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PARONELLA ? *OSTUNENSIS* N. SP. FROM THE UPPER CRETACEOUS OF APULIA (SOUTHERN ITALY)

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Key-words: Rudists, Taxonomy, Upper Cretaceous, Apulia.

Riassunto. Viene descritta una nuova specie di Radiolitide, *Paronella* ? *ostunensis* n. sp., su esemplari provenienti da livelli calcarei del Cretaceo superiore delle Murge sud-orientali (Puglia). L'ottimo stato di conservazione e l'abbondanza degli esemplari pugliesi, hanno consentito di discutere le relazioni tassonomiche tra i generi *Eoradiolites* Douvillé, 1909 e *Paronella* Wiontzek, 1934.

Abstract. A new radiolitid rudist, *Paronella* ? *ostunensis* n. sp. from the Late Cretaceous of Apulia is described. The excellent preservation of the fossil material made possible to discuss the validity of the genus *Paronella* Wiontzek, 1934.

Introduction.

During studies on the Late Cretaceous rudists of Apulia executed in the Ostuni area (South-Eastern Murge), some rudist specimens seemingly belonging to the genus *Distefanella* Parona, 1901 were recovered.

A more thorough examination revealed the presence of a ligamental ridge which precludes the specimens from being ascribed to the genus *Distefanella* Parona; more likely they are to be referred to the genus *Paronella* Wiontzek, 1934 and represent a new species, *Paronella* ? *ostunensis* (Pl. 20, fig. 1).

The specimens considered in this study were obtained from several localities around Pizzicucco (Brindisi, Sheet 191 Ostuni, III SO Casalini), in the southeastern Murgian area (Fig. 1). The limestone outcrops at Pizzicucco are part of a sequence ascribed to the Upper Cretaceous (Pieri & Laviano, 1989; Laviano & Pieri, in print). In particular, the layers bearing *Paronella* ? *ostunensis* n. sp. can be correlated with the middle part of the section "Strada dei Colli" which were assigned a Campanian- Early Maastrichtian age (Laviano, 1984, p. 191). Wiontzek's specimen *(Paronella volzanensis)* coming from "Kuppe 942 (Jeza), Umgebung von Woltschach" was considered by the Author possibly of Early Santonian age.

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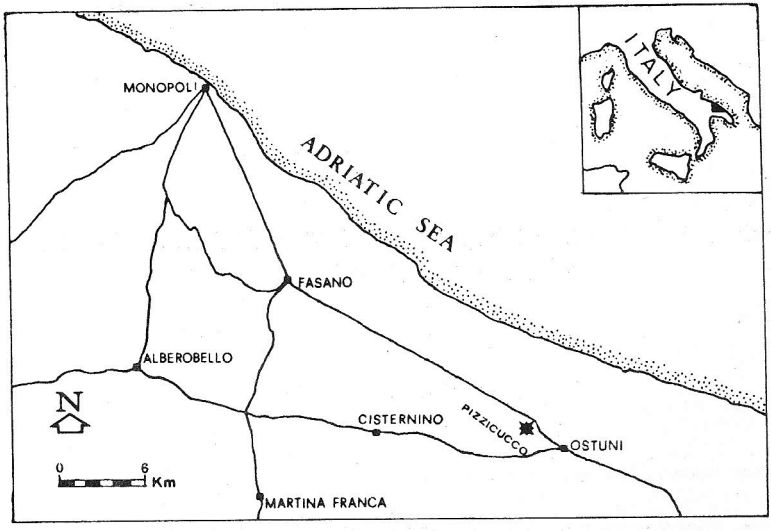

Fig. 1 - Map showing the location of fossiliferous area.

Systematic Palaeontology

Order Hippuritoida Newell, 1965

Superfamily *Hippuritacea* Gray, 1848

Family *Radiolitidae* Gray, 1848

Subfamily *Radiolitinae* Gray, 1848

Genus *Paronella* Wiontzek, 1934

Type-species: *Paronella volzanensis* Wiontzek, 1934 by monotypy.

1934 *Paronella* Wiontzek, p. 26.
1941 *Paronella* - Montagne, p. 80.
1957 *Paronella* - Astre, p. 47.
1969 *Paronella* - Dechaseaux & Coogan, p. N808, fig. E269,4.

Preliminary remarks.

Wiontzek (1934) erected the subgenus *Paronella* (type-species *P. volzanensis*) on a rudist fragment obtained from the surroundings of Volzana (Yugoslavia). According to its Author, *Paronella* is closely related to the genus *Distefanella* Parona, 1901, from which it differs in having the "Ligamentfalte". This taxon is poorly known since no additional specimens were recovered; reference can be found in Montagne (1941), Astre (1957) and Dechaseaux & Coogan (in Moore, 1969) only.The first two Authors provided a diagnostic key for the better known genera and subgenera; both regard the taxon as a

subgenus (1) and Montagne (1941) also reproduced Wiontzek's text-fig. 19. Dechaseaux & Coogan (1969), in their revision of rudist taxa included *Paronella* in the subfamily *Radiolitinae* and raised it to the genus rank.

Discussion.

Wiontzek (1934) based his new taxon on the presence of a very thin ligamental ridge in AV and of a transverse septum in the shell cavity: "Die neue Untergattung *Paronella* hat genau wie *Distefanella* ein vollkommen ausgebildetes Dorsalseptum. Jedoch besitzt sie eine Ligamentfalte, die aber bereits stark reduziert ist". The Author also noted that the outer layer of the shell wall is missing from his specimen, while the inner one, finely striate and 1 mm thick can be observed; furthermore he pointed out that the "Ligamentfalte" looks like a furrow on the external part of the shell.

It is to be noted that these remarks indicate the holotype as being an internal mould; this assumption also derives from the examination of some apulian specimens with an empty shell cavity and with the shell wall layers almost entirely disappeared; therefore, the empty shell cavity of some specimens has been filled with resin, and artificial internal mould similar to Wiontzek's specimen were obtained.

Because the poor preservation of his specimens, Wiontzek did not describe the myocardinal elements; concerning the other features, he pointed out that the taxonomic characters of *Paronella* are very similar on the whole to those of the genus *Distefanella*, and essentially focused on the transverse septum. The Author observed that, as in *Distefanella*, the septum develops from the inner layer of the shell wall and separates, within the shell cavity, a dorsal cavity extending all along the length of the attached valve (AV). In *Paronella* however, this dorsal cavity is in turn divided into two parts by the ligamental ridge. Furthermore, the Author noted that the transverse septum develops from the connection of the socket walls for teeth B' and B of the free valve (FV) and, though limited to this developmental stage, it is also present in *Eoradiolites* and in the older forms of *Biradiolites*. In *Distefanella* and *Paronella*, however, it extends over the entire length of the valve. On account of its presence and developmental stage, Douvillé (1913) identified the phyletic line: *Eoradiolites-Distefanella-Biradiolites;* subsequent to the finding of *Paronella*, Wiontzek (1934) identified two such lines: *Eoradiolites-Paronella-Distefanella* and *Eoradiolites-Biradiolites*.

The understanding of shell wall structure is an indispensable basis for investigating taxonomic differences. Important advances have been made on this subject in recent years only (Masse & Philip, 1972; Skelton, 1974). It has been established that shell wall structure of radiolitids consists of three layers: the calcitic outer prismatic layer, very often cellular in AV (this structure is exclusive to the family); the middle layer of

(1) As a matter of fact, Astre (1957) does not clearly define the taxonomic rank of *Paronella*. He says that his list of taxa includes genera and subgenera: "Je proposerais donc le mode de groupement suivant des genres et sous-genres...", and given the fact that all the taxa considered in his list are genera beyond any doubt, with the exception of *Fossulites*, it may presumed that only *Paronella* can be the other possible subgenus.

crossed lamellar aragonite; the inner layer of complex crossed lamellar aragonite with aragonitic myostracal prismatic elements (Taylor, Kennedy & Hall, 1969). The grooved teeth of FV and the respective AV sockets are formed by the middle layer, while they are completely submerged by the inner one.

The careful examination of several specimens of *Paronella* ? *ostunensis* n. sp. from Apulia has showed that particular attention must be paid to the aragonitic layers almost always absent owing to dissolution processes (Bathurst, 1971; Al-Aasm & Weizer, 1986). Sometimes istance of micrite (Pl. 17, fig. 2, 3; Pl. 18, fig. 1) varying into a fringe of calcitic cement (Pl. 21, fig. 2, 3) and lining the inner boundaries of the original aragonitic layers as well as the empty area between inner margins of both outer layer and the calcitized inner layer (Pl. 20, fig. 2) testify the loss of aragonite.

The same solution-deposition process occurred in the specimens shown in Pl. 20, fig. 4 and Pl. 21, fig. 3, in which, however, aragonite dissolution started early in the diagenetic history so that the filled voids along the boundary of the original aragonitic layers collapsed. This type of solution-reprecipitation process leaves no evidence (Pl. 20, fig. 4) or, partial evidence (Pl. 21, fig. 5) of the former presence of aragonite.

These observations evidence that the "Dorsalseptum" in many specimens of *Paronella* ? *ostunensis* n. sp. (the same phenomenon has been observed in some specimens of *Sauvagesia* from the Cenomanian limestones of Ruvo di Puglia, western Murge) is due to the aragonite transformation in calcite process.

It may therefore be presumed that *Paronella* is a synonym of *Eoradiolites* Douvillé, and, by implication, *Distefanella* a synonym of *Biradiolites* d'Orbigny. The reasons supporting a closer relationship with *Eoradiolites* are based on the following characters in common: structure of the shell wall; shell ornamentation; radial bands. The small ligamental ridge provides further evidence of affinity. As regard *Distefanella*, its absence from Apulia (the specimens attributed by Campobasso, 1972 to *Distefanella* cf. *bassanii*, *D. raricostata* and *D. heraki* belong to *Paronella* as proved by the observed presence of a small ligamental ridge) prevents any precise taxonomic information; more conclusive evidences of its supposed relationship with *Biradiolites* are not available so far. The status and the respective relationships of these taxa require careful consideration and their systematics is in need of revision (work in progress by the Author).

Paronella ? **ostunensis** n. sp.

Pl. 17-21

Derivation of name. Named after the town of Ostuni (SE Murge, Apulia).

Type-series. Holotype, DGGB 176 (Pl. 17. fig. 3; Pl. 18, fig. 1; Pl. 21, fig. 1). Paratypes, DGGB 160 (Pl. 18, fig. 2; Pl. 19, fig. 1; Pl. 20, fig. 4); DGGB 178 (Pl. 20, fig. 1), deposited in the rudist collection of the Department of Geology and Geophysics, University of Bari.

Type-horizon. Calcare di Altamura.

Geological age. Upper Campanian-Lower Maastrichtian.

Type-locality. Pizzicucco, Ostuni (Brindisi).

Repository. Department of Geology and Geophysics, University of Bari, Italy (from DGGB 160, DGGB 177-179, DGGB 184-185).

Diagnosis. AV very elongate, cylindrical to subcylindrical in shape. Ornamentation consisting of clearly-marked longitudinal ribs, occasionally protruding and sharp, or blunt and grouped together by 2,3 or more. The shell wall is thin (about 1/5 of the valve diameter); the outer calcitic layer (1 to 3 mm thick) can be cellular (with irregular subquadrangular cells) and/or solid. Radial bands are concave with "E" band (pseudofaeces rejection band) larger than "S" band (faeces rejection band) (Skelton, 1979, p. 101, fig. 7) The interband consists of 5-6 ribs similar to those decorating the shell. Very thin ligamental ridge. FV unknown.

Description. About 100 attached valves were examined, always embedded in the rock and incomplete. AV very long (the longest incomplete specimen is 40 cm in length), cylindrical or subcylindrical (Pl. 17, fig. 4); diameter ranging from 1 to 3 cm (measured at an unknown distance from the commissure) (Pl. 21, fig. 4, 5). External ornamentation: 20-24 ribs, either protruding and sharp, or bi-and/or polyfurcated and relatively blunt (Pl. 17, fig. 2, 3; Pl. 20, fig. 1, 2, 4). Radial bands are concave with the "E" band almost always larger than "S" band (Pl. 17, fig. 3; Pl. 20, fig. 1, 4). The "E" band, running opposite the ligamental ridge, is a concave groove of varying depth (Pl. 17, fig. 2, 3; Pl. 19, fig. 2; Pl. 20, fig. 1, 4). It is bounded by two ribs, which may be flat or more pronounced (Pl. 17, fig. 3; Pl. 19, fig. 2; Pl. 20, fig. 1, 4). Inside it is bordered by two very rounded ribs which impart it a typical bell shape (Pl. 17, fig. 2; Pl. 19, fig. 2; Pl. 20, fig. 4).

The "S" band is in the form of a more or less flat groove, mostly narrower than "E" band, though sometimes just as wide as the latter. The "S" band is bounded by sharp and very pronounced ribs; it is surrounded by bi-trifurcate ribs in those specimens with a greater number of flatter ribs (Pl. 17, fig. 1; Pl. 19, fig. 1; Pl. 20, fig. 1, 4; Pl. 21, fig. 1).

The interband consists of 2-3 ribs similar to those decorating the shell (Pl. 17, fig. 2, 3; Pl. 20, fig. 1, 4).

The ligamental ridge is very thin in its proximal portion (0.1- 0.2 mm), thicker at its distal part (0.5-0.6 mm) (Pl. 17, fig. 3; Pl. 18, fig. 1; Pl. 21, fig. 3).

The shell wall is very thin in respect to the whole valve diameter, about 1/5 of the latter one, and sometimes bends irregularly towards the shell cavity (Pl. 20, fig. 4). It is formed by three layers. The calcitic outer layer, 1 to 3 mm thick, shows cellulopris-matic structure with successive sheets of hollow cells, which appear quadrangular in radial section and either subrectangular or irregular in transversal view. Periodically the cellular sheets are replaced by dense non-cellular layer. Masse & Philip (1972) indicate the cellular structure with intercalation of compact layers as "structure mixte" (Pl. 17, fig. 2, 3; Pl. 18, fig. 1, 2; Pl. 19, fig. 1, 2; Pl. 20, fig. 1, 4, 5). The development of the cellular and/or compact structure in *Radiolitidae* shells has been described in detail by Milovanovic (1935, p. 16), Masse & Philip (op. cit.), Skelton (1974) and Amico (1978).

The microstructure of the layer (Skelton, 1974, 1979), visible in spite of evident recrystallisation phenomena of neomorphic calcite precipitation, consists of calcite prisma lying normal to the growth lines.

The aragonitic mid-layer is often absent having been removed by dissolution. Where present, it is very thin (0.2 mm), brown and compact and borders the ligamental ridge. Its microstructure is not visible due to recrystallisation.

The aragonitic inner layer, very thin (0.5 mm) except for the dorsal region where it is about 3 mm thick, is usually absent. The only evidence consists of a calcitic crust precipitated around its inner surface (Pl. 20, fig. 3; Pl. 21, fig. 2, 3). This calcitic crust simulates the "transverse septum" on the cardinal area.

Many specimens show three cavities in the cardinal area, arranged on either side of the ligamental ridge. From posterior to anterior side these are: 1) the socket for FV posterior tooth; 2) an accessory cavity bearing the ligamental ridge at its anterior border; 3) the socket for FV anterior tooth. The latter is slightly smaller than that of the posterior tooth (Pl. 17, fig. 2; Pl. 18, fig. 1; Pl. 21, fig. 2, 3). No evidence of the AV tooth.

The shell cavity is subdivided by coarse, oblique and curved tabulae originally aragonitic, with the concave side toward the commissure. At present, the tabula is evidenced by two calcitic layers deposited on the aragonitic one before it was lost (Pl. 17, fig. 4).

Discussion.

Comparison between *P.* ? *ostunensis* n. sp. and *P. volzanensis* Wiontzek is difficult due to the poor state of preservation of the unique specimen on which the latter species was based. Wiontzek (1934) wrote that his species resembles *D. salmojraghii* Parona, 1911. There is no similarity between *Paronella* ? *ostunensis* n. sp. and *D. salmojraghii*, the difference being especially apparent as regards the external ornamentation and the radial bands; anyway, it is particularly enhanced by the presence of the ligamental ridge.

Conclusion.

A taxonomic study on many apulian specimens enabled the Author: 1) to discuss the validity of the genus *Paronella* emphasizing that this genus is distinguished from the genus *Distefanella* by the presence of a small ligamental ridge and that both were based on a diagenetic character (Dorsalseptum); 2) to institute the new species *Paronella* ? *ostunensis* since it is believed that the type-species (*) is not confidently identifiable; 3) to suggest that *Paronella* can be a synonym of *Eoradiolites*, but this status will be established only after a revision work of both *Paronella* and *Distefanella*.

(*) The Author went through museum and university collections (London, Frankfurt, Münich, Graz, Vienna, Ljubljana, Zagreb and Beograd) in order to recover the holotype, but did not succeed in doing this.

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PLATE 17

Fig. 1, 2 - *Paronella* ? *ostunensis* n. sp. Transverse thin section through the AV of a specimen with bi-polyfurcated relatively blunt ribs. It is possible to observe the trace of neomorphic calcite precipitated along the inner shell wall layer and along the sockets for the FV teeth. Fig. 1 shows the "S" band in a thin section at a lower level. N. DGGB 180; x 4.2; x 2.5.

Fig. 3 - *Paronella* ? *ostunensis* n. sp. Holotype, transverse thin section of the AV showing the outer (calcitic) shell layer with celluloprismatic and solid structures. N. DGGB 176; x 2.4.

Fig. 4 - *Paronella* ? *ostunensis* n. sp. Longitudinal natural sections of AV showing the cylindrical shape of the shells and the horizontal sheets of neomorphic calcite replacing the original tabulae. N. DGGB 184; x 0.12.

PLATE 18

Fig. 1 - *Paronella* ? *ostunensis* n. sp. Holotype, a detail of the ligamental ridge. Observe from left to right: the anterior socket where the free valve's anterior tooth rest; an accessory cavity flanking the ligamental ridge; the posterior socket where the free valve's posterior tooth rest. The outer (calcite) shell layer is solid. N. DGGB 176; x 5.7.

Fig. 2 - *Paronella* ? *ostunensis* n. sp. Paratype, a detail of the (broken) ligamental ridge of the specimen represented in Pl. 20, fig. 4. N. DGGB 160; x 8.4.

PLATE 19

Fig. 1 - *Paronella* ? *ostunensis* n. sp. Paratype, detailed view of the "S" band of the specimen shown in Pl. 20, fig. 4. N. DGGB 160; x 7.5.

Fig. 2 - *Paronella* ? *ostunensis* n. sp. Detailed view of the "E" band of a specimen with celluloprismatic structure of the outer shell layer shown in Pl. 20, fig. 5. N. DGGB 179; x 7.5.

PLATE 20

Fig. 1 - *Paronella* ? *ostunensis* n. sp. Paratype, transversal thin section of a specimen showing the solid outer (calcitic) shell layer; the ornamentation consisting of 22 pronounced ribs and the characteristic radial bands; the interband consists of three ribs. N. DGGB 178; x 2.6.

Fig. 2 - *Paronella ? ostunensis* n. sp. Transverse thin section of a specimen occurred with the shell cavity filled by two different types of sediment. The dorsal cavity created by the dissolution of the aragonitic shell layers has been filled by sediment in a different time in respect to the shell cavity. N. DGGB 184; x 2.5.

Fig. 3 - *Paronella ? ostunensis* n. sp. Transverse natural section of a specimen with the original shell layers nearly completely dissolved. Note that, on the right side, only the outer shell layer is partly preserved. N. DGGB 185; x 2.6.

Fig. 4 - *Paronella ? ostunensis* n. sp. Paratype, transversal thin section of a specimen showing the solid outer (calcitic) shell layer, marked externally by 22 very protruding ribs. N. DGGB 160; x 2.8.

Fig. 5 - *Paronella ? ostunensis* n. sp. Transverse thin section of two specimens showing cellular and solid structure of the shell wall outer layer. (The specimen on the left side is the same of Pl. 19, fig. 2). N. DGGB 179; x 7.5.

PLATE 21

Fig. 1 - *Paronella ? ostunensis* n. sp. Detail of holotype "S" band. Outer layer of the shell wall cellular constructed. Observe its compact inner margin lyining the shell cavity (the aragonitic layers are lost). N. DGGB 176; x 3.6.

Fig. 2, 3 - *Paronella ? ostunensis* n. sp. Transverse natural sections showing the calcitized walls of the teeth sockets and accessory cavity. Observe as the inner margin of the original aragonitic inner shell layer simulates the "Dorsalseptum". N. DGGB 181, 183; x 2; x 3.3.

Fig. 4, 5 - *Paronella ? ostunensis* n. sp. Natural transverse sections of the AV showing their similarity to those of the genus *Distefanella* (note extremely thin shell wall layers). N. DGGB 182, 186; x 0.4; x 0.7.


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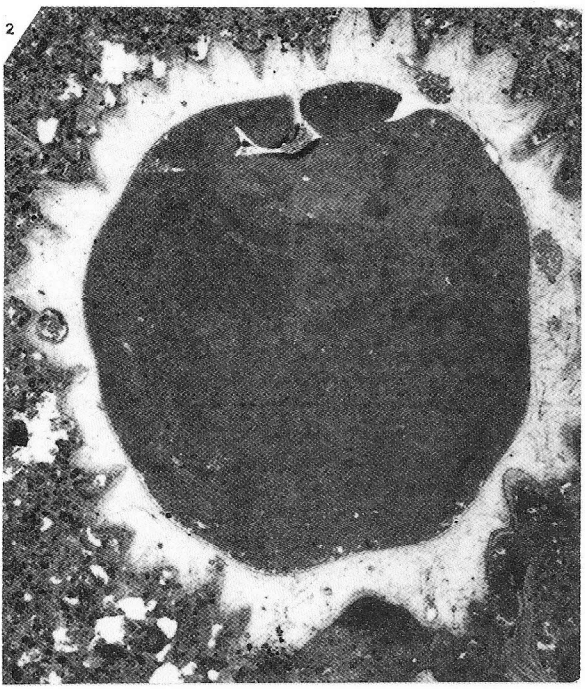
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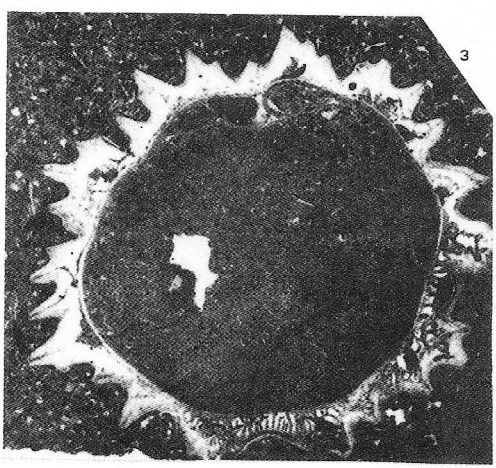
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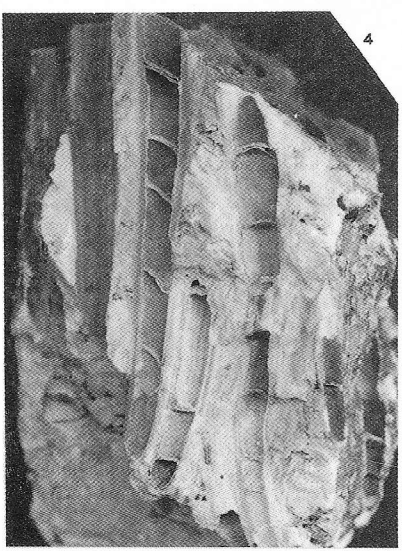
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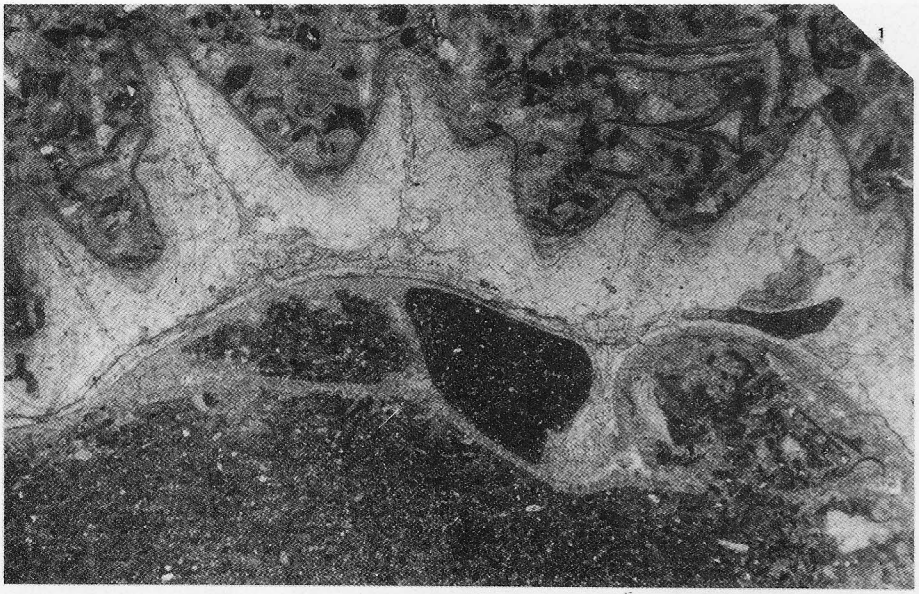
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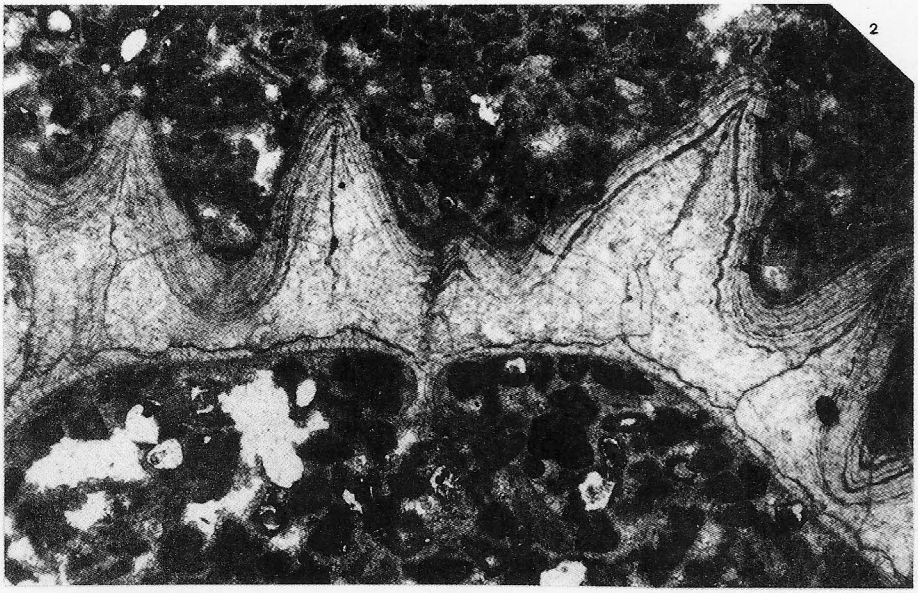
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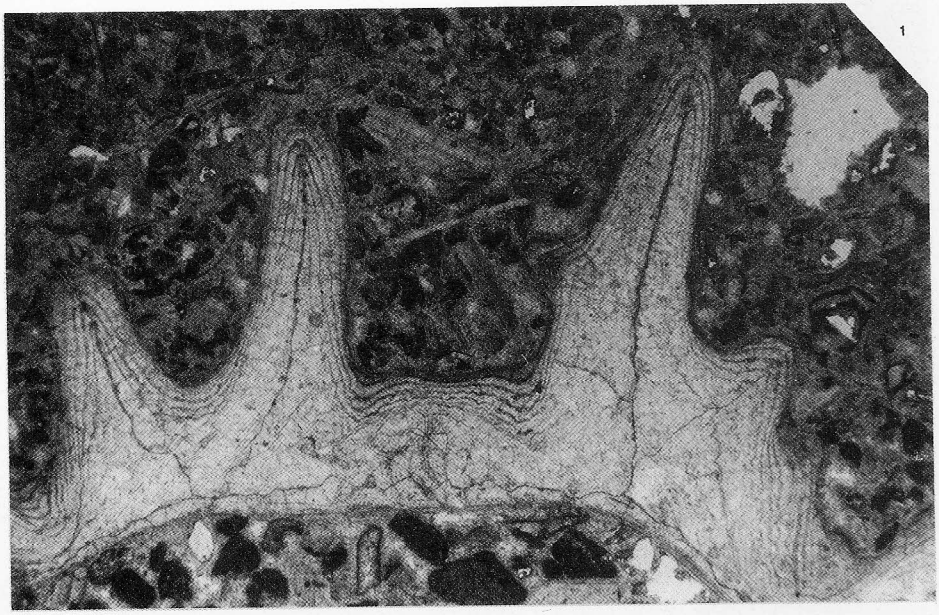
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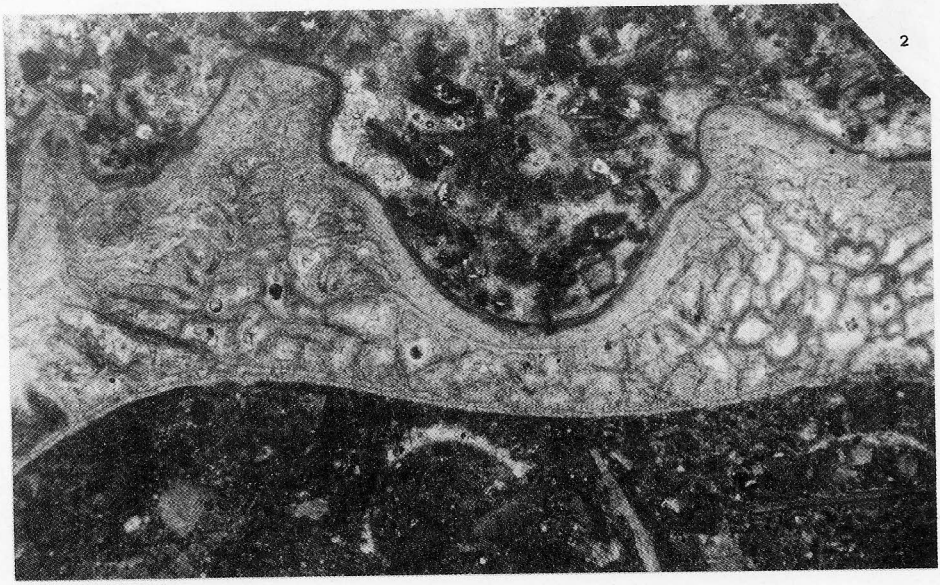
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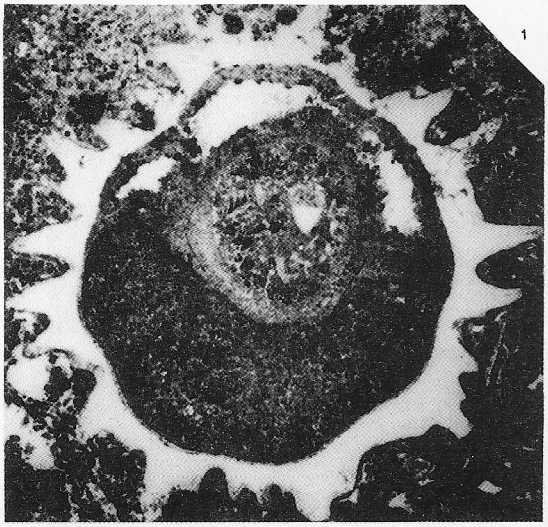
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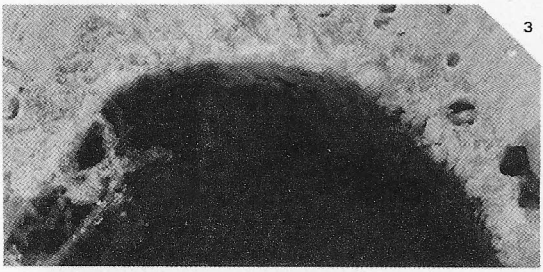
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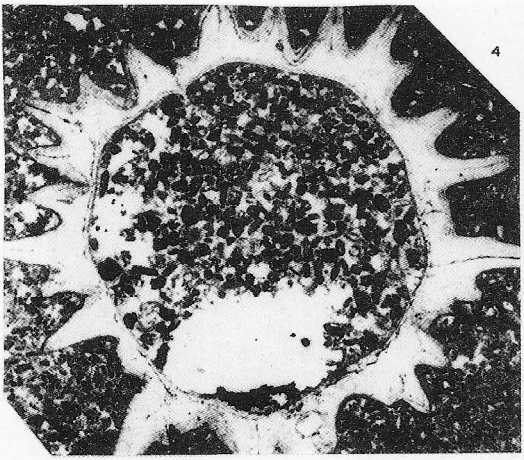
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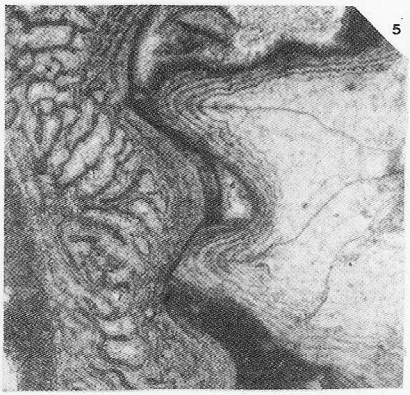
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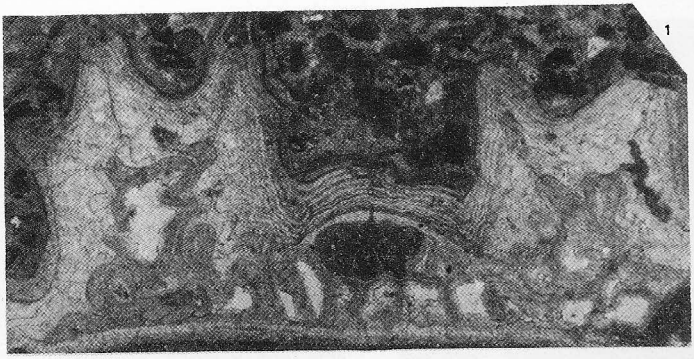
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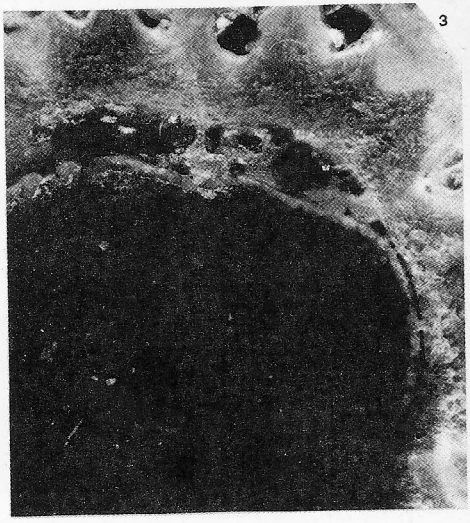
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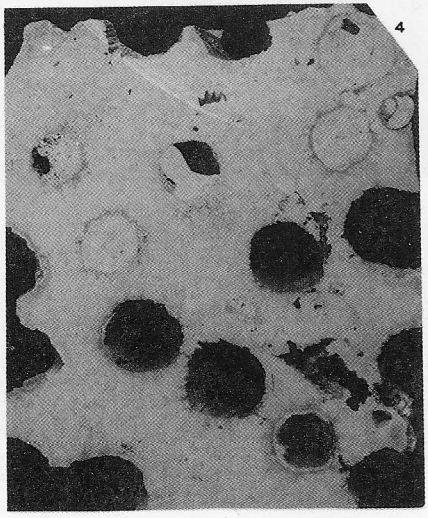
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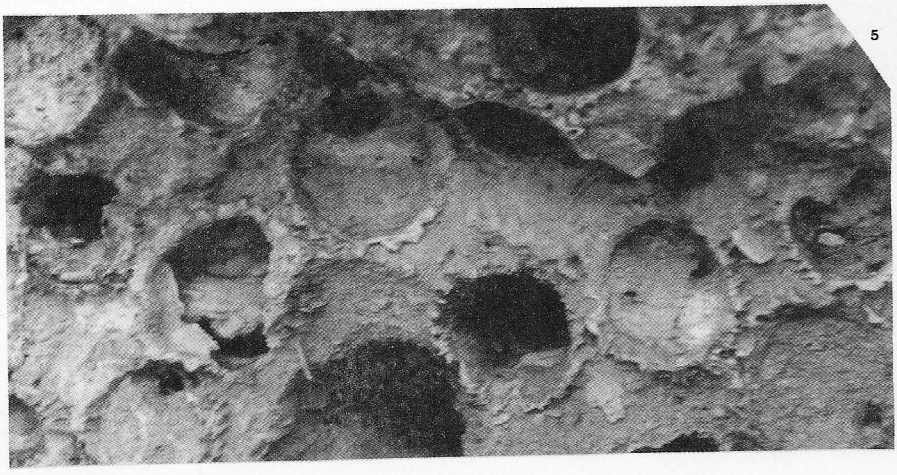
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