

***Neaguammina* n.gen., A NEW AGGLUTINATED FORAMINIFERAL GENUS FROM THE LOWER CRETACEOUS OF DSDP SITE 263 (INDIAN OCEAN)**

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Abstract: The new genus *Neaguammina* n.gen. is proposed for organically-cemented prolixoplectid foraminifera with trochospiral-triserial-biserial coiling and an interiomarginal aperture. We believe that many taxa that have formerly been assigned to the genus *Gaudryina* can now be placed in *Neaguammina* n.gen.

Abstrakt: Wyróżniono nowy rodzaj *Neaguammina* n.gen. w grupie otwornic aglutynujących z rodziny Prolixoplectidae. Otwornice tego rodzaju charakteryzuje trochospiralno-trójszeregowo-dwuszeregowy układ komór skorpki, ujście u podstawy ostatniej komory oraz ściany aglutynowane cementem organicznym. Autorzy uważają, że niektóre gatunki należące do rodzaju *Gaudryina* można obecnie zaliczyć do rodzaju *Neaguammina* n.gen.

Key words: agglutinated Foraminifera, taxonomy, *Neaguammina* n.gen., Lower Cretaceous.

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INTRODUCTION

It is now nearly universally accepted that one of the fundamental criteria for the suprageneric classification of the agglutinated foraminifera is the composition and microstructure of the cement that binds the test wall (e.g., Loeblich & Tappan, 1989; Bender, 1995). In the past decade numerous studies have emphasized the importance of cement composition as a primary criterion for distinguishing agglutinated foraminiferal genera and supra-generic groups.

In the Lower Cretaceous deep-water sediments of the boreal and austral seas, there are numerous triserial to biserial taxa which, for lack of a better name, have been informally assigned to the genus "*Gaudryina*". Traditionally, the genera "*Gaudryina*" and "*Dorothyia*" have been used for both calcareous and noncalcareous forms. The type species of *Gaudryina* (*G. rugosa* d'Orbigny, 1840) is known to possess a solid noncanalicate agglutinated wall with calcareous cement. Recently, Brönnimann, Whittaker and Zaninetti (1992) have restricted use of the genus *Gaudryina* to encompass only the calcareous forms, and described a new genus to account for the organically cemented forms. Their genus *Caronia* (type species: *Gaudryina exilis* Cushman & Brönnimann, 1948), is a modern brackish-water species de-

scribed from mangrove swamps. If we adopt this restricted definition, the Cretaceous organically-cemented triserial to biserial taxa cannot be placed in *Gaudryina*, or for that matter in the superfamily Textulariina as redefined by Loeblich and Tappan (1989).

We have examined the wall structure and mode of coiling of well-preserved specimens of a new species ("*Gaudryina*" *cuvierensis* Holbourn & Kaminski, 1995), which we recently described from DSDP Site 263 on the Cuvier Abyssal Plain off western Australia. Although we originally only tentatively placed this species in the genus "*Gaudryina*", we conclude that it cannot be placed in any of the previously defined organically-cemented genera known to us from the Lower Cretaceous. We therefore establish the new genus *Neaguammina* n.gen.¹

Materials and methods

We have studied 66 samples from the Lower Cretaceous of DSDP Site 263. Selected specimens were sectioned by mounting them in Ajak on an SEM stub and grinding them on a glass plate with a paste of distilled water and 500-grit abrasive powder. Specimens were photographed on a Zeiss 940 digital SEM at the Micropalaeontology Unit of

¹ Prof. Stanislaw Geroch received a first draft of this article in April 1995, and returned his comments to the first author in a letter dated May 25, 1995, along with specimens from the Carpathian flysch for comparison. It was the last item of correspondence M. A. Kaminski received from his friend and long-term collaborator. This paper is dedicated to his fond memory.

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SYSTEMATIC PALEONTOLOGY

Superfamily VERNEUILINACEA Cushman, 1911

Family PROLIXOPLECTIDAE Loeblich & Tappan, 1985

Genus *Neaguammia* Kaminski,
Holbourn & Geroch, n.gen.

Type species "*Gaudryina*" *cuvierensis* Holbourn & Kaminski, 1995

Etymology: Patronymic, in honour of Prof. Theodor Neagu (University of Bucharest), in recognition of his fine continuing work with the systematics of the prolinoxpectids.

Description: Test elongate, subcircular in cross section, with sub-parallel sides. Coiling initially trochospiral, with up to three whorls of small chambers, quickly becoming triserial, and finally biserial in the adult stage. The triserial part comprises the bulk of the test length. The coiling axis may twist slightly as the coiling reduces from triserial to biserial. Chambers in the biserial part are inflated, with depressed sutures. Aperture is a low arch at the base of the last chamber. Wall is solid, noncanaliculate, composed of a multiple layer of fine mineral grains held together by an organic cement, preserved as silica.

Remarks: The genus *Neaguammia* n.gen. differs from *Dorothyia* Plummer, 1931, in possessing silicified organic cement, rather than calcareous cement, and in its well-developed triserial stage. It additionally differs from *Gaudryina* d'Orbigny, 1839 in possessing a small, initially trochospiral stage. Although *Paragaudryina* Suleymanov is almost certainly noncalcareous, it differs in possessing a areal aperture and in lacking an initial trochospiral stage. The Paleozoic genus *Mooreinella* Cushman & Waters, 1928 differs in having a much reduced triserial part.

The genus *Gaudryinopsis* Podobina, 1975 closely resembles *Neaguammia* n.gen. in possessing an interiomarginal aperture, but its early stage is short, described as either triserial or trochospiral with three chambers per whorl, with inflated and subglobular chambers. In fact, all the specimens illustrated by Podobina (1975, pl. 12) from the Turonian to Santonian of Western Siberia possess a triserial part that is no more than one-third the total length of the adult test. Although Loeblich and Tappan (1987) did not comment on the composition of the wall of *Gaudryinopsis* (type species: *Gaudryina vulgaris* Kipriyanova, 1960), and also included calcareous species such as *Gaudryina gradata* Berthelin, 1880, in the remarks to the original description of *Gaudryinopsis*, Podobina (1975) clearly stated that the wall is agglutinated, "made of grains of quartz with secreted siliceous cement". Podobina assigned a number of the Cretaceous noncalcareous forms to *Gaudryinopsis*, including *Gaudryina filiformis* Berthelin, 1880. In our understanding, the genus *Gaudryinopsis* comprises exclusively organically-cemented forms that have a short triserial part followed by a longer biserial portion (see Holbourn & Kaminski, 1997). The isomorphic calcareous-cemented species *Gaudryina gradata* Berthelin, 1880 is best transferred to the newly emended genus *Kadriayina* Al-Najdi, 1975 (*sensu* Holbourn & Kaminski, 1997).

The genus *Caronia* Brönnimann, Whittaker & Zaninetti, 1992 (type species: *Gaudryina exilis* Cushman & Brönnimann, 1948) was described as "early stage triserial, short, followed by a longer biserial stage. Aperture interiomarginal arch in equatorial position. Wall agglutinated, thin, of the "Trochammina-type". *Caronia* differs from *Gaudryina* by its thin agglutinated wall and organic cement, and differs from *Gaudryinopsis* by the triangular shape of the initial triserial part of the test, and the wholly triserial coiling as revealed in dissected specimens.

Neaguammia n.gen. differs from the Late Cretaceous genus *Gerochammina* Neagu, 1990 in possessing an interiomarginal, rather than areal, aperture; and from *Prolinoxpecta* Loeblich & Tappan, 1985 by the presence of a well-developed triserial stage between the trochospiral and biserial stages. *Pseudomorulaepecta* Neagu & Neagu, 1995 from the Upper Jurassic of Romania was described as possessing a short low trochospirally coiled early stage "with a bulbaceous aspect" immediately followed by a biserial textularoid adult stage. This form has a noncalcareous wall, but differs from both *Neaguammia* and *Gaudryinopsis* in lacking a triserial stage.

Neaguammia cuvierensis (Holbourn & Kaminski, 1995)
Figs. 1–2

1995. "*Gaudryina*" *cuvierensis* Holbourn & Kaminski: Holbourn & Kaminski, p. 454, pl. 8, figs. 6–12.

1997. "*Gaudryina*" *cuvierensis* Holbourn & Kaminski: Holbourn & Kaminski, p. 53, pl. 24, figs. 4a–7b.

Material: Over 60 specimens.

Holotype: Fig. 2a (this paper).

Type-locality and horizon: Lower Cretaceous (probably Hauterivian to Barremian), DSDP Hole 263, Cuvier Abyssal Plain.

Type level: Sample 263-22R-3, 117–121 cm.

Description: Test elongate, subcircular in cross section, with sub-parallel sides. Coiling initially trochospiral, with two or three of small chambers. The initial whorl has five chambers, then coiling quickly becomes triserial, and finally biserial in the adult stage. The triserial portion consists of four to six whorls of chambers increasing in size slowly. The biserial portion, when present, is of variable length but typically consists of only one or two pairs of chambers. The coiling axis may twist slightly as the coiling reduces from triserial to biserial. Chambers are inflated, especially in the biserial portion, with depressed sutures. Aperture is a low arch at the base of the last chamber. Wall is solid, noncanaliculate, composed of a multiple layer of fine mineral grains held together by an organic cement, preserved as silica.

Remarks: We originally tentatively placed this species in the genus "*Gaudryina*", noting that it differs from *Gaudryina* as defined by Loeblich and Tappan (1987) in possessing a noncalcareous wall (Holbourn & Kaminski, 1995). Sections of specimens reveal that the wall is noncanaliculate, comprised of a multiple layer of fine mineral grains, with smooth inner and outer surfaces. In her initial report of the foraminifera from Site 263, Scheibnerová (1974) apparently did not document this taxon. We have found that this species is fairly common in many of our samples from this site.

Stratigraphic distribution: Lower Cretaceous (probably Hau-



Fig. 1. Paratype specimen of "*Gaudryina*" *cuvierensis* Holbourn & Kaminski, 1995; sample 263-22-3, 117–121 cm.; x 30

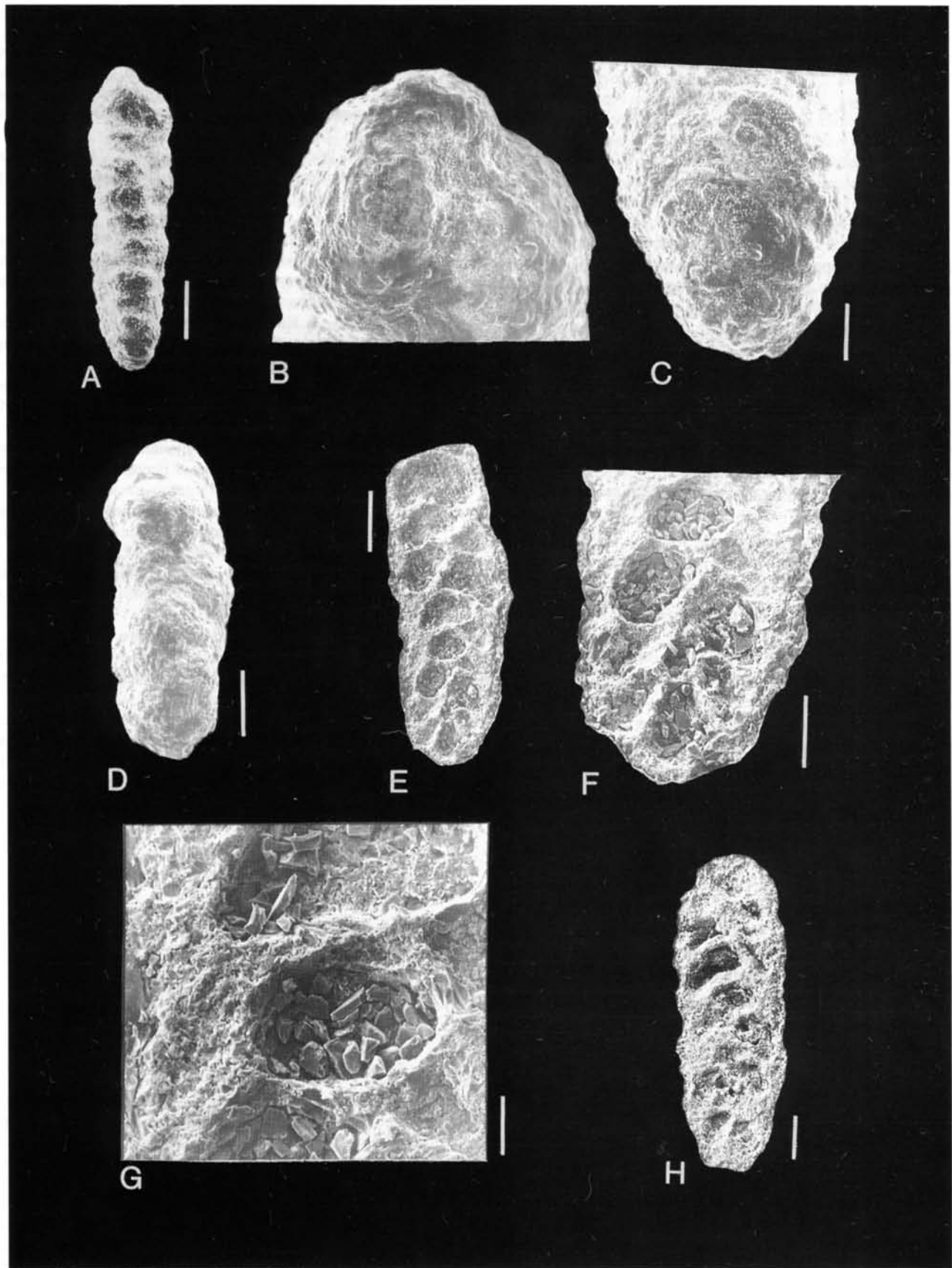


Fig. 2. SEM micrographs of *Neaguammia cuvierensis* (Holbourn & Kaminski, 1995). **A-C.** Sample 263-22R-2, 91-95cm. Length of scale bar: A – 200 μ m; B-C – 50 μ m. **D.** Sample 263-22R-3, 117-121cm. Length of scale bar – 100 μ m. **E-G.** Sectioned specimen revealing mode of coiling and wall structure; sample 263-22R-3, 117-121cm. Length of scale bar: E – 100 μ m, F – 50 μ m, G – 20 μ m. **H.** Sectioned specimen; sample 263-22R-3, 117-121cm. Length of scale bar – 50 μ m

terivian to Barremian).

Deposition of types: Deposited in the Micropalaeontological Collections of the Natural History Museum (London). Holotype = BMNH PF 53008.

DISCUSSION

The family Prolixoplectidae, as currently defined by Loeblich and Tappan (1987), is a heterogeneous grouping that contains both calcareous-cemented and noncalcareous (organically-cemented) genera of agglutinated foraminifera. Brönnimann, Whittaker and Zaninetti (1992) described the subfamily Caroniidae to encompass the noncalcareous forms that are initially triserial, such as their new genus *Caronia*. However, the noncalcareous trochospiral-triserial-biserial forms still require more investigation of their wall structure before an adequate classification can be devised. Indeed, if the recent study by Neagu and Neagu (1995) of agglutinated foraminifera from acid residues of Upper Jurassic limestones is any indication of the diversity of (yet undiscovered?) Mesozoic genera, there is little doubt that we are only beginning to understand the complexity and phylogeny of the proluxoplectid foraminifera.

As the modern species *Caronia exilis* is shallow-water form living in brackish environments, it is very likely that it is unrelated to the Early Cretaceous forms. We therefore prefer to use the names *Neaguammina* n.gen. and *Gaudryinopsis* for the Early Cretaceous deep-water and high-latitude genera that display trochospiral-triserial-biserial chamber arrangement and possess an interior marginal aperture. In our understanding, *Neaguammina* n.gen. is used for (predominantly Lower Cretaceous) forms with a well-developed triserial part and few biserial chambers, while the genus *Gaudryinopsis* *sensu* Holbourn and Kaminski (1997) can be applied to (predominantly mid to Upper Cretaceous) forms with a reduced triserial part. These forms may be related to the *Gerochammina-Karrerulina* group, which differ in their apertural characteristics. We believe that several of the noncalcareous "gaudryinids" from the Boreal Lower Cretaceous and the Alpine-Carpathian flysch that are commonly referred to as "*Gaudryina*" *sensu lato* can now be assigned to *Neaguammina* n.gen.

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Streszczenie

Neaguammina n.gen., NOWY RODZAJ W OBRĘBIE OTWORNIC AGLUTYNUJĄCYCH Z DOLNEJ KREDY OCEANU INDYJSKIEGO (DSDP, "SITE 263")

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W głębokowodnych osadach dolnej kredy Oceanu Indyjskiego znaleziono liczne otwornice aglutynujące, które charakteryzuje trójseryjny, przechodzący w dwuseryjny sposób zwinięcia skorupki. Były one dotychczas zaliczane do rodzaju *Gaudryina*. Według podziału systematycznego Loeblich i Tappan (1989), formy z rodzaju *Gaudryina* i *Dorothia* cechuje obecność cementu zarówno węglanowego jak i niewęglanowego. Typowy gatunek rodzaju *Gaudryina* (*G. rugosa* d'Orbigny, 1840) charakteryzuje masywna, nierowkowana ściana, spojona węglanowym cementem. Brönnimann, Whittaker i Zaninetti (1992) ograniczyli użycie nazwy rodzaju *Gaudryina* wyłącznie do form wapiennych, opisując nowy rodzaj *Caronia* o ścianie aglutynowanej cementem organicznym. Formy z rodzaju *Caronia* (gatunek typowy: *Gaudryina exilis* Cushman et Brönnimann, 1948) występują we współczes-

nych środowiskach brakicznych, a gatunek typowy został opisany z mangrowych bagien. Jeśli zaadoptujemy definicje powyższych rodzajów, to kredowe formy o skorupkach trochospiralno-trójseryjno-dwuseryjnych, spojonych cementem organicznym nie można zaklasyfikować do rodzaju *Gaudryina*, a tym samym do nadrodziny Textulariina (Loeblich i Tappan, 1989).

Autorzy zbadali strukturę ściany skorupki, sposób zwinięcia skorupki u otwornic z nowo opisanego gatunku z rodzaju *Gaudryina* (*G. cuvierensis* Holbourn et Kaminski, 1995), które zostały znalezione w 66 próbkach, z głębokowodnego wiercenia na Oceanie Indyjskim, u zachodnich wybrzeży Australii (Couvier Abyssal Plain; "DSDP Site 263"). Na tej podstawie utworzono nowy rodzaj *Neaguammina*, którego gatunkiem typowym jest *Neaguammina cuvierensis* (Holbourn et Kaminski, 1995) – Figs. 1–2.

Formy z rodzaju *Neaguammina* charakteryzuje skorupka wydłużona, prawie sferyczna w przekroju poprzecznym, o prawie analogicznych obu stronach w przekroju podłużnym. Komory początkowe są zwinięte trochospiralnie (do 3 zwojów). Komory starsze są ułożone dwuseryjnie, a komory najmłodsze charakteryzuje układ dwuseryjny. Część trójseryjna stanowi przeważającą część skorupki. U niektórych form oś zwinięcia może ulec skęceniu, powodując redukcję części trójseryjnej na rzecz dwuseryjnej. Komory inicjalne są spłaszczone, ze szwami obniżonymi. Otwór w kształcie nienapiętego łuku znajduje się u podstawy

ostatniej komory. Ściana skorupki jest masywna, nierowkowana, zbudowana wielowarstwowo z drobnoziarnistego materiału mineralnego, scementowanego cementem organicznym, przeobrażonym diagenetycznie w krzemionkę.

Wyróżniony rodzaj *Neaguammina* różni się od rodzaju *Dorothia* Plummer, 1931, poprzez obecność cementu krzemionkowego oraz poprzez wyraźnie rozwinięty trójseryjny układ komór. Od rodzaju *Gaudryina* d'Orbigny, 1839 odróżnia go z kolei obecność trochospiralnie zwiniętych komór początkowych. Bezwapniaste formy z rodzaju *Paragaudryina* Suleymanov różni od *Neaguammina* n.gen inny (arealny) typ otworu oraz brak trochospiralnie zwiniętych komór początkowych. Paleozoiczny rodzaj *Mooreinella* Cushman et Waters, 1928, podobnie jak *Prolixoplecta* Loeblich et Tappan, 1985 ma z kolei znacznie zredukowaną część trójseryjną skorupki. *Gaudryinopsis* Podobina, 1975, bardzo przypominający *Neaguammina* n.gen. i mający taki sam kształt ujścia, ma nieco odmienny sposób zwinięcia komór początkowych oraz ich kształt. Wszystkie ilustrowane formy (Podobina, 1975, pl. 12) charakteryzuje bardzo ograniczona część trójseryjna (1/3 wysokości skorupki). Kształt otworu i jego położenie u *Neaguammina* n.gen. odróżnia go od późnokredowych form z rodzaju *Gerochammina* Neagu, 1990. *Pseudomorulaeplecta* Neagu et Neagu, 1995 o niewapiennym cemencie różni się z kolei od nowo opisanego rodzaju poprzez brak trójseryjnej części skorupki.