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SEMI-MULTILAMELLAR GROWTH IN *Reptomulticava alhamensis*, A NEW CYCLOSTOME (BRYOZOA) SPECIES FROM THE TORTONIAN OF ALHAMA DE GRANADA (S. SPAIN)

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ABSTRACT

In the Tortonian beds of Alhama de Granada within the Granada Basin several large, oblate to spheroid, bryozoan colonies are found belonging to a new species of Cyclostomata. *Reptomulticava alhamensis* nov. sp. presents a semimultilamellar growth in contrast with the prevailing clear multilamellar growth in other *Reptomulticava* and related genera. Like *R. multigemmata*, this species buds axially.

Keywords: Cyclostomata (Bryozoa), Tortonian, Granada basin, subcolonies, lamellar growth.

RESUMEN

En el Tortoniense de Alhama de Granada se encuentran zoarios centimétricos de briozoos ciclostomados que pertenecen a *Reptomulticava alhamensis* nov. sp. El análisis de su crecimiento permite observar que se produce por un haz de zoecios que crecen en dirección distal y producen luego expansiones superpuestas de zoecios. Este crecimiento puede ser llamado semimultilaminar en oposición al claro crecimiento multilaminar con formación de subcolonias totalmente superpuestas que se observa en diversas especies próximas, abundantes, sobre todo, en el Cretácico.

Palabras clave: Briozoos Ciclostomados, Tortoniense, Depresión de Granada, subcolonias, crecimiento laminar.

INTRODUCTION

Large multilamellar cyclostome colonies are abundant in Mesozoic strata and their complex organization has been discussed by recent authors (Hillmer, 1971; Hillmer, Gautier and McKinney, 1975; Nye and Lemone, 1978; Pitt and Taylor, 1990; Walter, 1989 and 1991). There are also some monticulate multilamellar forms in Cenozoic, such as, for example, those described in the Neogene from Western France (Canu et Lecointre, 1933-34; Buge, 1957; Tillier, 1975).

In the Tortonian sequences (Upper Miocene) of the Granada Basin there are some monticulate, almost multilamellar zoaria of one cyclostome species not known at present. Because of its characteristic arrangement of zooecia, and the special kind of subcolonies of which it is constituted, its full description is particularly interesting. This description may add new insights to the discussion quoted above.

STRATIGRAPHY

The samples were collected in the Lower Tortonian, near Alhama de Granada (Fig. 1) at the Southwestern boundary of the Granada Basin. These oblate to spheroid colonies were accompanied by other big bryozoan colonies, planar, rotating spherical (ectoproctaliths or bryoliths) and toeshaped. All these forms are found in a sandy formation corresponding to a shoreface and shoreface to shelf environments (Fig. 2). The detailed stratigraphic situation and the sedimentary meaning of this and the other associated forms are discussed in Reguant *et al.* (1986-87, 1991).

SYSTEMATIC

Orden CYCLOSTOMATA Busk, 1852
Suborder TUBULIPORINA Milne-Edwards, 1838
Family **Diaperoeciidae** Canu, 1918
Genus *Reptomulticava* D'Orbigny, 1852

Reptomulticava alhamensis n. sp.

Pl. I and II

Derivatio nominis: From the locality of the specimens studied, Alhama de Granada (Granada, South Spain).

Stratum: Tortonian.

Material: 12 colonies, in some cases fragmentary, labelled as: R9205; R9206; R9207; R9208; R9215; R9216; R9217; R9218; R9222; R9223; R9224; R9225.

2 thin sections belonging to other specimens labelled as: R9201; R9212.

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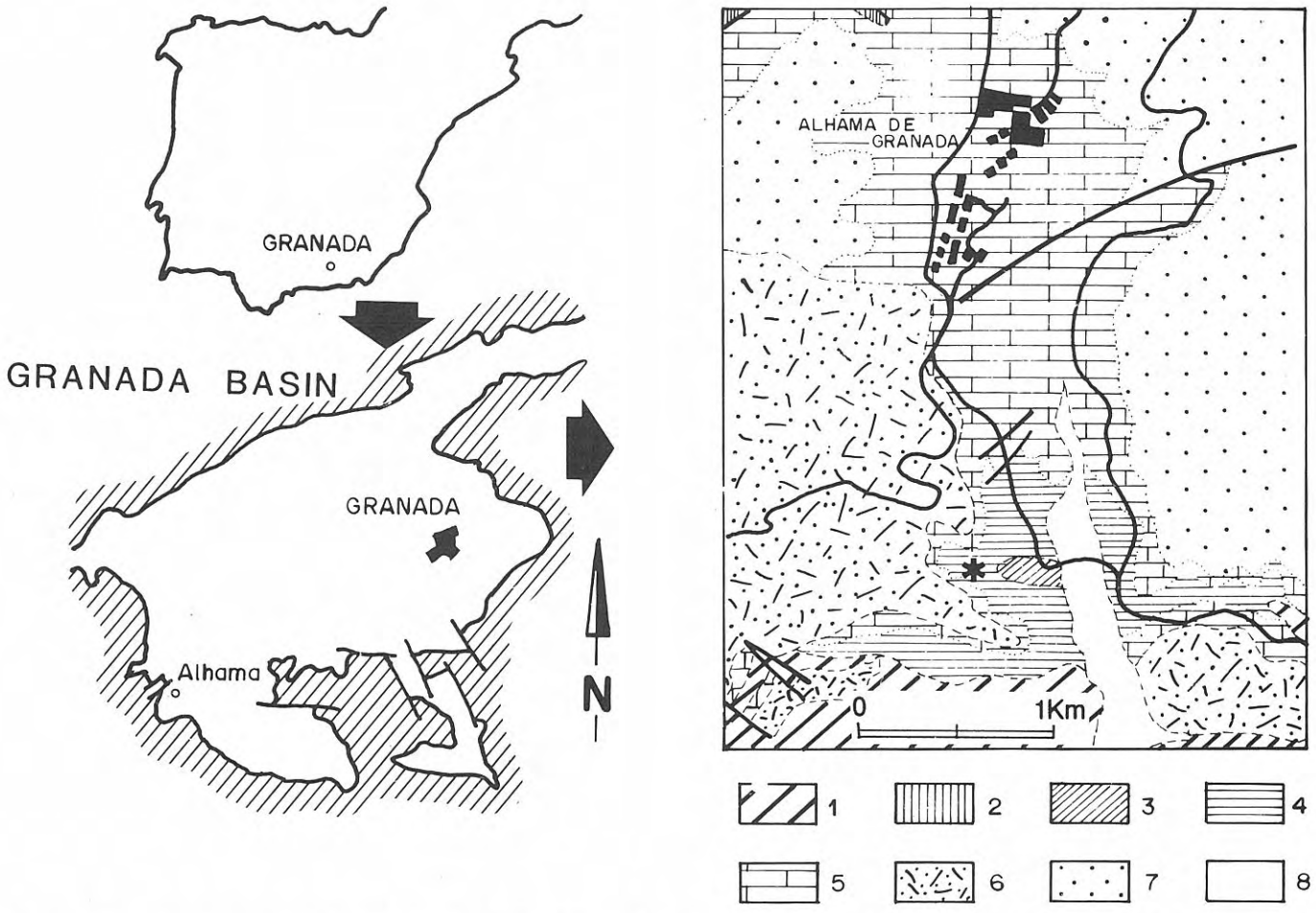


Figure 1. Location map and geological sketch of the Alhama de Granada area: 1) Alpujárride Unit; 2) Subbetic Unit; 3) Middle Miocene; 4) Sandy Formation (*type locality); 5) Calcarenitic Formation; 6) Conglomeratic Formation; 7) Marl Formation; 8) Alluvial cover. (From Reguant *et al.*, 1986-87, slightly modified).

Holotype: R9217 (Pl. I, Fig. 4).

Paratypes: R9201 y R9224.

Diagnosis: Zoarium large, massive, monticulate, semi-multilamellar, consisting of flabelliform subcolonies growing in the central part by axial budding and interconnected at many levels by lateral extensions made up of fused layers of zooecia. Gynozooecia at the edge of the central part.

Description: Zoarium massive, monticulate, almost multilamellar, oblate to spheroid (Fig. 3, and Pl. I, Fig. 3), large (up to 92 mm across).

The zoarium consists of subcolonies interconnected in many levels by lateral extensions constituted by fused layers of zooecia (Pl. I, Figs. 1, 4). Each level represents one stage of growth and thus the colony, as a whole, seems to be multilamellar. In fact, the central growth-line of the subcolony is not subdivided, and then there are no subcolonies superimposed as in many similar species. The chronological order of growth produces subcircular to polygonal, hat-shaped surface lumps, each corresponding to distinct subcolonies. Firstly, the growth is central through especially elongated zooecia. The lateral budding then creates the connecting layer between adjacent subcolonies (Pl. II, Figs. 1, 3).

In the central part of the subcolony, zooecia are long, subcylindrical and with a subparallel arrangement, forming a tight bundle (Pl. I, Fig. 2). In contrast, the zooecia of the connecting layers are shorter and in more regularly parallel disposition (Pl. I, Fig. 5). The diaphragms are present only in some long zooecia.

Transversal sections show that in the central part occurs axial budding (Hillmer, Gautier and McKinney, 1975) each zooecium producing 4 (or nearly 4) new zooecia. In transversal section, the starting axial budding outlines star-like patterns (Pl. II, Fig. 4). In the interconnecting layers the budding is lateral.

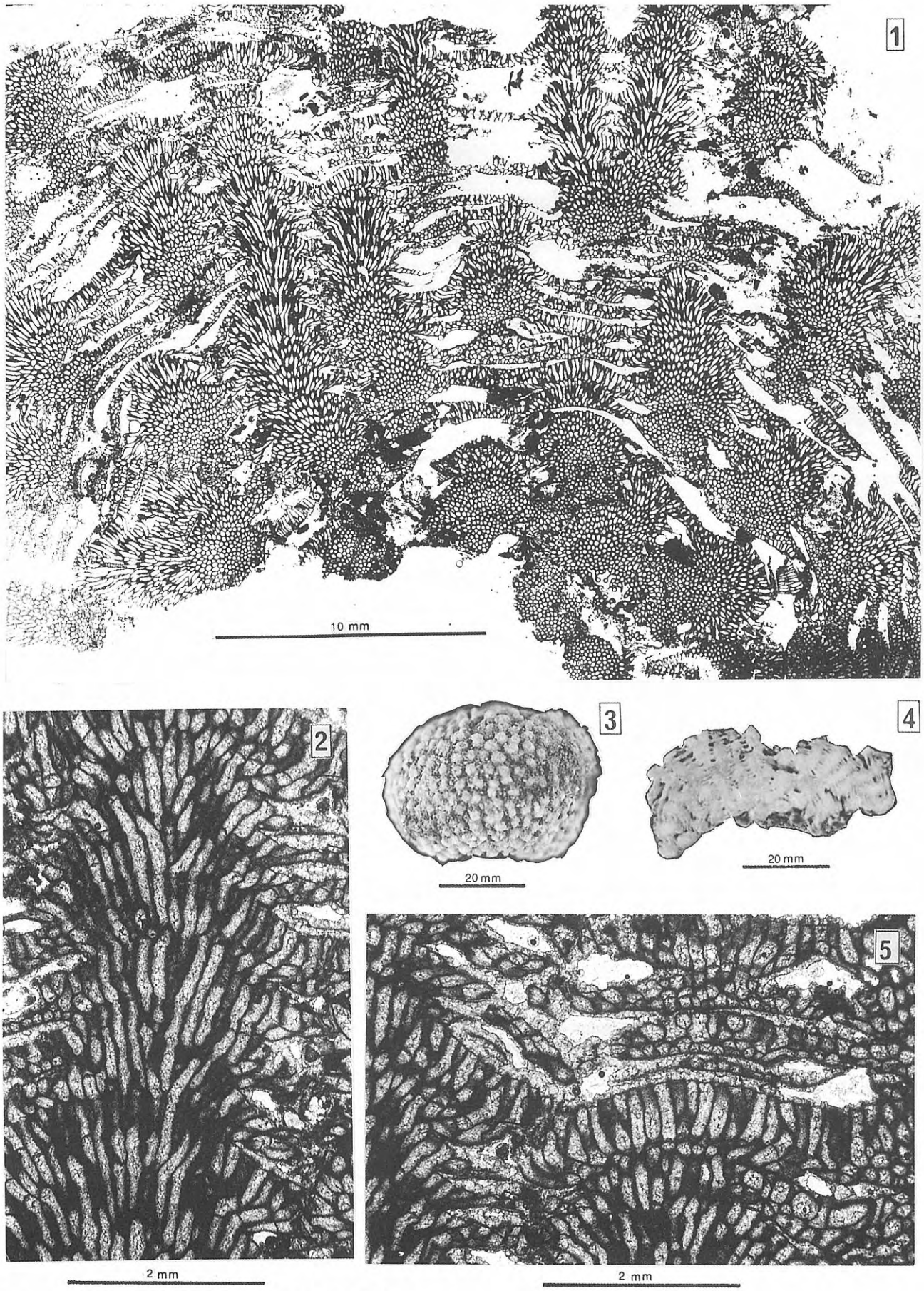
Zooecial aperture, not easily visible because of deficient preservation, is circular. It presents a distinct ring surrounded by a furrow separating the zooecium from the interzooecial filled space between adjacent zooecia (Pl. II, Fig. 2). No kenozooecia.

Gynozooecia, only seen in longitudinal section as swollen

Plate I

1 Near complete longitudinal thin section of colony R9201.
2 Enlarged part of Fig. 1 showing the central growing parts of the colony without distinct lamination.
3 External view of colony R9224.
4 Longitudinal section of colony R9217 (Holotype) showing the solid aspect of central growth area and multilamellar aspect in interconnecting layers.
5 Enlarged part of Fig. 1 showing interconnecting layers with a clear multilamellar aspect.

Plate I



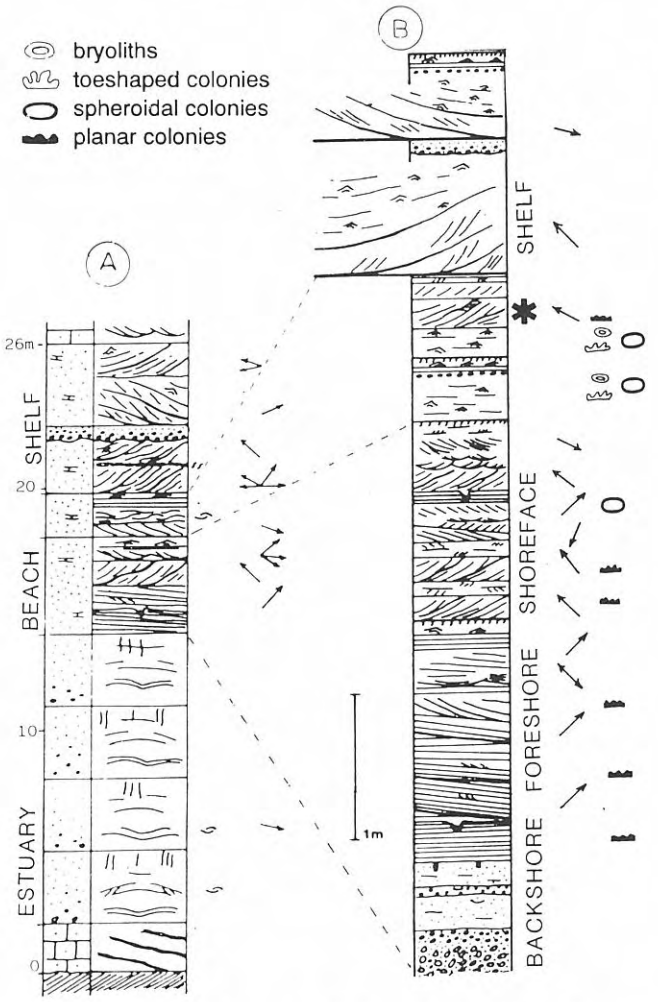


Figure 2. Sedimentological profiles of the Sandy Fm with indication of the location of the large bryozoan colonies: A) General profile; B) Beach unit (enlarged). (From Reguant *et al.*, 1986-87 slightly modified). (*Type level position).

areas crossed by some normal zooecia, are located from the edge of the central part of the subcolony to the connecting layers of zooecia (Pl. II, Fig. 4). They open to the voids between two adjacent superimposed connecting layers.

Biometrics: All biometric results are given in millimeters and in the following order: (number of measurements) arithmetic mean (standart deviation); range.

Zoaria measurements

DM: maximum diameter (long axis).

dm: minimum diameter (intermediate axis)

h: height (short axis).

This vertical life-position is assumed by some evidence in the field, and also by the arrangement of the bundles. However, these colonies may have rotated in their first life stages when they were smaller.

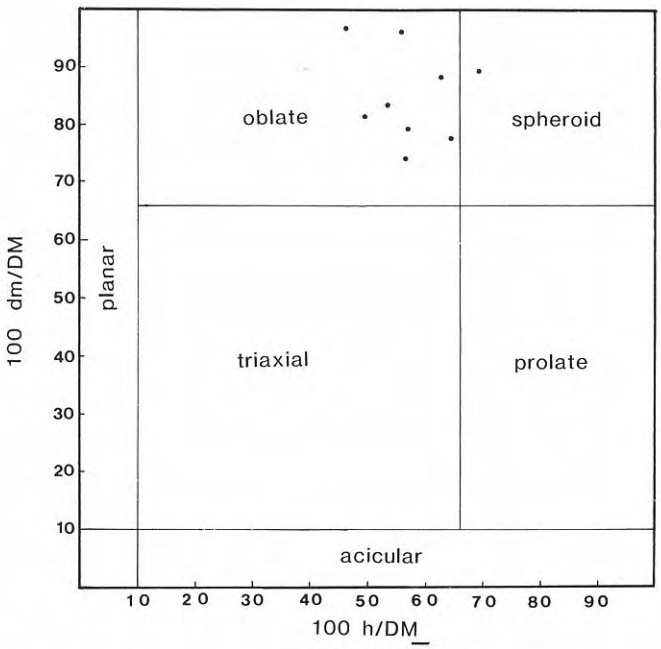


Figure 3. Zingg plots illustrating shape variation among 10 complete zoaria of *R. alhamensis*, after the model used by Balson and Taylor (1982).

DM = (12) 50.72 (17.45); 31.5 – 91.7
dm = (10) 43.195 (18.60); 27.7 – 88.7
h = (12) 29.55 (6.72); 20.0 – 42.4
100 dm/DM = (10) 86.06 (7.87); 74.2 – 96.7
100 h/DM = (12) 60.57 (10.37); 46.2 – 86.2
Em: distance beween two adjoining monticules.
Em = (90) 3.70 (0.31); 2.42 – 5.3

The Em was calculated on the arithmetic means of 8 colonies, on each of which 8 to 16 measurements were taken.

Zooecia measurements

a: diameter of the aperture.

Lz: length of the zooecia.

lz: width of the zooecia.

Lz and lz are measured in longitudinal cross sections and are, thus, equal or less than actual measures.

a (in specimen R9205) = (11) 0.128 (0.020); 0.091 – 0.15
(in specimen R9207) = (12) 0.097 (0.016); 0.075 – 0.125
(Zooecia of the central area)
Lz = (9) 0.948 (0.305); 0.640 – 1.680
lz = (9) 0.138 (0.016); 0.120 – 0.160
(Zooecia of the interconnecting layers)
Lz = (7) 0.534 (0.055); 0.480 – 0.640
lz = (7) 0.129 (0.019); 0.108 – 0.160

DISCUSSION

Reptomulticava radioporoidea Canu et Lecointre, 1934,

Plate II

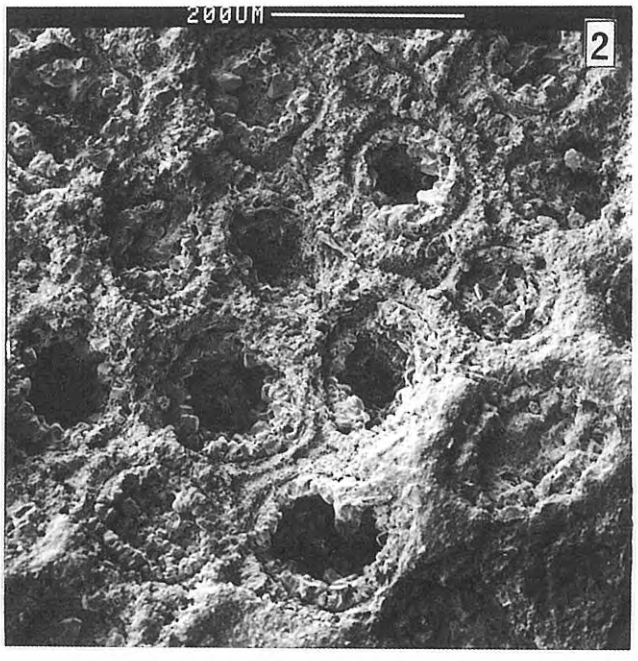
1 Partial longitudinal thin section showing the obstruction of one central growing unit by another overlapping unit of the same colony. This arrangement has allowed the preservation of the terminal stage of growth in the obstructed unit (sample R9212).

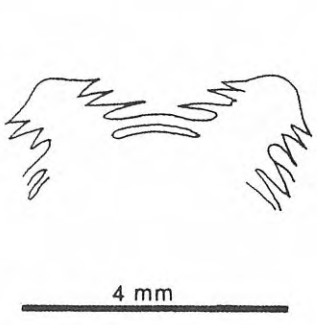
2 Enlarged partial view of a monticule showing the aspect of the aperture (sample R9207).

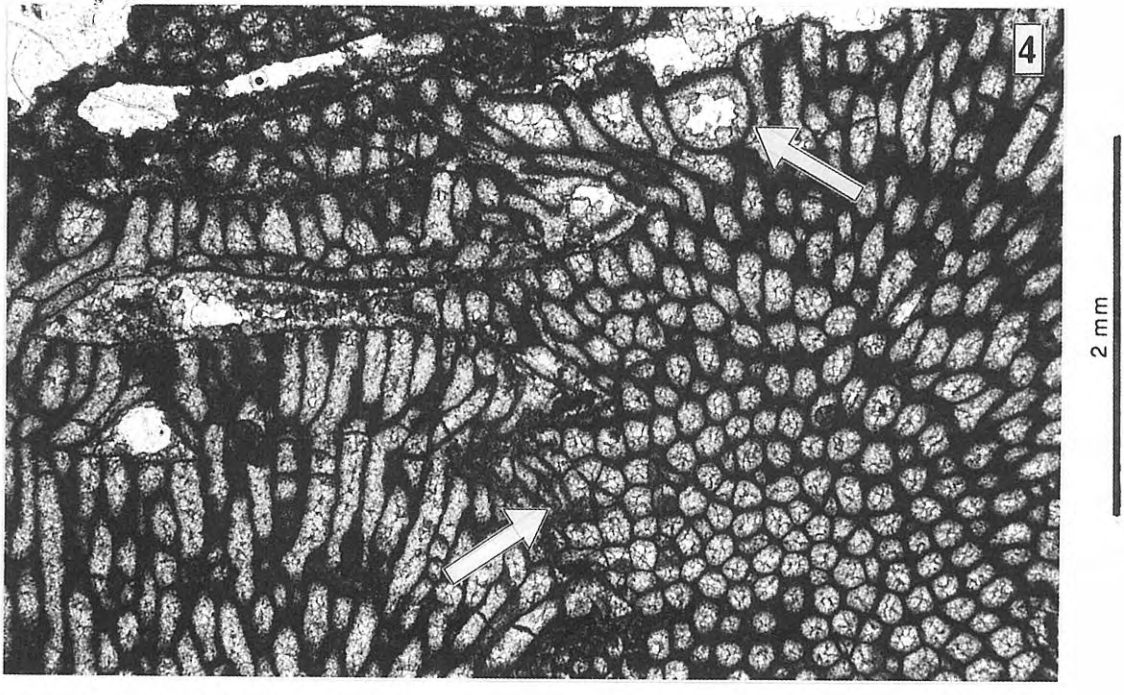
3 Schematic drawing of the terminal stage of growth and of the relationship of two adjacent hat-shaped monticules.

4 Enlarged part of the thin section of colony R9201 showing gynozooecia (upper arrow) and (in transversal section) star-like patterns within the zooecia and four new zooecia arising from one zooecium by axial budding (lower arrow).

Plate II







from the Middle Miocene of the Western France is a close species but, after an examination of the types conserved in the Muséum National d'Histoire naturelle (Paris), and the revision by Tillier (1975) it becomes clear that it is a different species. *R. radioporoidea* does not present the clear distinction between an area of tight bundles and an area of interconnecting zooecia layers. Then the meaning of monticula is slightly different. The buds occur laterally in the confluence of four zooecia and not by axial budding (*cfr.* Fig. 24 of Tillier *op. cit.*). In addition the diaphragms are abundant. In some aspects of budding there are important similarities from *R. radioporoidea* and the very well described cretaceous American species *Reptomulticava texana* (Nye and Lemoine, 1978).

Two cretaceous species are particularly close to our species: *Semimulticavea marginata* (Canu and Bassler) as described by Pitt and Taylor (1990) and *Reptomulticava multigemmata* Hillmer (1971). *Semimulticavea* differ from *Reptomulticava* by having kenozooecia. On the other hand, *S. marginata* and also *R. multigemmata* have subcolonies clearly superimposed, in contrast to the species described here. In addition, in *R. alhamensis* degenerative zooecia has not been seen before the axial budding as in *R. multigemmata.*

Finally it is interesting to observe the budding of the superimposed subcolonies by the zooecia of the underlying subcolony which crosse the boundaries of the clearly multilamellar zoaria of *Reptomulticava heteropora* (Roemer, 1839) from Valanginian of the Jura region (Walter, 1991). This arrangement has some similarity with that observed in *R. alhamensis*, but also in this case there is a clear superimposition of the subcolonies, as in other forms discussed here.

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