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REMARKS ON THE MORPHOLOGY AND PHYLOGENETIC DEVELOPMENT OF ROTALIPORA TURONICA BROTZEN, 1942, AND THALMANNINELLA CUSHMANI (MORROW), 1934

(Fig. 1, Pls. 3)

Abstract: The type material of *Rotalipora turonica* BROTZEN, 1942, and a large population of *Thalmanninella cushmani* (MORROW, 1934), from the Cenomanian of Tunisia and the West Carpathian of Slovakia, are examined and discussed. It is found that there are two species represented in the type material of *Rotalipora turonica* BROTZEN, 1942, *Rotalipora turonica* BROTZEN and *Rotalipora pommerana* n. sp., and that the species described by many authors as *Rotalipora cushmani* (MORROW) is, in fact, a *Thalmanninella*.

Резюме: Рассматривается и обсуждается типовой материал *Rotalipora turonica* BROTZEN, 1942, и крупная популяция *Thalmanninella cushmani* (MORROW, 1934), сеномана Туниса и Западных Карпат Словакии. Было установлено, что в таковом материале *Rotalipora turonica* BROTZEN, 1942, представлены два типа *Rotalipora turonica* BROTZEN и *Rotalipora pommerana* n. sp. и что вид описаный многими авторами как *Rotalipora cushmani* (MORROW), на самом деле, *Thalmanninella*.

Introduction

There are not many authors who assigned the type species of the genus *Rotalipora* BROTZEN, 1942, *Rotalipora turonica* BROTZEN, 1942, as synonymous with *Thalmanninella cushmani* (MORROW, 1934) (as, for example, did Loeblich et Tappan, 1961; Pessagno, 1967; Longoria, 1973 (part) and Weidich 1984), but there are many who assigned *Thalmanninella cushmani* (MORROW) to the genus *Rotalipora*. This later assignment probably emanated from the statement given by Sigal (1958) when he errected the family *Rotaliporidae* SIGAL, 1958, that the genus *Thalmanninella* SIGAL, 1948, should be regarded as synonymous with *Rotalipora* BROTZEN, 1942 ("morphogene" *Thalmanninella* SIGAL, 1948).

Our aim in this paper is to present evidence regarding that the phylogenetic development of *Rotalipora turonica* and *Thalmanninella cushmani* which indicates that the latter species, called by many authors *Rotalipora cushmani*, is, in fact, a member of the genus *Thalmanninella*, and that *Rotalipora turonica* which was described by BROTZEN (1942) in syntypic series is found to be comprised of two species, *Rotalipora turonica* BROTZEN (Fig. 10, in Brotzen, 1942, see Pl. 1, Figs. 4—8), which is emended below, and *Rotalipora pommerana* n. sp. (Fig. 11, 4, in Brotzen, 1942).

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Discussion

In the literature, and in particular in the Atlas de Foraminifères planctoniques du Crétacé moyen (mér boréale et Téthys), Robaszynski—Caron (1979), it is stated that the genus *Thalmanninella* as described by Sigal (1948), is synonymous with the genus *Rotalipora* BROTZEN, 1942. According to the explanation of these two authors the reason of the synonymy was the interpretation given by Sigal (1958) that the genus *Thalmanninella* SIGAL, 1948, is synonymous with the genus *Rotalipora* BROTZEN, 1942.

Maslakova (1961); Salaj—Samuel (1963, 1966); Began—Hašk o —Salaj—Samuel (1976) were of another opinion regarding the validity of these two genera. They stated that *Rotalipora* and *Thalmanninella* must be regarded as two distinct genera because they show different phylogenies.

Longoria (1973), on the other hand, separated these two genera on the grounds of morphological differences.

By examining the type material of *Rotalipora turonica* (Pl. 1, Figs. 4—8), all the specimens of this species deposited in Brotzen's collection, topotypes of *Rotalipora montsalvensis* MORNOD (Pl. 3, Figs. 4—6) and a large population

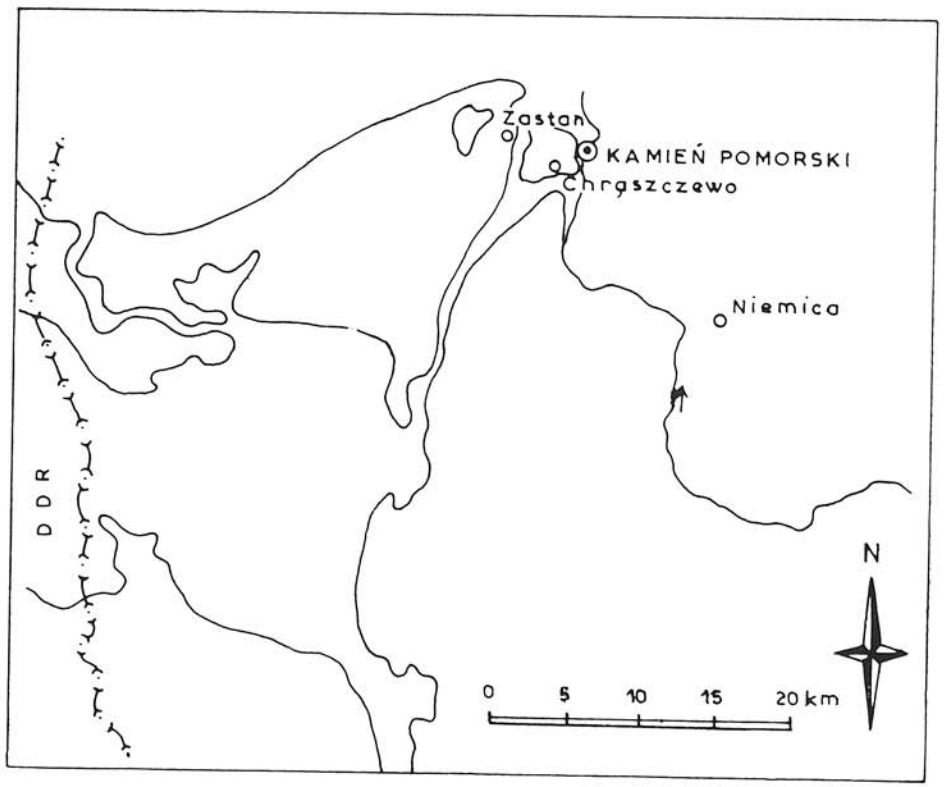


Fig. 1. Map of the northern part of Pommerania (northwestern Poland) showing the area studied by Brotzen (1942).

of *Thalmanninella cushmani* as well as other *Thalmanninella* and *Rotalipora* species from Tunisia and the West Carpathians of Slovakia, we found that *Rotalipora turonica* and *Rotalipora pommerana* n. sp. appears to have evolved from *Rotalipora montsalvensis minor* MORNOD and *Rotalipora montsalvensis montsalvensis* MORNOD, while *Thalmanninella cushmani* appears to have descended from *Thalmanninella evoluta* (SIGAL) (see Began—Hašk o—Salaj—Samuel, 1976, p. X. 9). Transitional forms showing gradual transition between them are figured in the work of Bellier (1983, Pl. 5, Figs. 1—4, 6—7 figured as *Rotalipora montsalvensis;* Pl. 5, Figs. 5, 8—10, 14 figured as *Rotalipora cushmani*).

The evidence resulting from this examination has further shown that the phylogenetic development of *Rotalipora turonica* is, *Ticinella roberti* (GANDOLFI) ⇒ *Whiteinella gandolfii* GAŠPARIKOVÁ—SALAJ ⇒ *Pseudoticinella bicarinata* (SAMUEL—SALAJ) ⇒ *Rotalipora montsalvensis minor* MORNOD ⇒ *Rotalipora turonica* BROTZEN. This evolutionary trend indicates the possibility that *Rotalipora turonica* and *Rotalipora pommerana* n. sp. were descended from globose forms which were developed from *Pseudoticinellas* or primitive *Whiteinellas*, both characterized by having a pustulose double keel. This pustulose double keel then developed into a distinct single keel in the members of *Rotalipora*.

"*Thalmanninella*" *cushmani* in the sense of Robaszynski—Caron (1979), on the other hand, is found to have evolved from *Thalmanninella evoluta* (see Salaj, 1980, Pl. 6, Fig. 12; Pl. 8, Figs. 3, 9, 11), a deduction which is supported by the appearance of intermediary forms between these two species found in the Tunisian and West Carpathians material examined.

We therefore suggest in agreement with Began et al. (1976) the evolutionary development of *Thalmanninella cushmani* to be: *Ticinella roberti* (GANDOLFI) ⇒ *Thalmanninella subticinensis* GANDOLFI ⇒ *Thalmanninella appenninica balernaensis* GANDOLFI ⇒ *Thalmanninella brotzeni* SIGAL ⇒ *Thalmanninella evoluta* (SIGAL) ⇒ *Thalmanninella cushmani* (MORROW).

This evolutionary trend supports the opinion that the species which is called by many authors *Rotalipora cushmani* is a *Thalmanninella*. There is not only the different evolutionary development of *Rotalipora turonica* and *Thalmanninella cushmani* which should be regarded as significant for their distinction but also their different morphologies. For this reason we compared the type material of *Rotalipora turonica* with the specimens of *Thalmanninella cushmani* recorded in the Cenomanian of Tunisia and West Carpathians and found them to be different in many respects. *Rotalipora turonica* possesses a very inflated to globose test which is single-keeled and has crescentic chambers in the final whorl. *Thalmanninella cushmani*, on the other hand, shows a biconvex but compressed, single-keeled test with hemicircular chambers in the last whorl rapidly increasing in size in the direction of coiling.

These morphological differences between *Rotalipora turonica* and *Thalmanninella cushmani* as well as their different phylogenies provide evidence which demonstrates that the latter species appears to have developed independently from *Rotalipora* as a distinct species within the genus *Thalmanninella*. We therefore assigne to the genus *Rotalipora* only those species which are found to be closely related and which are the following: *Rotalipora montsalvensis* MORNOD, *Rotalipora montsalvensis minor* MORNOD, *Rotalipora thomei* HAGN

—ZEIL, *Rotalipora turonica* BROTZEN and *Rotalipora pommerana* n. sp. (Pl. 2, Figs. 4—8).

Systematic description

Family *Globotruncanidae* BROTZEN, 1942
Subfamily *Rotaliporinae* SIGAL, 1958
Genus *Rotalipora* BROTZEN, 1942

Type species: *Rotalipora turonica* BROTZEN, 1942, text fig. 10.

Rotalipora turonica BROTZEN, 1942 emend.
(Pl. 1, Figs. 1—3, Pl. 2, Figs. 1—3)

1942 *Rotalipora turonica* n. sp. – Brotzen: Die Foraminiferengattung *Gavelinella* nov. gen. etc., p. 32, text fig. 10.

Description: Test medium-sezed, trochospiral, dextral and sinistral coiled into 2 1/2 whorls. Spiral side more convex than the umbilical side; equatorial periphery ovoid and globular furnished with a well developed single keel; initial chambers small and globular increasing gradually in size; they are followed by larger and globular chambers; the last whorl is composed of 5 very inflated chambers which are crescentic in shape; the sutures on the spiral side are curved, somewhat raised; on the umbilical side depressed and slightly curved or straight; umbilicus wide, shallow with a large lingula; one or two secondary apertures in each sutural depression umbilically; primary aperture extraumbilical-umbilical; surface pustulose on the spiral side, with prominent rugosities on the umbilical side.

Remarks: As noted by Longoria (1973); Brotzen (1942) described *Rotalipora turonia* in syntypic series from the Lower Turonian of Chrząszczewo (= Gristow), Niemica (= Nemitz) and Jordansee as well as from the Cenomanian of Zastan (= Zünz) and Świniec (= Schwenz) at Pommerania (Fig. 1). The examination of the type material and of all the specimens from the type sample (except for the specimen of Fig. 11, 4, in Brotzen, 1942, which was not available) indicated that the species *Rotalipora turonica* is, in fact, comprised of two species, namely *Rotalipora turonica* BROTZEN, 1942, represented by the specimen in Fig. 10 (Brotzen, 1942) which should be regarded as the holotype of this species, and by a new species *Rotalipora pommerana* n. sp., represented by the specimen in Fig. 11, 4 (Brotzen, 1942).

Rotalipora turonica differs from *Rotalipora pommerana* n. sp. in being smaller, in having a more lobate periphery and crescentic chambers throughout the final whorl.

Occurrence: *Rotalipora turonica* has been recorded by Brotzen (1942) in sedimentary beds at Pommerania (Fig. 1) which were, according to him, of Cenomanian and Turonian age. However, we suspect that these Upper Cretaceous rocks from which Brotzen (1942) collected his samples were not in situ, and the original location of these beds may never be found.

Stratigraphical range: In Tunisia and Slovakia *Rotalipora turonica* is found to be restricted within the *Thalmanninella cushmani* Zone.

Material: 30 specimens.

Rotalipora pommerana n. sp.
(Pl. 1, Figs. 7—8; Pl. 2, Figs. 4—8)

1942 *Rotalipora turonica* n. sp. — Brotzen: Die Foraminiferengattung *Gavelinella* nov. gen. etc., p. 32, text fig. 11,4.
1966 *Rotalipora cushmani turonica* BROTZEN — Salaj—Samuel: Foraminifera der Westkarpaten-Kreide, Taf. 14, Fig. 1a, b, c.
1976 *Rotalipora turonica* BROTZEN — Began—Hašk o—Salaj—Samuel: Standard profiles for microbiostratigraphical division etc., p. X. 7, Pl. 2, Fig. 8.
1980 *Rotalipora turonica* BROTZEN — Salaj: Microbiostratigraphie du Crétacé et du Paléogène de la Tunisie etc., Pl. 8, Fig. 11.
1983 *Rotalipora turonica* BROTZEN, 1942 — Bellier: Foraminifères planctoniques du Crétacé de Tunisie septentrionale etc., p. 49, Pl. 5, Figs. 11—13.

Type species: Figured in Pl. 2, Figs. 4—8 and deposited in Brotzen's Type Collection at the Swedish Museum of Natural History, section of Palaeozoology, Stockholm, Sweden.

Denomination: From the Latin name Pommerania.

Type level: Marls of the Uppermost Cenomanian.

Type locality: Chrząszczewo, Pommerania, Poland.

Plate 1

Figs. 1—3 — *Rotalipora turonica* BROTZEN. Spiral, umbilical and side views of the type species of Fig. 10 in Brotzen, 1942.
Figs. 4—6 — types species of *Rotalipora turonica* BROTZEN illustrated by Brotzen (1942, p. 32, Fig. 10.).
Figs. 7—8 — figure of *Rotalipora turonica* illustrated by Brotzen (1942, p. 32, Figs. 11, 4), now paratype of *Rotalipora pommerana* n. sp.

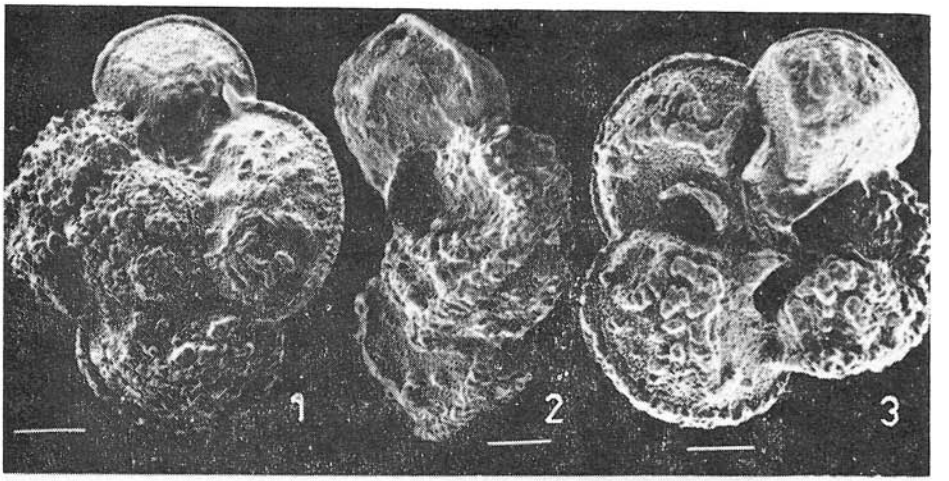
Plate 2

Figs. 1—3 — spiral, side and umbilical views of a specimen of *Rotalipora turonica* BROTZEN (from Brotzen's collection, loc. Chrząszczewo (= Gristow), Pommerania, Poland).
Figs. 4—8 — *Rotalipora pommerana* n. sp. Type species. Spiral, side and umbilical views of Brotzen's specimen *Rotalipora turonica* illustrated by Brotzen (1942, p. 32, Figs. 11, 4). Loc. Chrząszczewo (= Gristow), Pommerania.

Plate 3

Figs. 1—3 — *Thalmanninella cushmani* (MORROW). Spiral, side and umbilical views of a specimen from Brotzen's type collection. Loc. Chrząszczewo (= Gristow). Pommerania.
Figs. 4—6 — *Rotalipora montsalvensis* MORNOD. Topotype, R. d. Covayes Montsalvens. BSP 2540, Prof. D. Herm's collection, München.

Plate 1



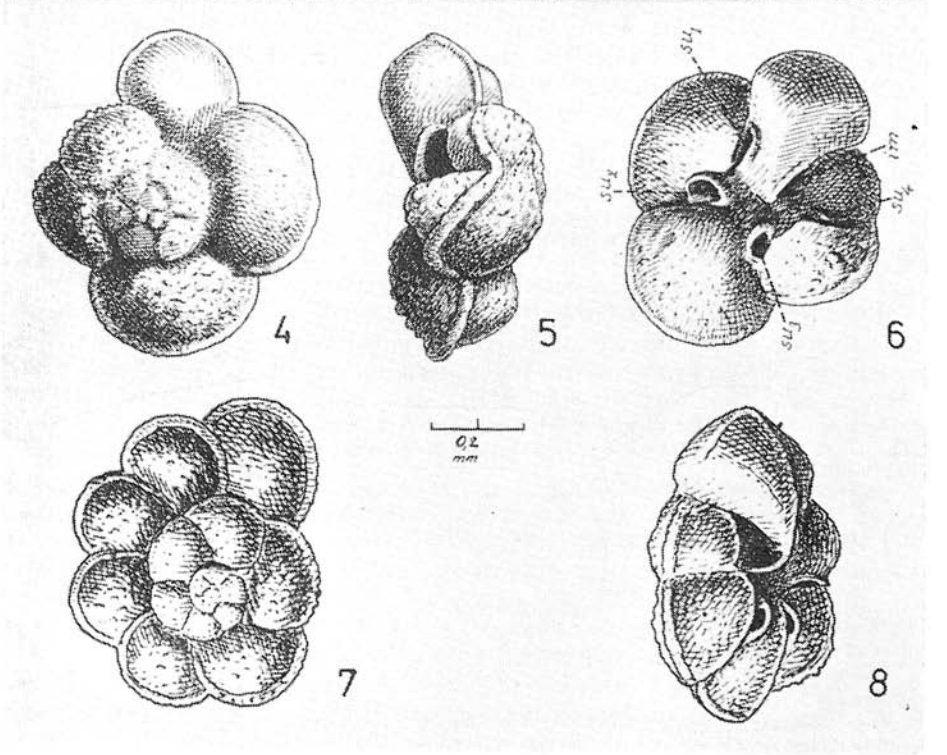
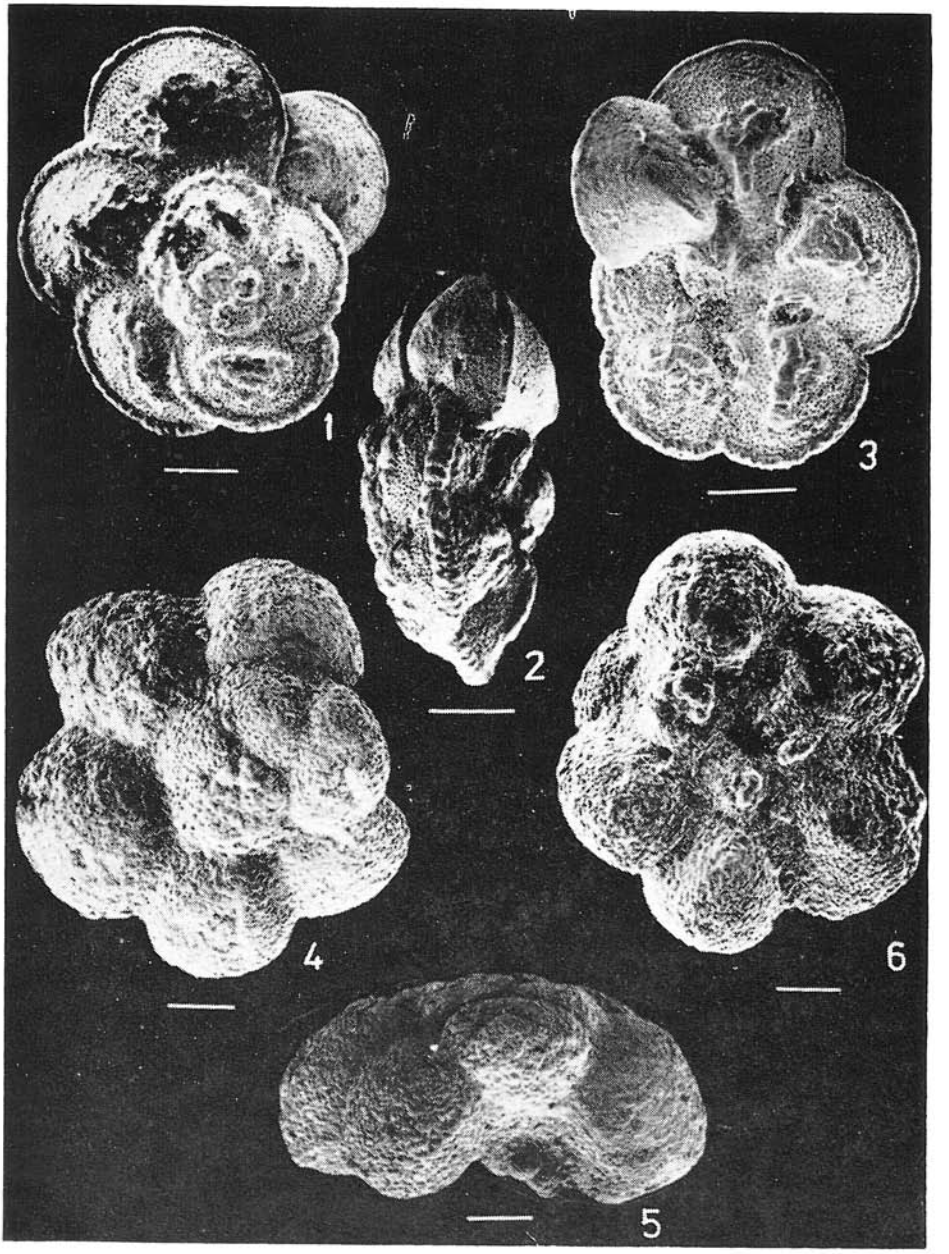


Plate 2

Plate 3



Material: 6 specimens from Chrząszczewo; 10 specimens from Djebel Fguira Salah, El Fahs, Tunisia; and 5 specimens from Stará Turá, Slovakia.

Diagnosis: A *Rotalipora* with a medium-sized biconvex, trochospiral and single-keeled test; spiral side strongly convex, umbilical side slightly convex; there are 7 chambers in the last whorl crescentic in shape except for the two last chambers which are hemicircular; umbilicus wide, shallow covered by the lingula; primary aperture extraumbilical-umbilical; supplementary aperture at each sutural depression on the umbilical side.

Description: Test medium-sized to large, trochospiral, dextral and sinistral coiled into 3 whorls. Spiral side strongly convex, umbilical side slightly convex. Exatorial periphery circular, lobate and furnished with a strongly beaded single keel. Initial chambers small and globular, are followed by large globular ones. The last whorl is composed by 7 crescentic chambers except for the ultimate which are hemicircular. On the umbilical side the chambers are furnished with prominent rugosities. The sutures on the spiral side are raised and curved, on the umbilical side they are slightly curved and depressed. Umbilicus small and shallow covered by the lingula. Supplementary apertures on each sutural depression umbilically. Primary aperture extraumbilical-umbilical. Surface pustulose on the spiral side, with raised rugosities on the umbilical side.

Dimensions of the holotype: maximal diameter 0.4 mm, minimal diameter 0.35 mm; thicknness: 0.16 mm.

Remarks: This species is characterized by the medium-sized test with 7 chambers in the last whorl which are crescentic in shape except for the two last chambers which are hemicircular. As pointed out above the specimen in Fig. 11, 4 (see Pl. 1, Figs. 7—8), illustrated by Brotzen (1942) and which was designated by Longoria (1973) as the lectotype of *Rotalipora turonica* belongs, in fact, to the new species.

Occurence: *Rotalipora pommerana* n. sp. is found by Brotzen (1942) in the "Turonian" of Gristow (= Chrząszczewo), Pommerania. However, according to the examination of the type material the beds in which *Rotalipora turonica* and the new species are found belong to the Uppermost Cenomanian namely to the *Thalmanninella cushmani* Zone.

Stratigraphical range: Uppermost Cenomanian.

Ecological remarks: *Rotalipora turonica* BROTZEN and *Rotalipora pommerana* n. sp. should be considered as Boreal types, colder-loving, as would also be testified by their globose chambers. These obviously penetrated into warmer waters by colder currents. Their different development from highly specialized warm-loving representatives of the genus *Thalmanninella* as *Thalmanninella evoluta* SIGAL and *Thalmanninella cushmani* (MORROW) is more understandable also from this ecological viewpoint. The last-mentioned species are from morphological viewpoint, in spite of different phylogenetic development, to a considerable extent to the character of the genus *Rotalipora*.

Depository:

All illustrated specimens are deposited in Brotzen's Type Collection at the Swedisch Museum of Natural History, section of Palaeozoology, Stockholm, Schweden.

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