

COILING MODES IN THE FAMILY PLECTORECURVOIDIDAE (FORAMINIFERIDA)

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Abstract: Specimens of *Pokornyammina*, *Thalmanammina* (?) and *Plectorecurvoides* were analysed for this study. Taxa with a biserial axis are coiled in the same manner as those with a uniserial axis. In *Pokornyammina irregularis* (Geroch) the biserial axis can be coiled in a “streptospiral thalmanamminiform” manner or a “streptospiral *sensu stricto*” manner. The shape of the chamber and the presence of biserial chamber arrangement lead us to believe that *Thalmanammina neocomiensis* should be transferred to the family *Plectorecurvoididae*.

Abstrakt: Przedmiotem badań autora była analiza sposobu ułożenia komór u otwornic aglutynujących należących do *Pokornyammina*, *Thalmanammina* i *Plectorecurvoides*. Wykazano brak różnic w sposobie zwinienia skorupki u form jedno- i dwuseryjnych. Otwornice z gatunku *Pokornyammina irregularis* (Geroch) charakteryzuje dwojaki sposób zwinienia dwuseryjnej części skorupki: “streptospiralny typu *Thalmanammina*” oraz “streptospiralny *sensu stricto*”. Biorąc pod uwagę kształt komór oraz dwuseryjny sposób ułożenia komór autor sugeruje, że *Thalmanammina neocomiensis* powinna być klasyfikowana w obrębie rodziny *Plectorecurvoididae*.

Key words: agglutinated Foraminifera, Plectorecurvoididae, systematic paleontology.

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INTRODUCTION

In Loeblich and Tappan’s monumental book, “Foraminiferal genera and their classification”, the family *Plectorecurvoididae* is represented by only one genus, *Plectorecurvoides*. This taxon has a biserial test “with a biserial axis planispirally enrolled”, similar to that of calcareous Cassidulinidae (Loeblich & Tappan, 1988). In 1994, Neagu and Platon described the new genus *Pokornyammina* and assigned it to the family *Plectorecurvoididae*. *Pokornyammina* differs from *Plectorecurvoides* in having a biserial axis streptospirally enrolled and sometimes in losing its biseriality during the later stages of growth. Geroch (1962) described *Thalmanammina neocomiensis*, which is a species that by means of its polygonal chambers and numerous biserial growth stages resembles *Plectorecurvoides*. Geroch recognized that disturbances of biseriality may occur in “different phases of growth of the chambers” in *Plectorecurvoides irregularis*.

The purpose of this paper is to carry out detailed observations of the coiling mode of two common species in the flysch Carpathians, *Thalmanammina neocomiensis* Geroch and *Plectorecurvoides irregularis* Geroch, in order to more precisely determine their generic affinity. The material used in this study has been collected from Aptian–Albian deposits of the Eastern Carpathians (Bota Valley, Bota Mare Valley, Macla Valley – Romania).

DISCUSSION

A “problem” that often occurs in micropaleontological literature is that of using the descriptive terms. Thus, it has been noticed (Platon & Kaminski, in preparation) that the term “streptospiral” has had several meanings in the literature. In general, any coil that is neither planispiral nor trochospiral has been described as streptospiral (twisted spiral). “Streptos” was borrowed from Greek and means “twined”. In the type species of *Recurvoides*, *Recurvoides contortus* Earland, the streptospiral enrollment consist of “an abrupt change in plane of coiling of 90 degrees” (Loeblich & Tappan, 1988). The planes of coiling are perpendicular one to another like in *Thalmanammina* but they always intersect along the same axis and thus only two planes may be distinguished (Fig. 1a). This manner of coiling has been termed “streptospiral recurvoidiform”. However, most of the fossil species of *Recurvoides* described in paleontological literature do not change their plane of coiling suddenly (e.g., *R. imperfectus* (Hanzlíková)). These taxa show a manner of coiling similar – but not exactly the same – to that described by Banner and Blow (1967) for the genus *Pulleniatina* rather than to that of *R. contortus*. This coiling type has been called “streptospiral *sensu stricto*” (Fig. 1b). In *Thalmanammina*, different planes of coiling, perpendicular one to another, intersect along different axes (Fig. 1c). Thus, more than two planes of coiling may occur. This particulate mode of coiling has been termed “streptospiral

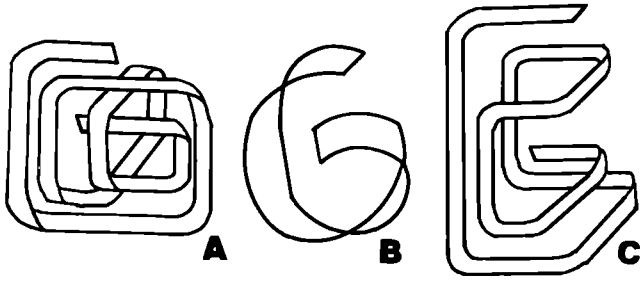


Fig. 1. Mode of coiling: (A) *Recurvoides contortus* like mode of coiling – “streptospiral recurvoidiform”; (B) “streptospiral *sensu stricto*” mode of coiling; (C) *Thalmannammina* like mode of coiling – “streptospiral thalmannamminiform”

thalmannamminiform”. Although the angles at which planes of coiling change their orientation might be less than 90 degrees, the change is still sudden and distinguishable from that of *Recurvoides*.

Taxa with a biserial axis show manners of coiling similar to those with uniserial axis. For example, *Plectorecurvoides alternans* Noth has a biserial axis planispirally enrolled. In *Pokornyammina clara* Neagu et Platon, the biserial axis is streptospirally enrolled but no abrupt changes have been noticed.

Several specimens of *Pokornyammina*, (?)*Thalmannammina* and *Plectorecurvoides* have been analysed for the purposes of this study. These taxa come from samples collected from ?Aptian–Albian deposits from the Eastern Carpathians (Romania). Almost all specimens of *Plectorecurvoides* belong to the species *P. alternans* (Fig. 2). One particular form of *Plectorecurvoides* is illustrated in Figure 3.

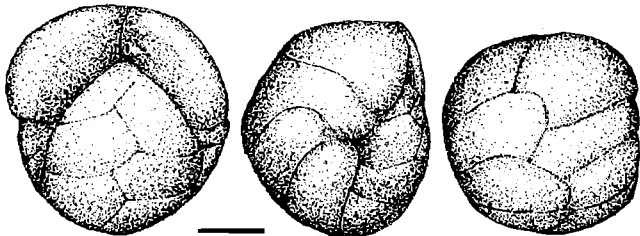


Fig. 2. *Plectorecurvoides alternans* Noth; biserial axis planispirally enrolled; Albian, Macla Valley. Scale bar = 200 µm

This form differs from *P. alternans* in having a reduced number of chambers. Only eight biserially arranged chambers form the last whorl. The biserial axis is planispirally en-

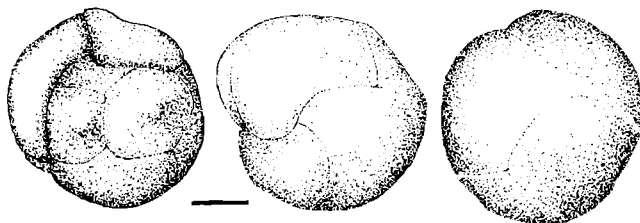


Fig. 3. *Plectorecurvoides* sp. 1; biserial axis planispirally enrolled; Albian, Macla Valley. Scale bar = 200 µm

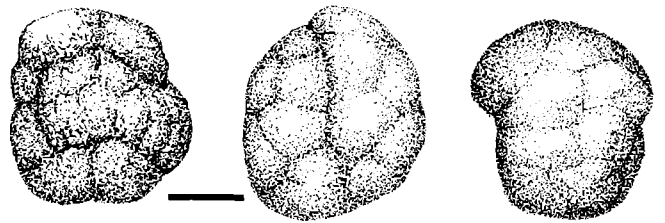


Fig. 4. *Pokornyammina irregularis* Geroch; biserial axis streptospirally enrolled (“streptospiral thalmannamminiform” mode of coiling); Albian, Macla Valley. Scale bar = 200 µm

rolled like in *P. alternans*. Unfortunately, only one specimen showing these characteristics has been found. Therefore a detailed study could not be undertaken.

The analysed *Pokornyammina* specimens show two basic styles of coiling. The first one (Fig. 4) is reminiscent of *Thalmannammina meandertornata* Neagu et Tocarjescu, from which, however, it differs by its biserial axis. Two planes of coiling, perpendicular to one another, may be observed on the external part of these specimens. The way in which early chambers are disposed relatively to the rest of the test could not be observed. The second one (Fig. 5), more prevalent in our samples, does not show abrupt

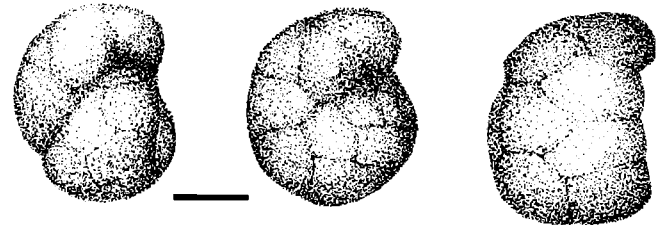


Fig. 5. *Pokornyammina irregularis* Geroch; biserial axis streptospirally enrolled (“streptospiral *sensu stricto*” mode of coiling); Aptian, Bota Mare Valley. Scale bar = 200 µm

changes of coiling direction. The biserial axis changes its direction in a “streptospiral *sensu stricto*” manner. However, intermediate forms between the two above mentioned types have been observed. It is worth mentioning that uniserial stages of growth have been observed in some of the individuals. In Figure 6, it may be observed that chambers 9, 10, 11 and 13, 14, 15 are not biserially arranged.

All specimens of *Pokornyammina* are assigned to the species *Pokornyammina irregularis* (Geroch). The size of specimens, the number of chambers, the chamber shape, the short uniserial stages all correspond to this taxon as it was originally described by Geroch. Geroch did not mention anything about a streptospiral manner of coiling of a biserial axis in the case of the *Plectorecurvoides irregularis*. According to his diagnosis, the last whorl of *Plectorecurvoides irregularis* has a biserial axis planispirally enrolled that might be disturbed in its initial part by chambers uniserially connected. This corresponds to a limited number of specimens in our samples. The variability of the taxon we are referring to is much larger and includes biserial axis streptospirally enrolled.

Alternating biserial and uniserial stages of growth have

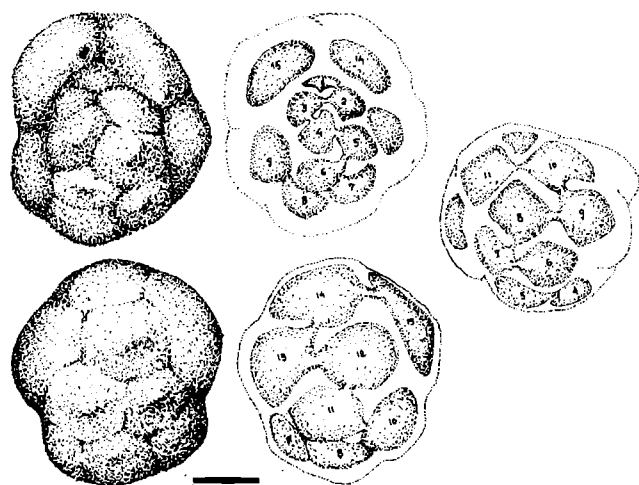


Fig. 6. *Pokornyammina irregularis* Geroch; 9-10-11 and 13-14-15: uniserial stages of growth; ?Aptian, Bota Mare Valley. Scale bar = 200 μ m

been observed in *Thalmannammina neocomiensis* (Geroch, 1962). Biserial stages as well as polygonal chambers of *Thalmannammina neocomiensis* are common characteristics of Plectorecurvoidea. However, numerous uniserial sets of chambers resemble *Thalmannammina* rather than one of *Plectorecurvoidea* taxa. The biserial arrangement of chambers in *Thalmannammina neocomiensis* led Geroch (1962) to speculate that *Plectorecurvoidea* derived from *Thalmannammina* which is geologically older. There is no doubt that *Thalmannammina neocomiensis* (Fig. 7), by means of its characters, shared by both *Thalmannammina* and *Plectorecurvoidea*, provides sufficient evidence for such an interpretation. However, the problem herein is to determine the genus to which this species belongs. As already mentioned, uniserial stages of growth have been recognized in the *Plectorecurvoidea* family (Geroch, 1962; Neagu & Platon, 1994). The shape of the chamber as well as the presence of the biserial chamber arrangements lead us to believe that *Thalmannammina neocomiensis* should be transferred to the family *Plectorecurvoidea*. Before doing so, one should first assign this species to one of the previously described genera of this family or describe a new genus. It is undoubtedly very tempting to describe a new taxa, but in my opinion too many taxa (especially species) are already described in paleontological literature. A quantitative analysis might be helpful in evaluating the entire morphologic variability of this species and in making a decision with regards to its generic position. Assessing the dominance of biserial or uniserial chamber arrangement type is the first step that should be accomplished. Most of our specimens of *Thalmannammina neocomiensis* have more chambers with "biserial" tube-like connections (Fig. 8) than chambers with "uniserial" tube-like connections (the ratio is about 10:8) but that is based on a rather limited number of specimens. The morphology of *Thalmannammina neocomiensis*, especially the overall type of coiling and the dominance of either biserial or uniserial tube like connections can hardly be documented for a statistically significant

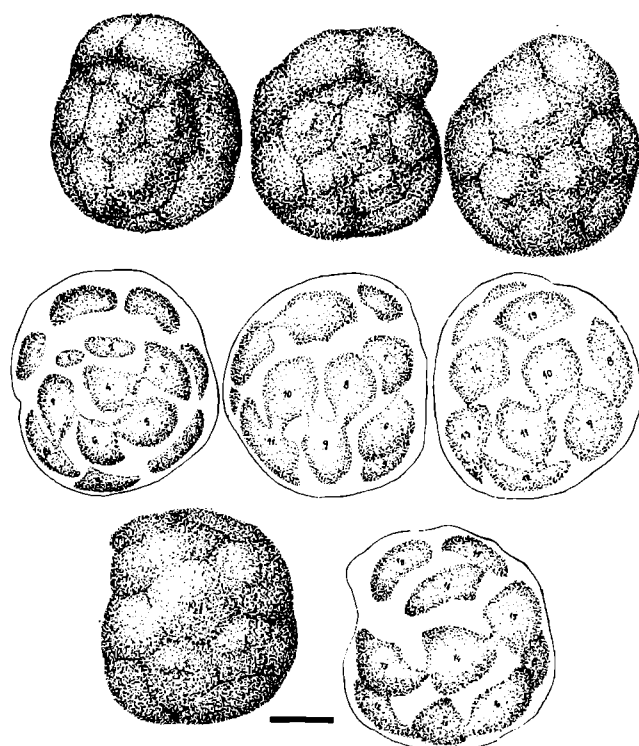


Fig. 7. *Thalmannammina* (?*neocomiensis*); alternating biserial and uniserial streptospirally enrolled; ?Aptian, Bota Mare Valley. Scale bar = 200 μ m

number of individuals. Furthermore, the analysis of only one individual is always very tedious. It can take hours until one can completely understand the whole morphology of just one specimen. On the other hand, even in the best preserved samples there are rare individuals in which all chambers and their tube-like connections can be observed.

CONCLUSIONS

Streptospirally enrolled biserial axis and alternating uniserial growth stages are undoubtedly characteristics of the family *Plectorecurvoidea*. Two types of streptospiral enrollment of the biserial axis may be found in *Pokornyammina irregularis* (Geroch): "streptospiral thalmannammini-form" and "streptospiral *sensu stricto*". Polygonal chambers and biserial stages of growth in *Thalmannammina neocomiensis* Geroch are common in the genus *Pokornyammina*, and in general, in the *Plectorecurvoidea* family.

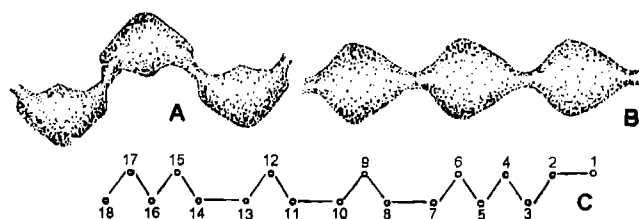


Fig. 8. Tube like connections and chamber arrangements in *Thalmannammina* (?*neocomiensis*): (A) Biserial tube like connections; (B) Uniserial tube like connections; (C) Alternating uniserial and biserial chamber arrangements

Therefore, this species should belong to the family *Plectorecurvoididae* rather than to the family *Ammosphaeroidinidae*.

SYSTEMATIC PALEONTOLOGY

Order FORAMINIFERIDA Eichwald, 1830

Suborder TEXTULARIINA Delage and Herourard, 1896
Superfamily HAPLOPHRAGMIACEA Eimer and Fickert,
1899

Family AMMOSPHAEROIDINIDAE Cushman, 1927
Subfamily RECURVOIDINAE Alekseychik - Mitskevich,
1973

Genus *Thalmanammina* Pokorny, 1951

Thalmanammina neocomiensis Geroch, 1962

Fig. 7

1959. *Plectorecurvoides* sp.: Geroch, p. 118, pl. 12, fig. 12.
1962. *Thalmanammina neocomiensis* Geroch: Geroch, 1962, p.
282, figs. 1, 3 (5-8).

Dimensions (in mm): 0.35-0.38.

Occurrence: Bota Mare Valley.

Superfamily SPIROPLECTAMMINACEA Cushman, 1927

Family PLEOCTORECURVOIDIDAE Loeblich
and Tappan, 1964

Genus *Plectorecurvoides* Noth, 1952

Plectorecurvoides alternans Noth, 1952

Fig. 2

1952. *Plectorecurvoides alternans* Noth: Noth, p.117-119, figs.
1,2.

1972. *Plectorecurvoides alternans* Noth: Neagu, p. 13, pl. 2, figs.
22-23.

Dimensions (in mm): 0.32-0.35.

Occurrence: Macla Valley.

Plectorecurvoides sp. 1

Fig. 3

Dimensions (in mm): 0.4.

Occurrence: Macla Valley.

Remarks: This form differs from *P. alternans* in having a reduced number of chambers. Only eight biserially arranged chambers form the last whorl. The biserial axis is planispirally enrolled like in *P. alternans*.

Pokornyammina Neagu et Platon, 1994

Pokornyammina irregularis (Geroch), 1962

Figs. 4-6

1959. *Plectorecurvoides* sp.: Geroch, p. 118, fig. 11.

1962. *Plectorecurvoides irregularis* Geroch: Geroch, p. 286, figs.
2, 3 (9, 10).

Dimensions (in mm): 0.27-0.38.

Occurrence: Bota Valley, Bota Marc Valley, Macla Valley.

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Streszczenie

SPOSÓB ZWIĘCIA KOMÓR W SKORUPKACH OTWORNIC Z RODZINY PLECTORECURVOIDIDAE

Emil Platon

Autor przeprowadził szczegółowe obserwacje sposobu zwięcia komór w skorupkach otwornic u dwóch gatunków, licznie występujących w Karpatach fliszowych, *Thalmanammina neocomiensis* Geroch i *Plectorecurvoides irregularis* Geroch. Celem pracy było określenie wzajemnego powinowactwa tych taksonów.

Termin „streptospiralny”, jest używany w literaturze mikropaleontologicznej z wieloma znaczeniami. Określenia tego używa się najczęściej do sprecyzowania sposobu zwięcia skorupki, która nie jest ani planispiralną ani też trochospiralną. W okazie typowym gatunku *Recurvoides contortus* Earland, streptospiralny sposób zwięcia został opisany jako „wyraźna zmiana w planie zwięcia komór o 90°” (Loeblich & Tappan, 1988). Płaszczyzny zwięcia są prostopadłe jeden do drugiego tak jak u *Thalmanammina* ale zawsze przecinają się wzdłuż tej samej osi i dlatego można wyróżnić tylko 2 płaszczyzny. (Fig. 1a). Autor proponuje nazwać ten sposób zwięcia jako „streptospiralny typu *Recurvoides*”. Niemniej jednak większość okazów opisanych w literaturze jako *Recurvoides* nie wykazuje tej cechy. Charakteryzuje je natomiast ułożenie komór zbliżone do *Pulleniatina* (Banner & Blow, 1967), które autor określa jako „streptospiralny *sensu stricto*” (Fig. 1b). Rodzaj *Thalmanammina* charakteryzuje z kolei obecność więcej niż dwóch płaszczyzn zwięcia komór, pros-

topa-dłych jedna do drugiej i przecinających się wzdłuż wielu osi (Fig. 1c). Ten sposób ułożenia komór został nazwany – „strep-tospiraly typu *Thalmanammina*”.

Taksony u których komory ułożone są dwuseryjnie mają taki sam sposób zwinięcia jak u osobników jednoseryjnych. Autor przeanalizował ten fakt na podstawie okazów należących do trzech rodzajów: *Pokornyammina*, ?*Thalmanammina* i *Plectorecurvoides*. Większość badanych okazów z rodzaju *Plectorecurvoides* należy do gatunku *P. alternans* (Fig. 2). Jeden, również z rodzaju *Plectorecurvoides* (Fig. 5) wykazuje odmienne cechy. Stwierdzono u niego mniejszą liczbą komór, a w ostatnim zwoju znajduje się 8 komór ułożonych dwuseryjnie. Natomiast dwuseryjna oś jest zwinięta planispiralnie, podobnie jak u *P. alternans*.

Autor badał również osobniki należące do *Pokornyammina*, które charakteryzują się dwoma różnymi sposobami ułożenia komór. Pierwszy z nich (Fig. 6) jest podobny jak u *Thalmanammina meandertornata* Neagu et Tocarjescu, różniąc się tylko obecnością dwuseryjnej osi zwinięcia. W zewnętrznej części skorupki widoczne są dwa płany zwinięcia komór, jeden prostopadły do drugiego. Nie widoczna jest natomiast najmłodsza część komór. Drugi ze sposobów zwinięcia (Fig. 7) – o wiele częstszy w badanych okazach – nie wykazuje ostrej zmiany kierunku zwinięcia skorupki. Dwuseryjna oś skorupki zmienia kierunek „strep-tospiralnie *sensu stricto*”. Autor obserwował ponadto inne formy, u których skorupka jest zwinięta w sposób pośredni między opisanymi powyżej. Jest warto podkreślić, że u tych form ko-

mory młodsze ułożone są jednoseryjnie (komory 9-11 i 13-15; Fig. 6).

Wszystkie badane okazy z rodzaju *Pokornyammina* zostały zaklasyfikowane jako *Pokornyammina irregularis* (Geroch). Wielkość okazów, liczba komór, kształt komór u tych osobników są w pełni zgodne z opisem holotypu przedstawionym przez Gerocha (1962). Geroch określił, że u *Plectorecurvoides irregularis* komory w ostatnim zwoju są zwinięte planispiralnie wokół dwóch osi, ale u niektórych okazów mogą być one zniszczone.

Na przemian dwu- i jednoseryjnie zwinięte komory charakteryzują formy z gatunku *Thalmanammina neocomiensis* (Geroch, 1962). Dwuseryjny sposób ułożenia oraz poligonalny kształt komór u *T. neocomiensis* występuje również u form z rodziny *Plectorecurvoididae*. Jakkolwiek często spotykany, jednoseryjny sposób ułożenia komór przypomina bardziej rodzaj *Thalmanammina* niż formy należące do *Plectorecurvoididae*.

Obecność dwuseryjnego układu komór u *Thalmanammina neocomiensis* (Geroch, 1962) pozwala sądzić według autora, że *Plectorecurvoides* wykształcił się na drodze ewolucji od *Thalmanammina*, która jest geologicznie od niego starsza. Według autora *Thalmanammina neocomiensis* (Fig. 7) posiadająca cechy zarówno *Thalmanammina* jak i *Plectorecurvoides* może potwierdzać taką interpretację. Kształt komór oraz dwuseryjnie zwinięta skorupka, to cechy pozwalające zaliczyć *Thalmanammina neocomiensis* do rodziny *Plectorecurvoididae*.