-*

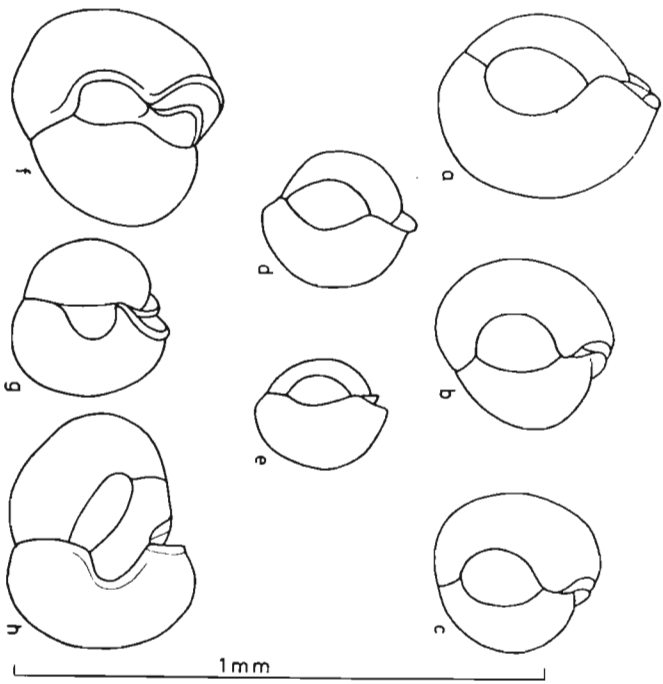


Fig. 12. — Variability of morphological features of *Milliolinella: a-c — M. subrotunda* (Montagu), Recent, English coast, Sussex; *d, e — M. subrotunda* (Montagu), Recent, Triest, Adriatic, specimens from Wiesner's collection; *f-h — M. banatiana* n.n., Miocene, Korytnica.

*rotunda*, the dimensions of which were a little smaller than those from the English coast, but undoubtedly belonging to this species (Text-fig. 12 d—e). This confirms Wiesner's designating it as the type species of the genus *Miliolinella* and supports the statement of Loeblich & Tappan in Treatise, who do not mention the new name proposed by Rhumbler.

### *Internal structure*

In the Miocene of Poland two kinds of "triloculine" Miliolidae with a flap-like tooth occur. The first group is with spherical or nearly spherical tests and with biloculine or partially triloculine morphology and pseudotriloculine internal structure which represents the genus *Pyrgoella*. The second group includes forms with kryptoquinqueloculine chamber arran-

gement and "triloculine" morphology and corresponds to the genus *Miliolinella* (Text-fig. 13a). The remarkable feature of the internal structure of *Miliolinella* is the ability to displace the axis of coiling in juvenile stage (Text-fig. 13b). This feature relates it to the genus *Varidentella*, which represents the transitional form between Quinqueloculinae and Miliolinellinae.

The proloculus sizes of *Miliolinella* range between 30—50 μ, belonging probably to the micro generation.

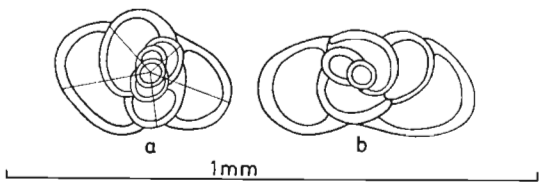


Fig. 13. — Diagrammatic sections showing the internal structure of *Miliolinella banatiana* n.n. Miocene, Korytnica: *a* — kryptoquinqueloculine chamber arrangement, section 396; *b* — turn of the coiling axis visible, section 394.

Fossil *Miliolinella* are distinctive for their great variation of morphological features. There occur forms with three, four or five chambers visible from outside within one species; there are also forms with a normal chamber arrangement or with a tendency to build last chambers in a single plane or to uncoil them in the mature or gerontic stage (e.g. *Miliolinella banatiana* n.n., Text-fig. 12 f—h).

Similar observation was also made earlier by Bogdanowich (1969) that some species of *Miliolinella* with triloculine morphology show kryptoquinqueloculine internal structure and a tendency to displace the coiling axis. Since the taxonomical range of the genus *Miliolinella* relates it thereby to the genus *Scutuloris*, Bogdanowich proposes to join both genera and to return to the Wiesner's conception of the genus, after its diagnosis has been emended. Since the examination of *Miliolinella* from the Miocene of Poland confirms the observation of Bogdanowich concerning the internal structure, the genera *Miliolinella* and *Scutuloris* were united and the diagnosis of Wiesner and partially those of Loeblich & Tappan (1964) was completed.

### *Shape of the aperture*

The aperture of *Miliolinella* species of Poland has the form of a transverse, semicircular opening, partially filled with a flap-like or sickle-shaped tooth (Text-fig. 2g). It is slightly protruding over the aperture

edge and extends throughout the breadth of the chamber. There occur also specimens without tooth, which is possibly due to the damage of the aperture.

*Crenulate aperture*

There have been also found specimens with triloculine chamber arrangement and with the internal structure and morphology like that of *Miliolinella*, but with a slightly different aperture (Text-fig. 14). It is in the shape of a transverse slit extended throughout the breadth of the last

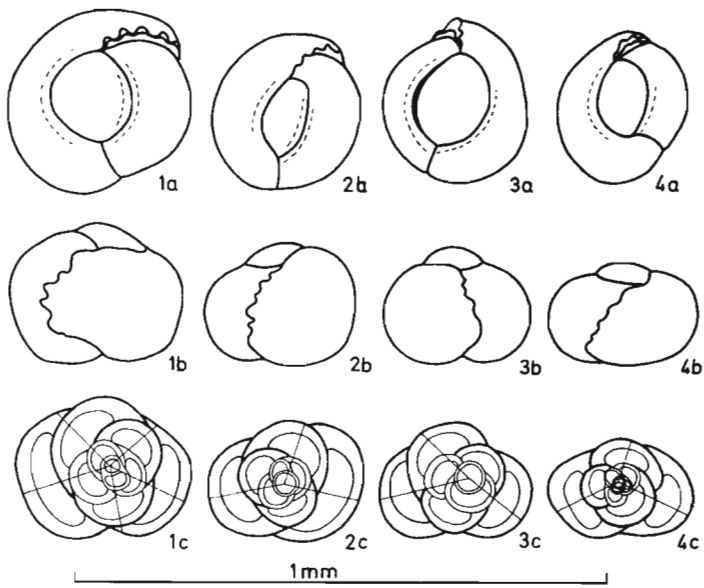


Fig. 14. — Variability of morphology and internal structure of *Crenatella mira* n.gen., n.sp.: *1* — kryptoquinqueloculine chamber arrangement; *2-4* — pseudotriloculine chamber arrangement; *a* — side view, *b* — apertural view, *c* — cross-section.

chamber but with crenulate margins of the aperture and of the sickle-shaped tooth (Text-fig. 2h). The crenulate border of the tooth and the chamber wall indent in young specimens and close the aperture. In older specimens the aperture is open. The crenulation is then irregular and the tooth is sometimes absent, leaving the empty slit-like hole, bordered with irregular serrate edge of the chamber.

The internal structure is kryptoquinqueloculine in the initial part, then pseudotriloculine. The proloculus sizes are 20—40 μ.

Specimens described above are recognized as belonging to the new genus *Crenatella*.

## PROPOSITION OF RECLASSIFICATION OF SUBFAMILIES AND GENERA

### Family **Miliolidae** Ehrenberg, 1839
### Subfamily **Quinqueloculininae** Cushman, 1917

Five or more chambers visible, at least in the early stage quinqueloculine chamber arrangement, chambers not subdivided: *Quinqueloculina* d'Orbigny, 1826; *Ammomassilina* Cushman, 1933; *Articulina* (part)? d'Orbigny, 1826; *Cycloforina* n.gen.; *Dentostommina* Cushman, 1933; *Dogielina* Bogdanowich et Voloshinova, 1949; *Flintinella* Didkovsky, 1960; *Hauerina* d'Orbigny, 1839; *Heterillina* Munier-Chalmas & Schlumberger, 1905; *Lachlanella* Vella, 1957; *Miliola* Lamarck, 1804; *Palaeomiliolina*? Loeblich & Tappan, 1964; *Pateoris* Loeblich & Tappan, 1953; *Podolia* Serova, 1961; *Poroarticulina*? Cushman, 1944; *Pseudomassilina* Lacroix, 1938; *Sigmoilopsis* Finlay, 1947; *Siphonaperta* Vella, 1957; *Spirosigmoilina* Parr, 1942.

### Subfamily **Miliolinellinae** Vella, 1957

Three or two chambers visible, at least in the early stage kryptoquinqueloculine or pseudotriloculine chamber arrangement, chambers not subdivided: *Miliolinella* Wiesner, 1931; *Affinetrina* n.gen.; *Biloculinella* Wiesner, 1931; *Crenatella* n.gen.; *Cribropyrgo* Cushman & Bermúdez, 1946; *Cruciloculina* d'Orbigny, 1839; *Flintina* Cushman, 1921; *Pyrgo* Defrance, 1824; *Pyrgoella* Cushman & E. M. White, 1936; *Sinuloculina* n.gen.; *Tortonella* Didkovsky, 1957; *Triloculina* d'Orbigny, 1826; *Varidentella* n.gen.; *Wellmanella* Finlay, 1947.

*Remarks.* — *Massilina* Schlumberger, 1893 is joined with *Quinqueloculina; Scutuloris* Loeblich & Tappan, 1953 is joined with *Miliolinella; Sigmoilina* Schlumberger, 1887 is regarded as invalid (Barker 1960), until its new type species is chosen; *Nummoloculina* Steinmann, 1881 should be placed with the family Fischerinidae, Millett, 1898; *Idalina* Schlumberger & Munier-Chalmas, 1884, *Involvohauerina* Loeblich & Tappan, 1955, *Nevillina* Sidebottom, 1905, *Polysegmentina* Cushman, 1946, *Schlumbergerina* Munier-Chalmas, 1882 should be placed with the subfamily Fabulariinae Ehrenberg, 1839; *Ptychomiliola* Eimer & Fickert, 1899, *Tubinella* Rhumbler, 1906, and *Articulina* (part)? should be probably included to the family Nubeculariidae Jones, 1875, subfamily Nodobacullariinae Cushman, 1927; *Parrina* Cushman, 1931, and *Pavoninoides* Bermúdez, 1949 would be placed with Nodobacullariinae or Miliolinellinae, after reexamination of their initial part.

## GENERAL CONCLUSIONS

The reclassification of the subfamilies under consideration is to be based on three types of the internal structure, at least in juvenile stage of microspheric generation: quinqueloculine for the subfamily Quinqueloculininae, kryptoquinqueloculine, triloculine and pseudotriloculine for the subfamily Miliolinellinae. The subfamily Miliolinae Ehrenberg, 1839 is reduced. The subfamily Fabulariinae Ehrenberg, 1839 is characterized by a complex interior of chambers, which are subdivided into chamberlets and therefore its existence is regarded as valid, although it includes forms with chamber arrangement like in previous subfamilies. The subfamily Tubinellinae Rhumbler, 1906 represents forms with early milioline stage reduced and its affiliation to Miliolidae needs revision.

The apertural shape is recorded as a generic factor only. It is suggested to preserve the names of subfamilies but to emend their definitions and to distribute the genera according to their internal structure. The name of the subfamily Quinqueloculininae does not pose any problem as it suggests the uinqueloculine internal structure of the genera. The term Miliolinellinae proceeds fortunately from *Miliolinella* which has kryptoquinqueloculine internal structure and triloculine morphology and may remain the type genus of the subfamily.

## LIST OF SPECIES ASSIGNED TO THE DISCUSSED GENERA

It is suggested to place species listed below, known from literature, according to their morphological criteria of the aperture and chamber arrangement, to the discussed genera. Only those species were taken into consideration whose description and illustration do not pose a problem in their classification. In order to demonstrate the alterations, original names of genera applied by authors of species were preserved. The list is not exhaustive and contains species chosen as examples only, taken from the Catalogue Ellis and Messina and some other papers concerning Miliolidae (Schlumberger, 1893; Cushman, 1917; Martinotti, 1921; Bogdanowich, 1947, 1952, 1960; Le Calvez, 1947; Serova, 1955; Didkovsky, 1961; Krasheninnikov, 1959; Maissuradze, 1965; Venglinsky 1953, 1958).

Genus *Quinqueloculina*: *Massilina rugosa* Sidebottom, 1904; *M. secans tropicalis* Collins, 1958; *Miliolina bogdanowiczi* Serova, 1955; *M. inflatecarinata* Venglinsky, 1953; *M. minakovae* Bogdanowich, 1952; *M. pusillocostata* Venglinsky, 1953; *M. spondiungeriana* Serova, 1955; *M. transcarpatica* Venglinsky, 1953; *Quinqueloculina akneriana* d'Orbigny, 1846; *Q. araucana* d'Orbigny, 1839; *Q. auberiana* d'Orbigny, 1839; *Q. bouena* d'Orbigny, 1846; *Q. buchiana* d'Orbigny, 1846; *Q. cora* d'Orbigny, 1839; *Q. cuvieriana* d'Orbigny, 1839; *Q. dutemplei* d'Orbigny, 1846; *Q. haidingerii* d'Orbigny, 1846; *Q. kapitiensis* Vella, 1957; *Q. lamarckiana* d'Orbigny, 1839; *Q. lenticularis* Reuss,

1850; *Q. notata* Reuss, 1850; *Q. pauperata* d'Orbigny, 1846; *Q. peregrina* d'Orbigny, 1846; *Q. punctata* Reuss, 1853; *Q. schweyeri* Bogdanowich 1965; *Q. secans* d'Orbigny, 1826; *Q. (Q.) sigmoilinoides* Vella, 1957; *Q. speciosa* Reuss, 1856; *Q. striatopunctata* Karrer, 1867; *Q. striolata* Reuss, 1850; *Q. triangularis* d'Orbigny, 1846; *Q. ungeriana* d'Orbigny, 1846, *Q. yabei* Asano, 1936, *Sigmoilina haidingerii aculeata* Bogdanowich, 1952; *Triloculina angulata* Karrer, 1867; *T. dichotoma* Reuss, 1850; *T. pseudohemisphaerica* Le Calvez, 1947.

Genus *Lachlanella*: *Massilina corrugata* Collins, 1958; *Miliolina goesi* Wiesner, 1923; *Miliolina parkeri* Brady, 1881; *Quinqueloculina (Lachlanella) bicostoides* Vella, 1957; *Q. (L.) collenae* Vella, 1957; *Q. (L.) cooki* Vella, 1957; *Q. nussdorfensis* d'Orbigny, 1846; *Q. (L.) rebeccae* Vella, 1957; *Q. subpolygona* Parr, 1945; *Q. undosa* Karrer, 1867; *Q. variolata* d'Orbigny, 1878; *Triloculina architectura* Todd, 1952.

Genus *Cycloforina*: *Miliolina akneriana argunica* Gerke, 1938; *M. akneriana longa* Gerke, 1938; *M. andrussovi* Bogdanowich, 1952; *M. badenensis carinata* Serova, 1955; *M. dmitrievae* Bogdanowich, 1952; *M. dorsicostata* Venglinsky, 1953; *M. glomus* Silvestri, 1896; *M. gracilissima* Bogdanowich, 1952; *M. karreri ovata* Serova, 1955; *M. latelacunata* Venglinsky, *M. nicopolica* Jartzeva, 1951; *M. perlucida* Bogdanowich, 1947; *M. predcarpatica* Serova, 1955; *M. serovae* Bogdanowich, 1952; *M. toreuma* Serova, 1955; *Quinqueloculina angularis* d'Orbigny, 1905; *Q. badenensis* d'Orbigny, 1846; *Q. bicarinata* d'Orbigny, 1878; *Q. bicostata* d'Orbigny, 1839; *Q. clotho* Karrer, 1868; *Q. contorta* d'Orbigny, 1846; *Q. costata* Karrer, 1867; *Q. costata* d'Orbigny, 1878; *Q. crassicostata* Terquem, emend. Le Calvez, 1947; *Q. delicatula* Vella, 1957; *Q. disparilis* d'Orbigny, 1893, *Q. eos* Reuss, 1869; *Q. gracilis* Karrer, 1867; *Q. grignneensis* Le Clavez, 1947; *Q.grinzingensis* Reuss, 1850; *Q. hauerina* d'Orbigny, 1846; *Q. hexacostata* Le Calvez, 1947; *Q. (Q.) incisa* Vella, 1957; *Q. juleana* d'Orbigny, 1846; *Q. lippa* Le Calvez, 1947; *Q. lachesis* Karrer, 1868; *Q. lucida* Karrer, 1868; *Q. ludwigi* Reuss, 1866; *Q. miles* Vella, 1957; *Q. rakosiensis* Franzenau, 1881; *Q. reticulata* Karrer, 1862; *Q. stalkeri* Loeblich & Tappan, 1953; *Q. stelligera* Schlumberger, 1893; *Q. venusta* Karrer, 1868; *Q. vermicularis* Karrer, 1868; *Q. zigzag* d'Orbigny, 1846; *Triloculina striatella* Karrer, 1868.

Genus *Affinetrina*: *Miliolina chrysostoma* Chapman, 1909; *M. compressa* Wiesner, 1912; *M. cubanica* Bogdanowich, 1947; *M. deplanata* Rhumbler, 1906; *M. ferox* Rhumbler, 1906; *M. ucrainica* Serova, 1952; *M. voloshinovae* Bogdanowich, 1947; *Quinqueloculina bogatschovi* Bogdanowich, 1969; *Q. chutzievae* Bogdanowich, 1960; *Q. voloshinovae timenda* Chutzieva; 1960; *Triloculina bassensis* Parr; 1945; *T. bermudezi* Acosta, 1940; *T. carinata* d'Orbigny, 1839; *T. confirmata* Krasheninnikov, 1959; *T. eburnea* d'Orbigny, 1839; *T. frederica* Le Calvez, 1947; *T. gualtieriana* d'Orbigny, 1839; *T. planciana* d'Orbigny, 1839; *T. striolata* Cushman, 1918; *T. subgranulata* Cushman, 1918.

Genus *Sinuloculina*: *Massilina robustior* Cushman & Valentine, 1930; *Miliolina angustioris* Bogdanowich, 1952; *M. consobrina plana* Voloshinova, 1952; *M. consobrina sarmatica* Gerke, 1952; *M. delicatula* Kolesnikova 1952; *Quinqueloculina bacillum* Martinotti, 1921; *Q. mayeriana* d'Orbigny, 1846; *Q. pseudoangustissima* Krasheninnikov, 1959; *Triloculina consobrina* d'Orbigny, 1846; *T. cuneata* Karrer, 1861; *T. cylindrica* d'Orbigny, 1852; *T. decipiens* Reuss, 1850; *T. elongata* d'Orbigny, 1905; *T. flavescens* d'Orbigny, 1905; *T. idae* Vella, 1957; *T. incerta* Terquem, 1878; *T. inflata* d'Orbigny, 1826; *T. laevigata* d'Orbigny, 1878; *T. microdon* Reuss, 1850; *T. nitens* Reuss, 1850; *T. nitida* d'Orbigny, 1839; *T. propinqua* Terquem, 1882; *T. pseudoinflata* Didkovsky, 1961; *T. pyrula* Karrer, 1867; *T. rotunda* d'Orbigny, 1893; *T. truncata* Karrer, 1865, *Vermiculum oblongum* Montagu, 1803.

Genus *Triloculina*: *Miliolina bujturensis* Franzenau, 1890; *M. eggeri* Bogdanowich, 1947; *M. gubkini* Bogdanowich, 1952; *M. insignis* Brady, 1880; *Triloculina affinis* d'Orbigny, 1852; *T. austriaca* d'Orbigny, 1846; *T. gibba* d'Orbigny, 1826; *T. globulus* d'Orbigny, 1839; *T. intermedia* Karrer, 1868; *T. marioni* Schlumberger, 1893; *T. neudorfensis* Toula, 1900; *T. rugosa* d'Orbigny, 1905; *T. schreiberiana* d'Orbigny, 1839; *T. tricarinata* d'Orbigny, 1826; *T. turgida* Reuss, 1851.

Genus *Varidentella*: *Massilina protea* Parker, 1953; *Miliolina akneriana rotunda* Gerke, 1938; *M. complanata* Gerke et Issaeva, 1952; *M. pseudocostata* Venglinsky, 1958; *M. reussi* Bogdanowich, 1947; *M. sulacensis* Gerke, 1952; *Quinqueloculina echinata* Maissuradze, 1965; *Q. nanae* Maissuradze, 1965; *Q. sarmatica* Karrer, 1877; *Triloculina lutea* d'Orbigny, 1839, *T. rosea* d'Orbigny, 1839; *T. verchovi* Didkovsky 1961; *T. volhynica* Didkovsky, 1961.

Genus *Adelosina*: *Quinqueloculina josephina* d'Orbigny, 1846; *Q. konkensis* Bogdanowich, 1958; *Q. longirostra* d'Orbigny; 1826; *Q. mariae* d'Orbigny, 1846; *Q. obsoleta* Costa, 1856; *Q. partschii* d'Orbigny, 1846; *Q. plicosa* Costa, 1850; *Q. schreibersii* d'Orbigny, 1846; *Triloculina anceps* Reuss, 1850; *T. brongnarti* d'Orbigny, 1826; *T. dubia* d'Orbigny, 1905; *T. kochi* Reuss, 1855; *T. linneiana* d'Orbigny, 1839; *T. pulchella* d'Orbigny, 1846; *T. sulcata* Karrer, 1868.

## SYSTEMATIC DESCRIPTIONS

### Family **Nubeculariidae** Jones, 1875
### Subfamily **Spiroloculininae** Wiesner, 1920
### Genus *Adelosina* d'Orbigny, 1826, emend.

*Type species: Adelosina laevigata* d'Orbigny, 1826.

*Synonyms: Retorta* Walker & Boys, 1784; ?*Pollontes* de Monfort, 1808; *Uniloculina* d'Orbigny *in* de la Sagra, 1839.

*Diagnosis.* — Test with quinqueloculine internal structure in microspheric generation; the megalospheric generation with cornuspirine initial part, composed of large proloculus and tubular second chamber encircling proloculus, third chamber placed in plane of coiling 90° apart, next chambers in plane of coiling 130—160° apart; the juvenile stage of mega II generation in the characteristic lenticular form, which may grow into planispirally arranged, slightly evolved forms; 3, 4 or 5 chambers visible from the outside chambers with floor; aperture circular at the end of the neck, with a short, bifid tooth.

### Family **Miliolidae** Ehrenberg, 1839
### Subfamily **Quinqueloculininae** Cushman, 1917, emend.

*Synonyms*: cited in Loeblich & Tappan, 1964.

*Diagnosis.* — Chambers one-half coil in length, at least in juvenile stage in quinqueloculine arrangement, with chambers alternating in planes of coiling 120—160° apart, typically about 140° apart, later chambers may be

added in planes of coiling increasing gradually to 180°; the early quinqueloculine stage in megalospheric II generation may be reduced; 5 or more chambers externally visible; chambers not subdivided. Jurassic to Recent.

## Genus *Quinqueloculina* d'Orbigny, 1826, emend.

(Pl. XII, Figs. 1, 2)

*Type species: Serpula seminulum* Linné, 1758.

*Synonyms: Frumentarium* Fichtel & Moll, 1798; *Multiloculina* Abich, 1859; *Massilina* Schlumberger, 1893.

*Diagnosis.* — Test with earliest chambers in quinqueloculine arrangement in both microspheric and megalospheric generations; 5 chambers visible externally, 4 chambers on one side of the test and 3 on the opposite side; later chambers may be added on alternate sides with plane of chamber addition enlarging gradually to 180° or more in the adult; a few last chambers added in a single plane and showing fragments of 2—3 older chambers of quinqueloculine stage in the middle of the test; chambers with floor at least in mature stage; aperture oval-elongate, flush with the surface, with a long tooth consisting of Y-shaped septum and a thin platform.

*Remarks.* — It differs from *Lachlanella* in having chambers with floor in the adult and in producing the massiline stage; it differs from *Cycloforina* in having the elongate, not circular aperture, the massiline stage and the chamber floor in mature stage. Cretaceous to Recent.

## Genus *Lachlanella* Vella, 1957, emend.

*Type species: Quinqueloculina (Lachlanella) cooki* Vella, 1957.

*Synonym: Quinqueloculina* d'Orbigny, 1826, pars.

*Diagnosis.* — Test with internal structure as in *Quinqueloculina* but more regularly coiled and with subquadrate chambers without floor; the massiline stage is absent; 5 chambers visible externally; aperture elongate with subparallel sides and typically reflexed lip and a tooth consisting of a long, slender septum and a small V-shaped platform.

*Remarks.* — It resembles *Quinqueloculina* in its chamber arrangement but differs in its elongate aperture with subparallel sides and in lacking chamber floor and massiline stage in the adult. Cretaceous to Recent.

## Genus *Cycloforina* n.gen.

(Pl. XII, Fig. 3)

*Type species: Quinqueloculina contorta* d'Orbigny, 1846.

*Synonym: Quinqueloculina* d'Orbigny, 1826, pars.

*Derivatio nominis:* Lat. *cyclicus* — circular, *foris* — gate.

*Diagnosis.* — Test with internal structure as in *Quinqueloculina* but more regularly coiled; chambers without floor; always 5 chambers visible externally; aperture typically at the extended end of the final chamber, circular, with a short, bifid or squareshaped tooth.

*Remarks.* — It differs from *Quinqueloculina* and *Lachlanella* in having circular, closed aperture and a short tooth. Jurassic to Recent.

## Subfamily **Miliolinellinae** Vella, 1957, emend.

*Diagnosis.* — Chambers one-half coil in length, typically in kryptoquinqueloculine arrangement at least in juvenile stage, e.g. three outer chambers are completed with two internal chambers of previous whorl in the quinqueloculine arrangement; later chambers may be added in triloculine arrangement in planes of coiling 115—130° apart, or pseudotriloculine with one angle between the three last chambers $< 90°$, or biloculine in planes of coiling increasing to 180°; the initially kryptoquinqueloculine or triloculine stages may be lacking; 3 or 2 chambers visible externally; chambers not subdivided. Jurassic to Recent.

### Genus *Miliolinella* Wiesner, 1931, emend.

*Type species: Vermiculum subrotundum* Montagu, 1803.
*Synonym: Scutuloris* Loeblich & Tappan, 1953.

*Diagnosis.* — Test with kryptoquinqueloculine juvenile stage in both microspheric and megalospheric generations but with three last chambers arranged in pseudotriloculine order, with one angle $< 90°$; the swinging of coiling axis in the ontogeny is observed; test outline nearly circular or broadly oval in cross-section; 3 chambers visible externally; aperture semicircular or transversely enlarged, nearly filled with a flap-like tooth. Oligocene to Recent.

*Remarks.* — It differs from *Triloculina* in having semicircular aperture filled with a flap-like tooth.

### Genus *Affinetrina* n.gen.
(Pl. XIII, Figs. 4, 5)

*Type species: Triloculina planciana* d'Orbigny, 1839.
*Synonym: Triloculina* d'Orbigny, 1826, pars.
*Derivatio nominis*: Lat. *affinis* — related, *tri* — three; related with *Triloculina*.

*Diagnosis.* — Test with internal structure as in Triloculina but with an oval or flattened rather than triangular outline in cross-section, and with

high slitlike aperture nearly filled with a long, slender tooth, slightly enlarged at the end; 3 chambers visible externally. Miocene to Recent.

*Remarks.* — It differs from *Triloculina* in its narrow, high aperture shape with a long tooth and in its oval outline in crosssection.

## Genus *Crenatella* n.gen.
(Pl. XLII, Fig. 6)

*Type species: Crenatella mira* n.gen. n.sp.
*Synonym: Triloculina* d'Orbigny, 1826, pars.
*Derivatio nominis*: Lat. *crenatus* = crenate.

*Diagnosis.* — Test nearly circular, with rouded outline; 3 chambers externally visible; internal structure initially pseudotriloculine, later kryptoquinqueloculine, with a tendency to arrange the last two chambers in a single plane; aperture like in *Miliolinella*, but with crenulate border of the last chamber indenting with the sickle-shaped tooth. Miocene.

*Remarks.* — It differs from *Miliolinella* in possessing crenulate border of the last chamber and tooth.

## *Crenatella mira* n.gen., n.sp.
(Pl. XIII, Figs. 6—8, Text-figs. 14)

*Holotypus*: Pl. XIII, Fig. 6.
*Paratypi*: Pl. XIII, Figs. 7, 8.
*Locus typicus*: Niskowa near Nowy Sącz.
*Stratum typicum*: Miocene, Tortonian, Badenian.
*Derivatio nominis*: Lat. *mirus* — strange.

*Material.* — over 50 specimens stored in the Department of Paleontology and Stratigraphy of the Academy of Mining and Metallurgy in Cracow, Poland (No. 200, sections No. 384—389).

Dimensions: length 0.3—0.5 mm, breadth 0.2—0.4 mm.

*Diagnosis.* — Shape nearly circular, periphery broadly rounded, 3 chambers visible from outside; internal structure initially pseudotriloculine, then kryptoquinqueloculine, with a tendency to place the last chambers in a single plane; aperture transverse-slitlike, like in *Miliolinella*, but with irregular crenulate border of the chamber edge indenting with the sickle-shaped tooth.

*Description.* — Shape of the test nearly circular, periphery broadly rounded; chambers broad, semicircular, the middle chamber irregularly oval, convex; sutures slightly depressed, bordered; wall thick; surface smooth, polished; aperture a little oblique, transverse slit throughout the width of the chamber, with the edges crenulate and with the tooth in the shape of a sickle with crenulate border or with no tooth.

*Variability.* — The variability is seen in the various shape of the chambers and in the square or straight position of the aperture with respect to the previous chamber. The aperture is in some specimens nearly closed by indentations between finger-like projections of final chamber and a tooth (Pl. XIII, Fig. 8). Some specimens are without tooth and the aperture is open, bordered with the serrate edge of the last chamber.

*Dimorphism and ontogeny.* — Sectioned specimens are probably of micro generation, with proloculus sizes of 20—40 μ. The internal structure initially pseudotriloculine, with one angle between last three chambers $< 90°$ and two angles $> 130°$; in the mature stage kryptoquinqueloculine or nearly planospiral, with two last chambers arranged in a nearly single plane. The chamber outline semicircular in juvenile stage, in the mature stage it becomes sickle-shaped. Sometimes a deviation of the coiling axis in the juvenile stage is seen.

*Remarks.* — It differs from *Miliolinella subrotunda* (Montagu) in having smaller size of the test and crenulate border of the aperture and tooth.

## Genus *Sinuloculina* n.gen.

(Pl. XII, Figs. 4, 5)

*Type species: Biloculina cyclostoma* Reuss, 1850.

*Synonym: Triloculina* d'Orbigny, pars, *Biloculina* d'Orbigny, pars.

*Derivatio nominis*: Lat. *sinus* — sine, *loculus* — chamber; chamber arranged in sinusoidal curve.

*Diagnosis.* — Test initially with kryptoquinqueloculine chamber arrangement, later chambers added in planes of coiling increasing irregularly to 180° or more, so that alternating chambers form the sinusoid curve in sections; three proloculus sizes are distinguished; chambers without floor, broadly overlapping the preceding chamber and giving externally triloculine or biloculine appearance; aperture large, rounded or oval, usually bordered with a thick rim, filled with a thick, bifid tooth, protruding over the aperture edge. Cretaceous to recent.

*Remarks.* — It differs from *Massilina* in its kryptoquinqueloculine, not quinqueloculine juvenile stage, in lacking chamber floor and in its rounded aperture shape; it differs from *Triloculina* in lacking triloculine stage in the adult and in its broadly rounded, not triangular outline of the test.

## Genus *Triloculina* d'Orbigny, 1826, emend.

*Type species: Miliolites trigonula* Lamarck, 1804.

*Diagnosis.* — Test initially with kryptoquinqueloculine chamber arrangement at least in microspheric generation, later chambers pseudotriloculine or triloculine; test shape equilateral-triangular or ovate-triangular in

cross-section; the early kryptoquinqueloculine stage in megalospheric generation may be lacking; three proloculus sizes are recognized; 3 chambers visible externally; aperture rounded with a short, bifid tooth. Jurassic to Recent.

*Remarks.* — It differs from *Affinetrina*, *Crenatella*, *Varidentella* and *Miliolinella* in its round aperture with a short, bifid tooth and its triangular cross-section; from *Sinuloculina* in lack of planospiral stage in the adult and also in triangular cross-section.

## Genus *Varidentella* n.gen.

(Pl. XIII, Figs. 1, 2, 3)

*Type species: Miliolina reussi* Bogdanowich, 1952.
*Synonym: Quinqueloculina* d'Orbigny, 1826, pars.
*Derivatio nominis*: Lat. *varius* — variable, *dens* — tooth.

*Diagnosis.* — Test with internal structure similar to *Quinqueloculina*, but with a tendency to kryptoquinqueloculine chamber arrangement and to turn off the coiling axis about 90° after forming a few initial chambers or just after proloculus and sometimes returning to the previous direction; 3, 4 or 5 chambers visible externally; aperture semicircular to slit-like, transverse, square, with broad, quadrangular tooth often transformed into a narrow band or with no tooth. Miocene to Recent.

*Remarks.* — It differs from *Miliolinella* in having the quadrangular tooth instead of a flap filling the aperture and from *Quinqueloculina* and *Cycloforina* in the ability to turn coiling axis in the ontogeny, in a tendency to kryptoquinqueloculine chamber arrangement and in the transverse position of the aperture and tooth. Probably the transitional form to Miliolinellinae.

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EWA ŁUCZKOWSKA

## MILIOLIDAE (FORAMINIFERIDA) Z MIOCENU POLSKI CZĘŚĆ I. PODSTAWY KLASYFIKACJI

*Streszczenie*

Badając Miliolidae z miocenu Polski zwrócono uwagę na to, że u różnych gatunków, zaliczanych zwykle do tego samego rodzaju, widoczne jest znaczne zróżnico-

wanie w wykształceniu ujścia i budowy wewnętrznej. Zróżnicowanie to pozwoliło na wydzielenie dwu grup o odrębnych cechach morfologicznych i ontogenetycznych, które dały podstawę do zrewidowania dotychczasowej klasyfikacji rodziny Miliolidae.

Pierwsza grupa obejmuje formy o wewnętrznej budowie kwinkwelokulinowej, z kątami przyrostu komór około 140° i conajmniej pięcioma komorami widocznymi na zewnątrz. Należą tu przede wszystkim formy o cechach typowych dla rodzaju *Quinqueloculina*, tj. z podłużnie owalnym ujściem i długim, prostym lub rozdwojonym zębem oraz posiadające właściwość budowania komór z dnem. Te same cechy obserwuje się u form należących do rodzaju *Massilina*, którego młodociane stadium kwinkwelokulinowe jest nie do odróżnienia od innych kwinkwelokulin. Ponieważ istnieje szereg form przejściowych między obu rodzajami, uznano formy massilinowe za stadium dojrzałe (lub starcze?) form kwinkwelokulinowych. W konsekwencji rodzaj *Massilina* (jako młodszy) włączono do synonimów rodzaju *Quinqueloculina*, proponując zaznaczenie ich obecności w taksonomii przez litery MS — massilinowe stadium ontogenetyczne i QS — kwinkwelokulinowe stadium ontogenetyczne, umieszczane przy odpowiednich formach.

Inne okazy kwinkwelokulinowe, nie posiadające podłużnie owalnego ujścia i cechy wytwarzania komór z dnem, wyróżniono jako należące do odrębnych rodzajów: *Lachlanella* Vella, 1957, którego cechą charakterystyczną jest obecność podłużnie szparowatego ujścia z równoległymi brzegami i długim, prostym zębem, oraz *Cycloforina* n.gen., posiadający okrągłe ujście z krótkim zębem, umieszczone na końcu przedłużonej nieco ostatniej komory.

Drugą grupę stanowią formy o wewnętrznej budowie kryptokwinkwelokulinowej, tj. posiadające widoczne na zewnątrz 3 komory, które w połączeniu z dwiema niewidocznymi na zewnątrz komorami poprzedniego zwoju tworzą cykl kwinkwelokulinowy, z kątami przyrostu komór ±140°. W stadium dojrzałym okazy tej grupy mogą mieć budowę trilokulinową, tj. z kątami przyrostu komór ±120°, względnie pseudotrilokulinową, tj. nieregularnie trilokulinową, z dwoma kątami $> 130°$ i jednym kątem $< 90°$, mierzonymi między trzema komorami ostatniego zwoju. W tej grupie wyróżniono 4 nowe rodzaje: *Varidentella* n.gen., z poprzecznie półkolistym ujściem i taśmowatym, niskim zębem oraz z charakterystyczną cechą obrotu osi zwoju o około 90° w ciągu ontogenezy; *Affinetrina* n.gen., z podłużnie szparowatym ujściem i długim zębem jak u *Lachlanella; Sinuloculina* n.gen. z okrągłym ujściem i krótkim, rozdwojonym zębem jak u *Triloculina* i *Cycloforina*, ale z tendencją do ułożenia ostatnich komór w jednej płaszczyźnie; *Crenatella* n.gen. o budowie wewnętrznej jak u *Miliolinella*, lecz posiadający poprzecznie szparowate ujście z karbowanym brzegiem i podobnie karbowanym, sierpowatym zębem. Opisano również nowy gatunek *Crenatella mira*, jako typowy dla rodzaju *Crenatella*.

W budowie wewnętrznej stwierdzono obecność w obu grupach 3-ch generacji o różnej wielkości proloculus, mikro, mega I i mega II. Istnieją również gatunki o niezróżnicowanych wielkościach proloculus, należące do generacji mikro lub mega I.

Zaproponowano nowy układ w klasyfikacji podrodzin w obrębie rodziny Miliolidae. Podrodzina Quinqueloculininae rozpatrywana jest jako obejmująca rodzaje pierwszej grupy, tj. o budowie kwinkwelokulinowej conajmniej w stadium począt-

kowym, z 5-ma lub więcej komorami widocznymi na zewnątrz. Podrodzina Miliolinellinae obejmuje rodzaje drugiej grupy, o budowie kryptokwinkwelokulinowej, trilokulinowej lub pseudotrilokulinowej, z trzema lub dwiema komorami widocznymi na zewnątrz. Podrodzina Fabulariinae pozostaje nie zmieniona, ze względu na skomplikowaną budowę wewnętrzną komór. Podrodziny Miliolinae i Tubinellinae uległy likwidacji, gdyż obejmują formy o poprzednich typach budowy wewnętrznej. Kryterium kształtu ujścia uznano za cechę taksonomiczną rodzaju, nie nadającą się do klasyfikacji wyższego rzędu, np. podrodzin.

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ЭВА ЛУЧКОВСКА

## MILIOLIDAE (FORAMINIFERIDA) ІЗ МИОЦЕНА ПОЛЬШИ ЧАСТЬ I. ВОПРОСЫ КЛАССИФИКАЦИИ

*Резюме*

В процессе исследования Miliolidae из миоцена Польши было обращено внимание на то, что у разных видов, относимых обычно к одному роду, отмечаются существенные различия в развитии устья и внутреннем строении. На основании этих особенностей удалось выделить две группы с различными морфологическими и онтогенетическими признаками, которые заставляют пересмотреть принятую классификацию семейства Miliolidae.

К первой группе относятся формы с квинквелокулиновым внутренним строением, с нарастанием камер под углом около 140° и по крайней мере пятью камерами, наблюдающимися с внешней стороны. Сюда относятся, в первую очередь, формы, характеризующиеся типичными чертами рода *Quinqueloculina:* удлиненно овальным устьем и длинным, простым или раздвоенным зубом, обладающие свойством образования камер с дном. Такие же признаки наблюдаются у форм, относящихся к роду *Massilina,* юная, квинквелокулиновая стадия которых не отличима от других квинквелокулин. В связи с тем, что между этими родами существует ряд промежуточных форм, принято считать масслиновые формы в качестве взрослой (или старческой?) стадии квинквелокулиновых форм. Соответственно род *Massilina* (как младший) решено отнести к синонимам рода *Quinqueloculina,* предлагая различать их в таксономии буквенными индексами: MS — массилиновая онтогенетическая стадия и QS — квинквелокулиновая онтогенетическая стадия, помещаемыми при названиях соответствующих форм.

Другие квинквелокулиновые особи, не обладающие удлиненно овальным устьем и свойством образования камер с дном, рассматриваются как представители других родов: *Lachlanella* Vella, 1957, характерным признаком которого

является щелевидное устье с параллельными краями и длинным, простым зубом, и *Cycloforina* n. gen., отличающегося округлым устьем с коротким зубом, которое располагается на конце немного удлиненной последней камеры.

К второй группе относятся формы с криптоквинквелокулиновым строением, у которых три камеры, заметные с внешней стороны, совместно с двумя незаметными камерами предыдущего оборота, образуют квинквелокулиновый цикл с углом нарастания камер ±140°. Во взрослой стадии особи этой группы могут обладать трилокулиновым строением, характеризующимся нарастанием камер под углом ±120°, или же псевдотрилокулиновым, т. е. нерегулярным трилокулиновым строением, с двумя углами >130° и одним углом <90°, замеряемыми между тремя камерами последнего оборота. В этой группе определены 4 новых рода: *Varidentella* n. gen., с поперечным полукруглым устьем, низким, ленточным зубом, отличающийся характерным свойством поворота оси оборота почти на 90° в течение онтогенеза; *Affinetrina* n. gen., с продольным, щелевым устьем и длинным зубом как у *Lachlanella; Sinuloculina* n. gen., с округлым устьем и коротким, раздвоенным зубом как у *Triloculina* и *Cycloforina*, но с тенденцией расположения последних камер в одной плоскости; *Crenatella* n. gen., с внутренним строением как у *Miliolinella*, но обладающий поперечным щелевидным устьем с нарезанным краем и серповидным, тоже нарезанным зубом. Кроме того, описан новый вид *Crenatella mira*, типичный для рода *Crenatella*.

По внутреннему строению представителей обеих групп определены три генерации, характеризующиеся разной величиной пролокулюма: микро, мега I и мега II. Встречаются также виды с величиной пролокулюма, не разрешающей отнести их к определенным генерациям микро или мега I.

Предложена новая система в классификации подсемейств внутри семейства Miliolidae. Подсемейство Quinqueloculininae, охватывающее роды первой группы, которые характеризуются квинквелокулиновым строением по крайней мере в начальной стадии, с пятью и более камерами, видными с внешней стороны. Подсемейство Miliolinellinae охватывает роды второй группы, отличающиеся криптоквинквелокулиновым, трилокулиновым или псевдотрилокулиновым строением, с тремя или двумя камерами, видными с внешней стороны. Подсемейства Miliolinae и Tubinellinae устраняются, так как они включают формы, характеризующиеся перечисленными выше типами строения. Форма устья признается таксономическим признаком рода, не пригодным для высших таксонов, например подсемейств.

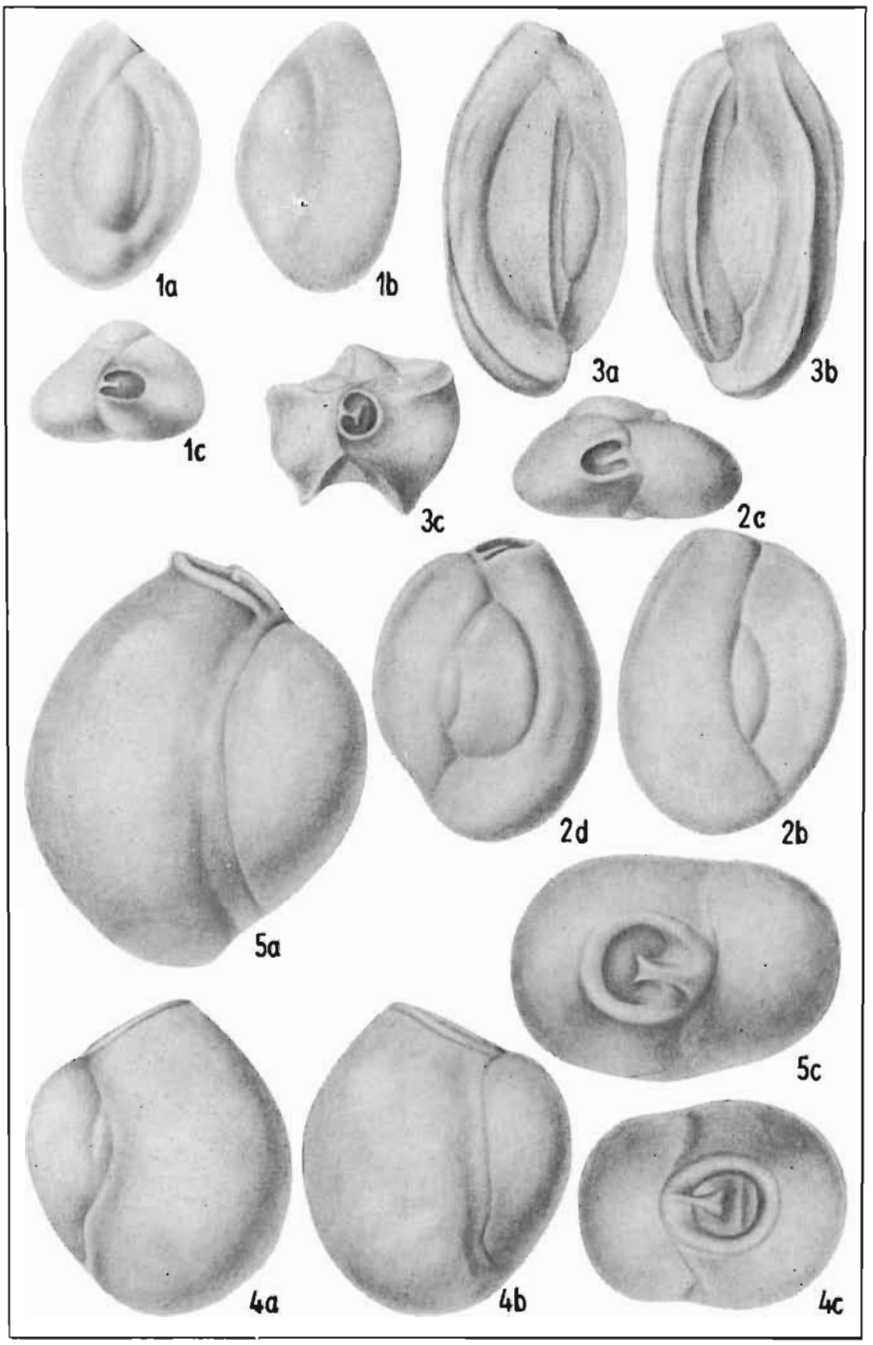
## EXPLANATION OF PLATES

### Plate XII

Fig. 1. *Quinqueloculina seminulum* (Linné). Recent, Black Sea; typical form; ×90.
Fig. 2. *Quinqueloculina seminulum* (Linné). Recent, Black Sea; "Massiline" form; ×90.
Fig. 3. *Cycloforina contorta* (d'Orbigny). Miocene, Gliwice Stare (F-150/1); ×90.
Fig. 4. *Sinuloculina cyclostoma* (Reuss). Miocene, Węglinek; typical form with three chambers visible (F-176/1); ×90.
Fig. 5. *Sinuloculina cyclostoma* (Reuss). Miocene, Węglinek; form with biloculine appearance (F-176/2); ×90.
*a*, *b* — opposite sides, *c* — apertural view.

### Plate XIII

Fig. 1. *Varidentella reussi* (Bogdanowich). Miocene, Machów 255 borehole (near Tarnobrzeg), depth 66,7 m; typical form (F-138/1); ×102.
Fig. 2. *Varidentella reussi* (Bogdanowich). Miocene, Machow 255 borehole, depth 56,0 m; gerontic form (F-138/2); ×102.
Fig. 3. *Varidentella reussi* (Bogdanowich); Miocene, Zrecze 3 borehole (near Chmielnik), depth 101,90 m; juvenile stage (F-138/3); ×102.
Fig. 4. *Affinetrina planciana* (d'Orbigny). Miocene, Gliwice Stare; "triloculine" form (F-179/2); ×90.
Fig. 5. *Affinetrina planciana* (d'Orbigny). Miocene, Gliwice Stare; typical form (F-179/); ×90.
Fig. 6. *Crenatella mira* n.gen. n.sp. Miocene, Niskowa near Nowy Sącz; holotype (F-200/1); ×147.
Fig. 7. *Crenatella mira* n.gen. n.sp. Miocene, Niskowa near Nowy Sącz; paratype with elongate test (F-200/2); ×147.
Fig. 8. *Crenatella mira* n.gen. n.sp. Miocene, Niskowa near Nowy Sącz; paratype, juvenile form (F-200/3); ×147. *a*, *b* — opposite sides, *c* — apertural view.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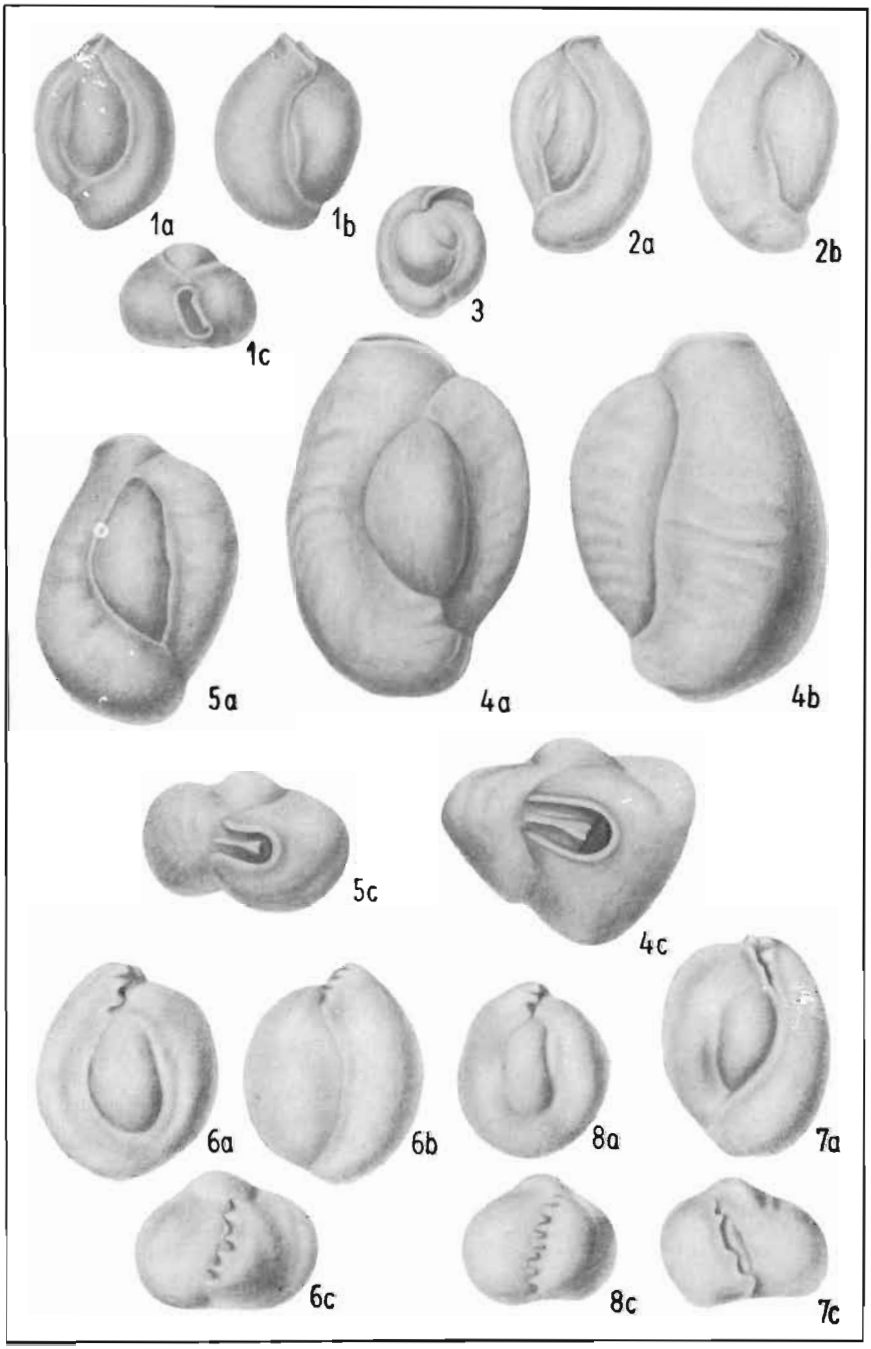
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