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Upper Cretaceous Bryozoa from Need's Camp, South Africa

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UPPER CRETACEOUS BRYOZOA FROM NEED'S CAMP, SOUTH AFRICA

by

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ABSTRACT

The bryozoan fauna from the Upper Cretaceous limestones of the lower quarry at Need's Camp, South Africa is revised. Eighteen cyclostomatous species are identified, of which twelve are new: *Desmeplagioecia primitiva, Diastopora solida, Pustulopora minuta, Spiropora irregularis, Clausa crassa, Foliopora expansa, Idmidronea robusta, Idmidronea africana, Idmidronea capensis, Idmidronea langi, Idmonea compressa,* and *Multicavea rotunda.* The fauna seems to indicate a shallow-water, strongly agitated environment and differs in composition from the probably contemporaneous fauna from Madagascar. There is a suggestion that distinct biogeographical provinces may be represented.

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INTRODUCTION

The Bryozoa discussed in this study are from the lower limestone quarry of Need's Camp, approximately halfway between East London and King William's Town in the Cape Province of South Africa. Limestone has been quarried from two small sites in the area, which lie 5 km apart, and in the topographically lower, eastern quarry a small, 1,5 m thick patch of limestone is currently exposed. This limestone is highly fossiliferous and is composed largely of bryozoa together with echinoids, brachiopods, corals and bivalves. Benthic foraminifera and ostracodes are also present.

Cyclostomatous bryozoa have been described previously from the quarry by Lang (1908), but unfortunately his type material appears to be lost and it is not possible to be certain of all his identifications on the basis of his illustrations alone (cf. table 1).

Other cyclostomatous bryozoa have also been described previously from the Upper Cretaceous of the southern hemisphere, but knowledge of these faunas is very incomplete. Canu (1911) described 69 species from the Upper Cretaceous of the Argentine, of which 18 were cyclostomes and later (Canu, 1922) described 22 species from the Maastrichtian of the East Coast of Madagascar, including eight cyclostomes.

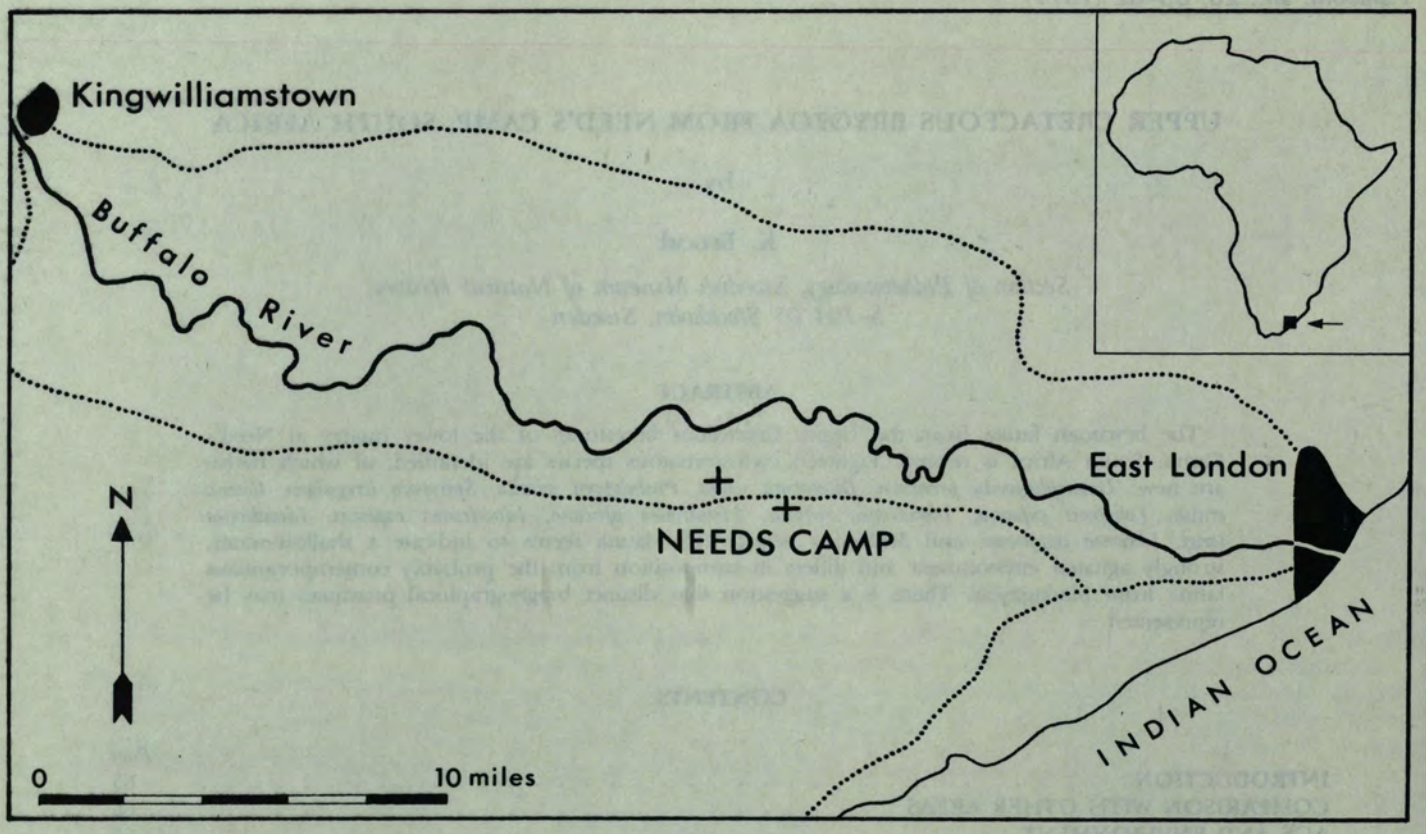


Figure 1. Map showing the situation of the Need's Camp quarries.

Recently, Maastrichtian and Palaeocene cyclostomes have been described from the west coast of Madagascar (Brood, 1976).

Generally each of these earlier authors identified their material with European species, but revision of the Southern Hemisphere faunas reveals that commonly these identifications are incorrect and that Asian and African specimens are specifically distinct from European ones. There are, however, exceptions.

The terminology used in this study is the same as in Brood (1972) unless otherwise stated. The following abbreviations are used:

azap = autozooecial aperture, width
azp = autozooecial peristome, width
daf = distance between fascicles of autozooecia
az/mm² = number of autozooecial apertures in 1 mm²
O.R. = observed range
s = standard deviation
$\bar{x}$ = arithmetical mean (given with confidence interval)
V = coefficient of variation

The type specimens are deposited in the collections of the Palaeozoological Department, the Swedish Museum of Natural History, Stockholm, Sweden (serial numbers RM By 23600 — 23685). A set of topotypes is deposited in the collections of the Department of Palaeontology of the British Museum (Natural History), London.

COMPARISON WITH OTHER AREAS

Since few bryozoan faunas are known in detail from the Upper Cretaceous outside Europe a comparison between different areas for stratigraphical and biogeographical purposes is difficult. However, some similarities and dissimilarities may be pointed out despite the incomplete nature of the material.

In previous work the cyclostomatous faunas of the northern and southern hemispheres were considered to be basically similar (Lang, 1908; Canu, 1911, 1922). In fact, despite the common presence of certain species such as *Pustulopora variabilis* and *P. virgula*, the faunas are quite distinct. It should also be realised that some identifications of widely distributed cyclostomatous species, or rather species groups, in the southern part of the world are based on material which is imperfectly preserved and may later have to be revised when better material becomes available.

Eighteen cyclostomatous species have been identified from the Need's Camp material, of which four also occur in the Upper Maestrichtian of Madagascar, namely: *Lichenopora betsibokensis, Diastopora madagascarensis, Pustulopora virgula* and *P. variabilis*. The remaining 14 are as yet known only from South Africa. However, this discrepancy between a South African and a Madagascan fauna should perhaps not be stressed since the ecological settings were not identical. There is nevertheless the suggestion of a

Table 1.

Comparison of Lang's specific determinations and those used in the present paper.

Lang, 1908	This paper
Filisparsa ramosa d'Orbigny	*Foliopora expansa* n.sp.
Filisparsa fragilis Marsson	*Foliopora expansa* n.sp.
Diastopora compressa (Goldfuss)	*Diastopora solida* n.sp.
Idmonea virgula d'Orbigny	*Idmidronea africana* n.sp.
Crisina cenomana d'Orbigny	*Idmidronea africana* n.sp.
Crisina excavata (d'Orbigny)	?
Crisina marginata (d'Orbigny)	?
Tervia dorsata (von Hagenow)	*Idmidronea langi* n.sp.
Tervia gibbera Gregory	*Idmidronea capensis* n.sp.
Tervia decurrens (Pocta)	?
Entalophora virgula (von Hagenow)	*Pustulopora virgula* (von Hagenow)
Entalophora conjugata von Reuss	*Pustulopora variabilis* von Hagenow
Entalophora echinata (Römer)	*Pustulopora variabilis* von Hagenow
Entalophora madreporacea Goldfuss)	*Clausa crassa* n.sp.
Spiropora verticellata (Goldfuss)	*Spiropora irregularis* n.sp.

biogeographical difference.

Two species from Need's Camp occur also in the Upper Cretaceous of South America (Canu, 1911) and suggest a link between these regions. However, the Argentine fauna consists almost entirely of encrusting forms on shells, whereas that from Need's Camp consists chiefly of erect species.

Two species, *Pustulopora virgula* and *P. variabilis,* also occur in Europe and are apparently widely distributed since they also occur in Madagascar.

AGE AND ENVIRONMENT

The limestone at the lower quarry of Need's Camp has been suggested by Lang (1908) to be of Campanian or Maastrichtian age from investigation of the bryozoans. Although most of the identifications made by Lang are now rejected, the present study supports his age assessment. This date is suggested by the presence of the species *Lichenopora betsibokensis, Diastopora madagascarensis* and *Pustulopora variabilis.* All occur both in the Need's Camp material and in the Maastrichtian of Madagascar. An Upper Campanian or Maastrichtian age is also suggested by MacGowran and Moore (1971).

Lang (1908) suggested a resemblance between the faunas of Need's Camp (Lower Quarry) limestone and the bryozoan limestone from Faxe in Denmark, but although bryozoa are common in both localities, the similarity is not very close. In the Danian of Scandinavia at localities such as Faxe, the cyclostomatous bryozoans consist chiefly of pustuloporids (erect, cylindrical stems), hornerids (double walled with idmidronid growth) and idmidronids (Brood, 1972). At Need's Camp the idmidronids are dominant among the cyclostomes and constitute more than 90 % of these if counted as specimens. The bryozoan fauna of Need's Camp therefore provides a closer ecological similarity in gross composition with the shallow water Campanian of southern Sweden (Brood, 1972), where the idmidronids are the dominating growth form. The bryozoan fauna therefore suggest a shallow water, reasonably high energy environment. Agitation of the water is further suggested by the presence of dorsal supports of kenozooecia and the stout shape of many bryozoan colonies.

SYSTEMATIC DESCRIPTIONS

Desmeplagioecia primitiva n.sp.
(figs. 4, 5)

Type specimens

Holotype: RM By 23626. Paratypes: RM By 23627–23628.

Diagnosis

A *Desmeplagioecia* with small, crowded autozooecia and a small gonozooecium.

Description

The zoarium is encrusting, forming small circular discs. The autozooecia are irregularly arranged in the centre of the colony, but tend to become arranged in uniserial rows near the margin, and are densely crowded. The autozooecial peristomes are short and open obliquely towards the surface of the colony. The autozooecial aperture is generally circular. The surfaces of the zooecia are faintly striated transversally.

The gonozooecium is situated near the margin of the colony. It is small and transversely elongated, approximately twice as wide as long and measures 0,35 × 0,70 mm in the holotype. Its oeciostome is terminal and tubular. The oeciopore is smaller than the aperture of an autozooecium, measures 0,040 mm in the holotype, and is transversely oval in outline.

Dimensions

Holotype and paratype.

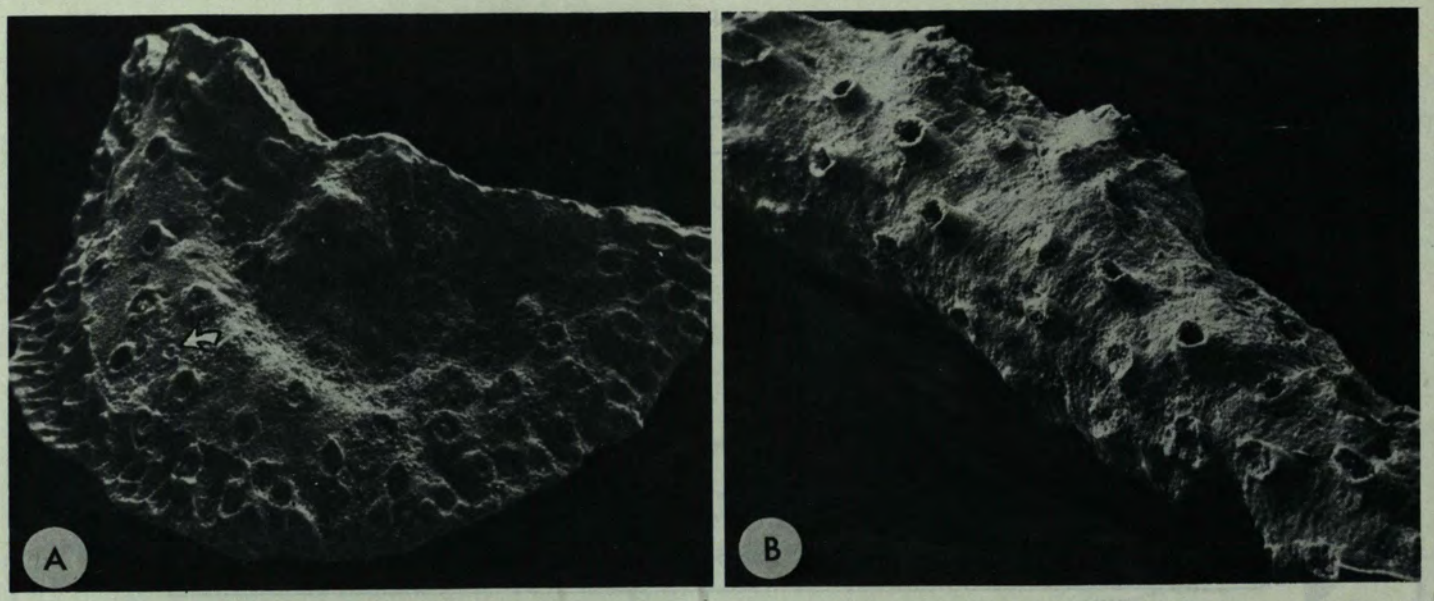


Figure 2. *Diastopora madagascarensis* Brood. A. Specimen with gonozooecium. Oeciopore at arrow. RM By 23643. X 35. B. Surface of encrusting specimen. RM By 23644. X 40.

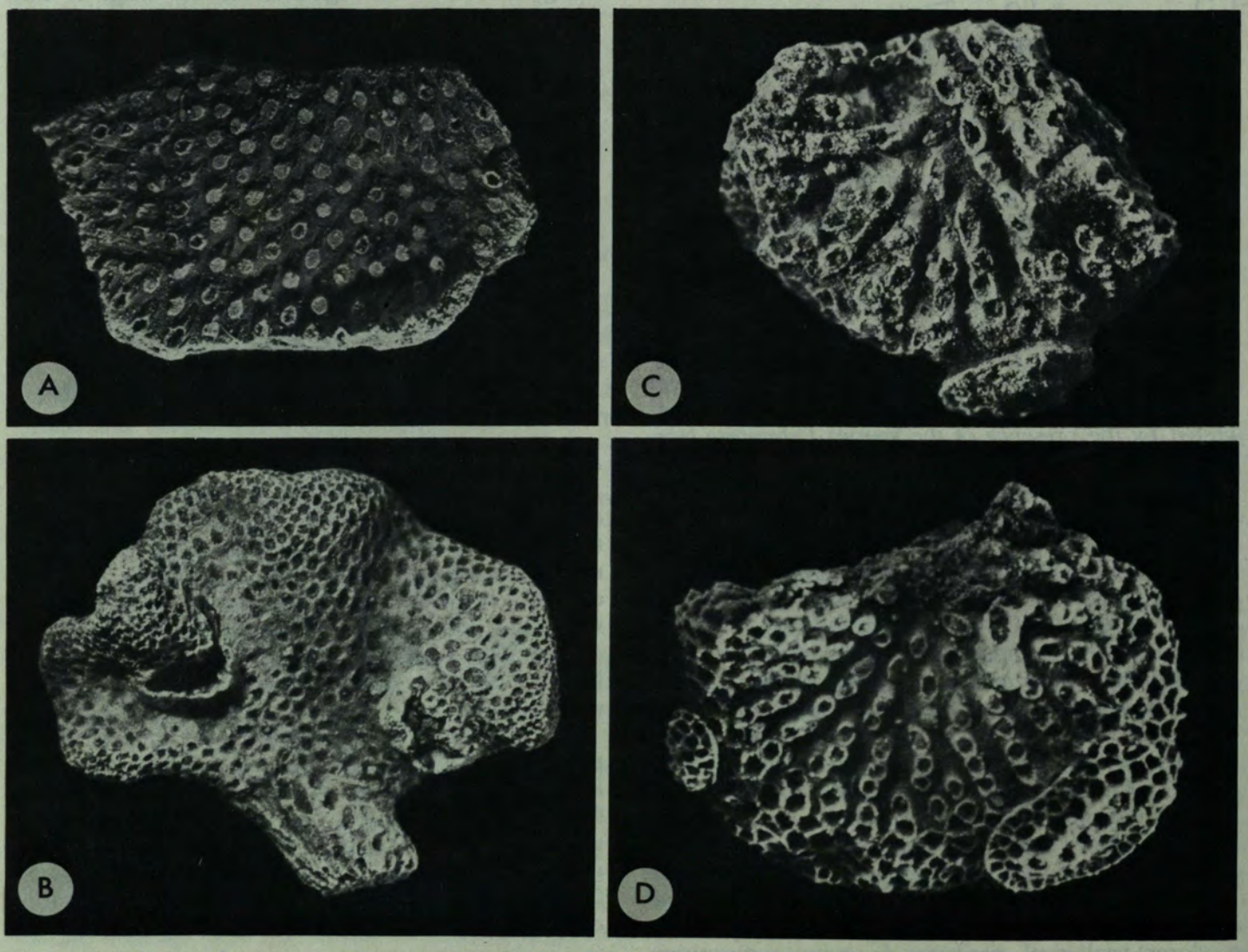


Figure 3. *Diastopora solida* n.sp. A. Specimen with well preserved peristomes. RM By 23647, paratype. X 20. B. Surface of bifoliate specimen with two gonozooecia. RM By 23645, holotype. X 14. *Theonoa striata* (Canu). C. Fragment of colony with subcolony. RM By 23635. X 25. D. Specimen with two subcolonies. RM By 23636. X 25.

	O.R.	$\bar{x}$	V	S	N
azap . .	0,050 — 0,068	0,057 ± 0,001	8,63	0,004 9	47
azp . . .	0,067 — 0,090	0,077 ± 0,004	16,72	0,012 8	47

Remarks

This species is characterized by its small dimensions and crowded autozooecia.

Diastopora madagascarensis Brood, 1976

(fig. 2)

1922 *Diaperoecia papyracea* (d'Orbigny); Canu, p. 137, Pl. XI, Figures 9, 10.

1976 *Diastopora madagascarensis* Brood, p. 400.

Referred Material 23643 — 23644.

Remarks

This species also occurs in the Maastrichtian and Palaeocene of Madagascar (Canu, 1922; Brood, 1976).

Diastopora solida n.sp.

(fig. 3 A, B)

Type specimens

Holotype: RM By 23645. Paratypes: RM By 23646–23649.

Diagnosis

A *Diastopora* with comparatively thick zoaria, autozooecia of moderate size and a large gonozooecium.

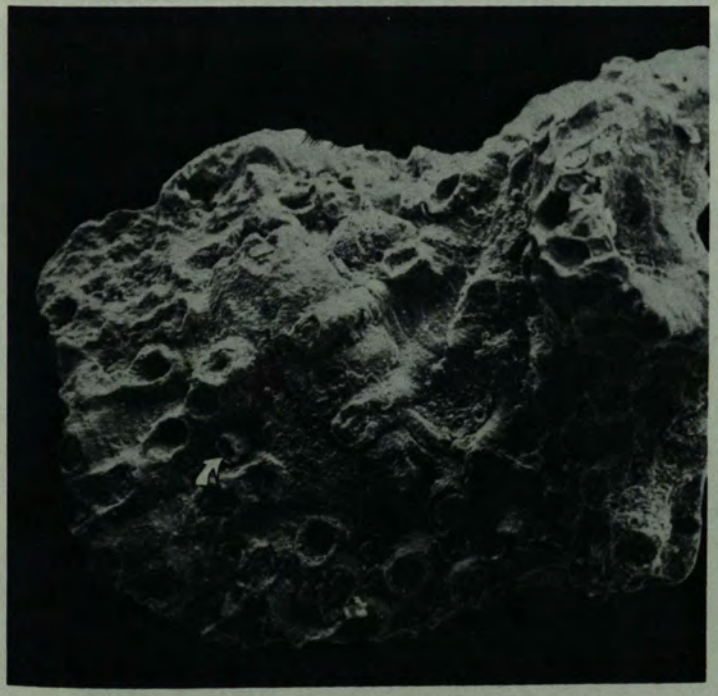


Figure 4. *Desmeplagioecia primitiva* n.sp. Specimen with gonozooecium. RM By 23626, holotype. X 50. Oeciopore at arrow.

Description

The zoarium is encrusting or erect, forming thick bilaminar fronds which are up to 1 mm thick. The autozooecia are long in section, curve gently outwards, and open in quincunx or irregularly. They are crowded, with short peristomes. The autozooecial aperture is circular and of moderate size. Commonly, the autozooecial peristome is absorbed especially near the margin of the bilaminate fronds.

The gonozooecium is large and transversely expanded. It is approximately 1 mm long and 1,5 mm wide.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
azap. . .	0,065 — 0,080	0,069 ± 0,001	5,79	0,004 0	49
azp . . .	0,077 — 0,112	0,087 ± 0,004	16,43	0,014 3	49
az/mm² .	26 — 33	30,7 ± 1,2	13,44	4,128	49

Remarks

This species is characterized by its massive zoarium with small autozooecial dimensions. The most common growth form in Need's Camp material is the bilaminate *"Mesenteripora"* type, which would normally be indicative of a shallow water environment.

D. solida differs from *D. madagascarensis* in having larger autozooecia and a thicker zoarium. It differs from *Diaperoecia formosa* (Canu, 1922) in having a thicker zoarium and a smaller gonozooecium.

Theonoa striata (Canu, 1911)

(fig. 3 C, D)

1911 *Actinopora striata* Canu, p. 276, Pl. XII, Figure 4.

Referred material

RM By 23634—23637.

Remarks

In the Need's Camp material there are several small fragments of a species which agree well with *T. striata* from the Upper Cretaceous of the Argentine.

Foliopora n.gen.

Type species. *Foliopora expansa* n.sp.

Derivation

Folium (Latin) = leaf, referring to the leaf-like shape of the zoarium.

Diagnosis

A tubuliporid genus with a leaf-like zoarium, where the autozooecia open on one side only. The reverse side lacks kenozooecia. Gonozooecium a much expanded sac, enveloping several autozooecial peristomes.

Description

The zoarium consists of an erect, leaf- or fan-shaped stem. The autozooecia open irregularly on one side

of the stem. The reverse side is free from kenozooecia.

The gonozooecium is large and flat, enclosing several autozooecial peristomes. The gonozooecial oeciopore is approximately of the same size as the autozooecial aperture and is transversely oval.

Remarks

Foliopora is characterized by its short, erect stems with the autozooecia opening on one side only. Superficially, the genus resembles *Nevianopora* or *Filisparsa,* but differs from *Nevianopora* in lacking the regular arrangement of autozooecia. It differs from *Filisparsa* in having much shorter and more expanded stems and a larger gonozooecium. This new genus may be related to *Filisparsa* and may therefore be tentatively referred to the family Filisparsidae Brood.

A modern species which possibly belongs to this genus is *Diaperoecia arcuata* Harmelin from the Mediterranean (Harmelin, 1976). There are other modern species commonly referred to *Diaperoecia* which might also be placed here.

Foliopora expansa n.sp.

(figs. 7 B, E, F; 8)

1908 *Filisparsa ramosa* d'Orbigny; Lang, p. 2, Pl. I, Figure 1.

Type material

Holotype: RM By 23678. Paratypes: RM By 23679—23684.

Diagnosis

Flat, erect stems with autozooecia opening on one side. Autozooecia of moderate size. Gonozooecium flat, much expanded, enclosing several autozooecial peristomes.

Description

The zoarium is erect and consists of single or dichotomously branching stems, which are flat and approximately 1 mm wide. Generally, the stems are curved towards the reverse side. The autozooecia open irregularly on the frontal side and are densely crowded. Peristomes of the autozooecia are generally short with a circular aperture. The dorsal side of the colony is smooth and free from autozooecia, but may be transversely striated. Kenozooecia are lacking.

The gonozooecium is large and much expanded. It encloses several autozooecial peristomes. The oeciopore is smaller than an autozooecial aperture, is circular in outline and not adjacent to an autozooecial peristome.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
azap . .	0,070 — 0,100	0,078 ± 0,002	7,74	0,006 1	46
azp . . .	0,093 — 0,120	0,109 ± 0,002	6,99	0,007 6	46

Remarks

F. expansa has a superficial likeness to species of *Filisparsa* and Lang (1908) identified it with *F. ramosa* from the Turonian of Europe. It differs, however, from that species in general shape and size.

Idmonea compressa n.sp.

(figs. 6; 7 A, C, D)

Type specimens

Holotype: RM By 23650. Paratypes: RM By 23651–23657.

Diagnosis

An *Idmonea* with a compound zoarium consisting of small subcolonies which are approximately 1 mm long and 0,5 mm wide. Autozooecia are arranged in lateral rows, but do not form fascicles. Subcolonies are surrounded by many small kenozooecia with hexagonal distal walls.

Description

The zoarium consists of small, elongate or oval subcolonies united by areas of kenozooecia. The subcolonies consist of short transverse rows of autozooecia which contain three to four zooecia each. There are approximately 5–15 rows of zooecia in each subcolony. Fascicles are never formed. Generally the innermost zooecium is the largest and the lateral ones decrease in size outwards. The exterior part of the autozooecium is short and hexagonal in outline. Autozooecial apertures are circular and small.

Between the subcolonies there are areas of kenozooecia. These are long in section but terminate with a hexagonal or rhombic distal wall. Kenozooecial walls form a reticulate pattern on the zoarial surface.

The interzooecial walls are thick and measure up to 0,050 mm. Exterior walls may be up to 0,100 mm thick. Diaphragms are generally absent.

The gonozooecium is narrow and placed in the centre of a subcolony and forms a thin immersed elongation between the autozooecial rows. It is approximately 1 mm long and 0,2 mm wide.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
azap . . .	0,070 — 0,110	0,090 ± 0,002	6,37	0,005 7	59
azp	0,125 — 0,140	0,129 ± 0,001	3,57	0,004 6	59
az length	0,150 — 0,400	0,335 ± 0,015	16,89	0,056 9	59

(All measurements taken from the inner autozooecia.)

Remarks

This species differs from the contemporary *Reptoclausa jugum* Voigt from the Turkmenistan in having shorter kenozooecia and three to four autozooecia per row.

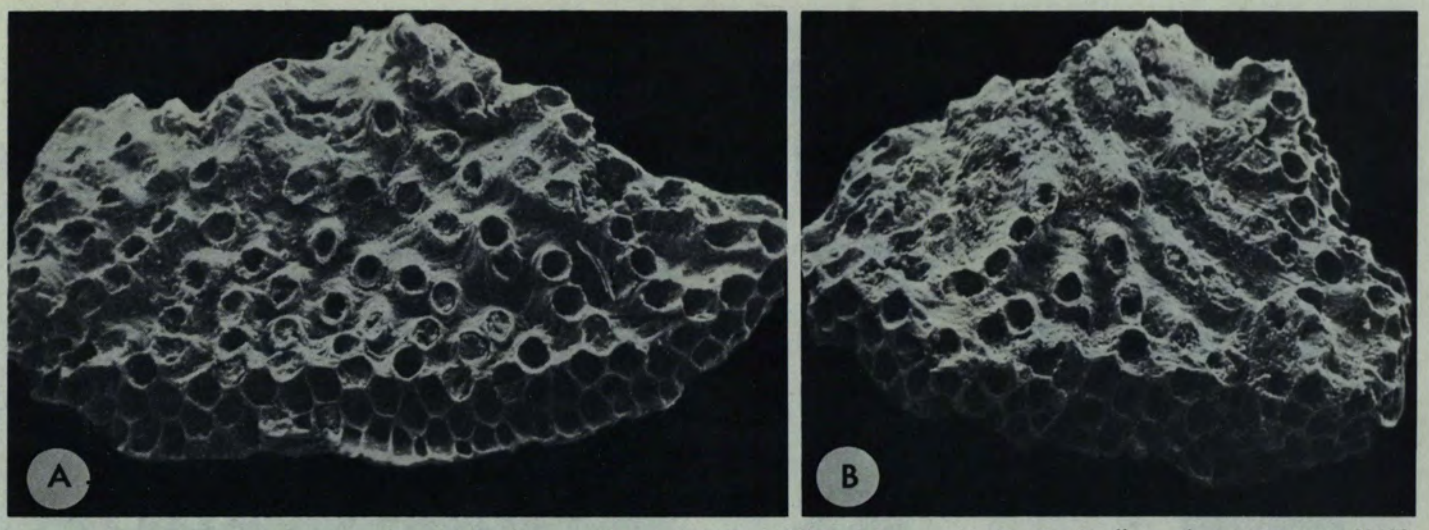


Figure 5. *Desmeplagioecia primitiva* n.sp. A. Broken specimen. RM By 23627, paratype. X 40. B. Small specimen. RM By 23628, paratype. X 40.

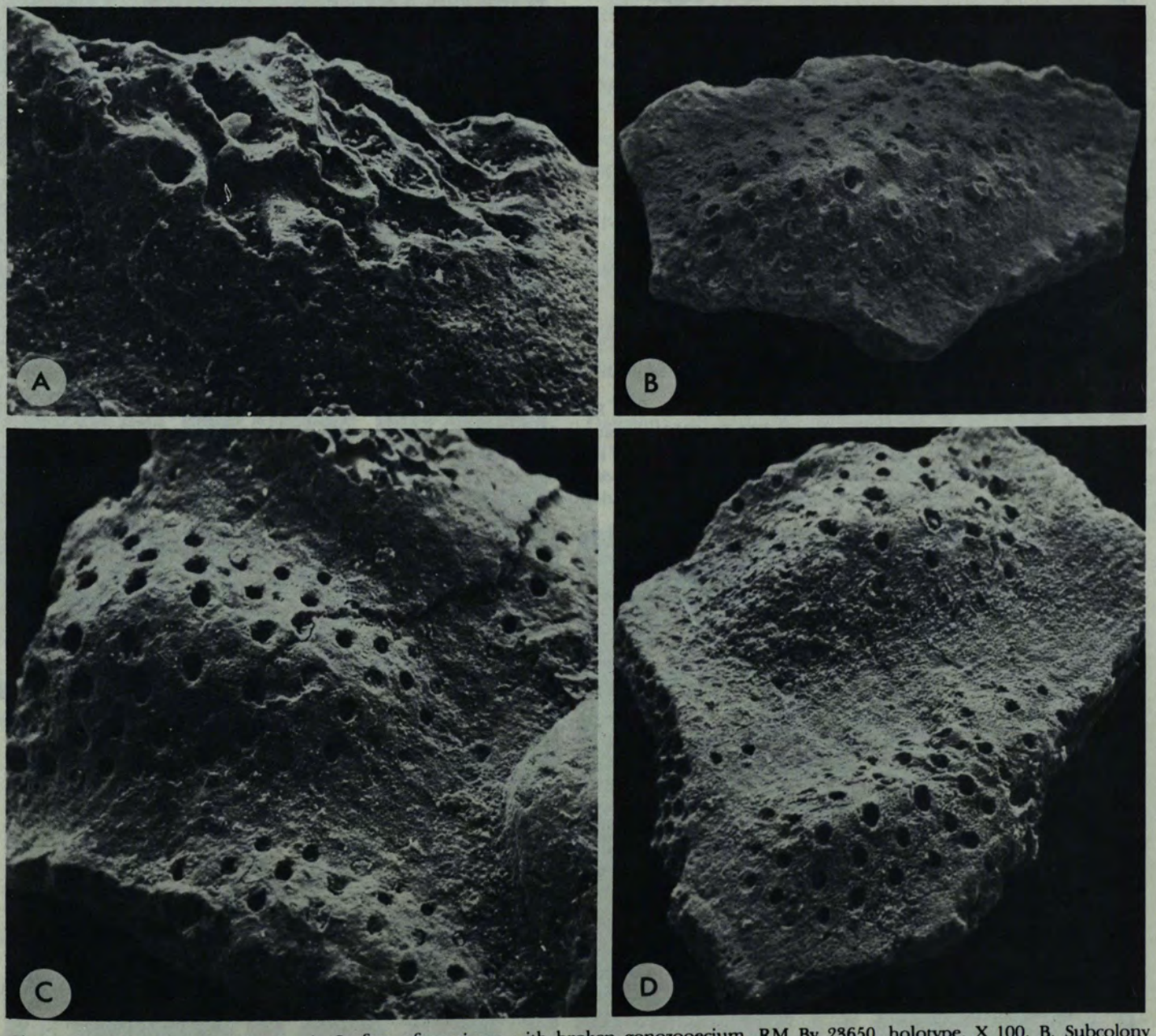


Figure 6. *Idmonea compressa* n.sp. A. Surface of specimen with broken gonozooecium. RM By 23650, holotype. X 100. B. Subcolony with gonozooecium. RM By 23652, paratype. X 50. C. Specimen with several subcolonies. RM By 23650, holotype. X 40. D. Specimen with two subcolonies. RM By 23652, paratype. X 30.

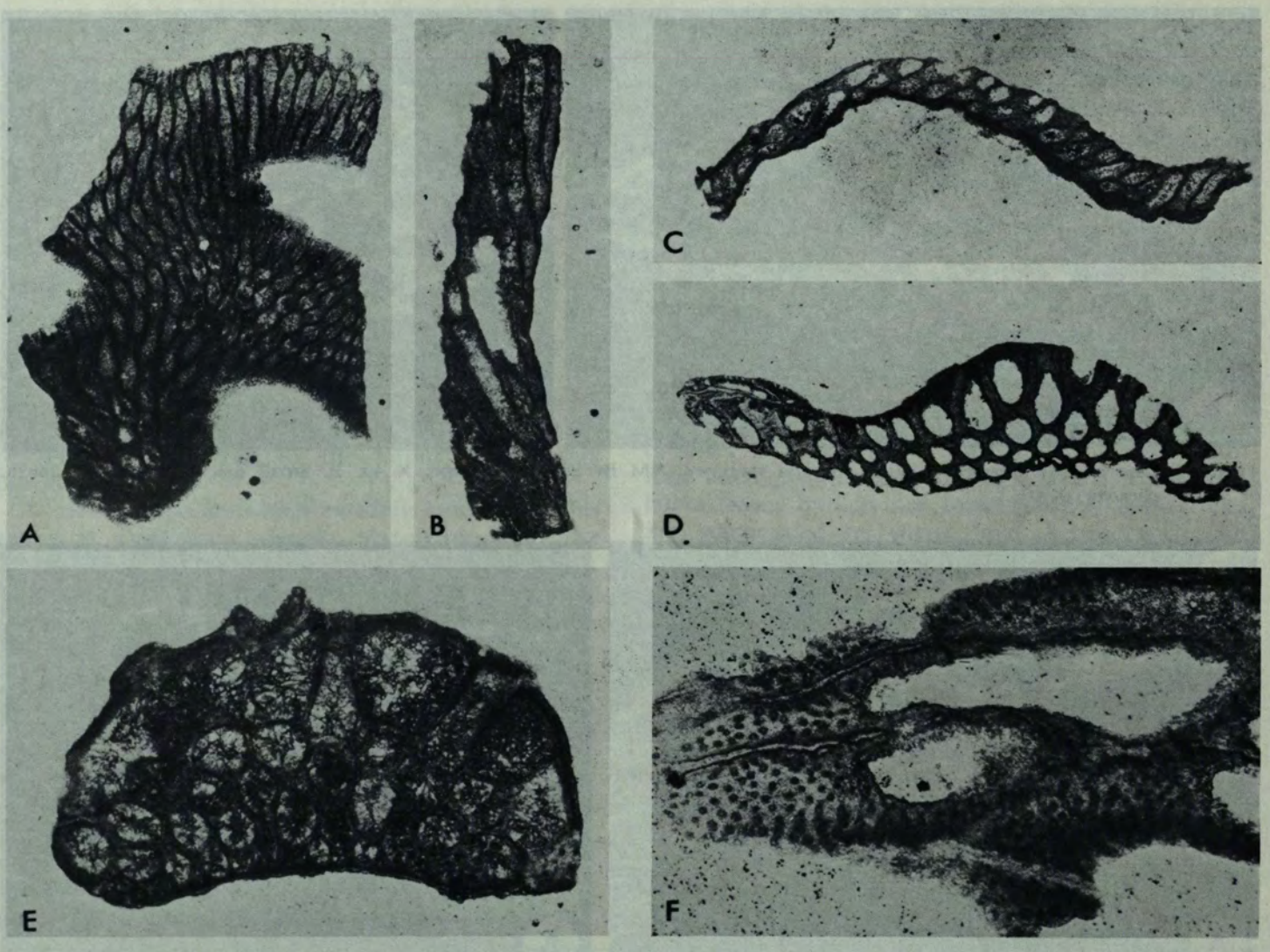


Figure 7. *Idmonea compressa* n.sp. A. Tangential thin section. RM By 23657, paratype. X 25. C. Longitudinal thin section showing short zooecia and thin zoarium. RM By 23655, paratype. X 25. D. Transverse section of subcolony. Note multilayered part to the left. RM By 23654, paratype. X 35. *Foliopora expansa* n.sp. B. Longitudinal thin section showing autozooecia. RM By 23682, paratype. X 30. E. Transverse thin section showing gonozooecium. RM By 23683, paratype. X 55. F. Tangential section of frontal part of autozooecia showing pseudopores. RM By 23684, paratype. X 100.

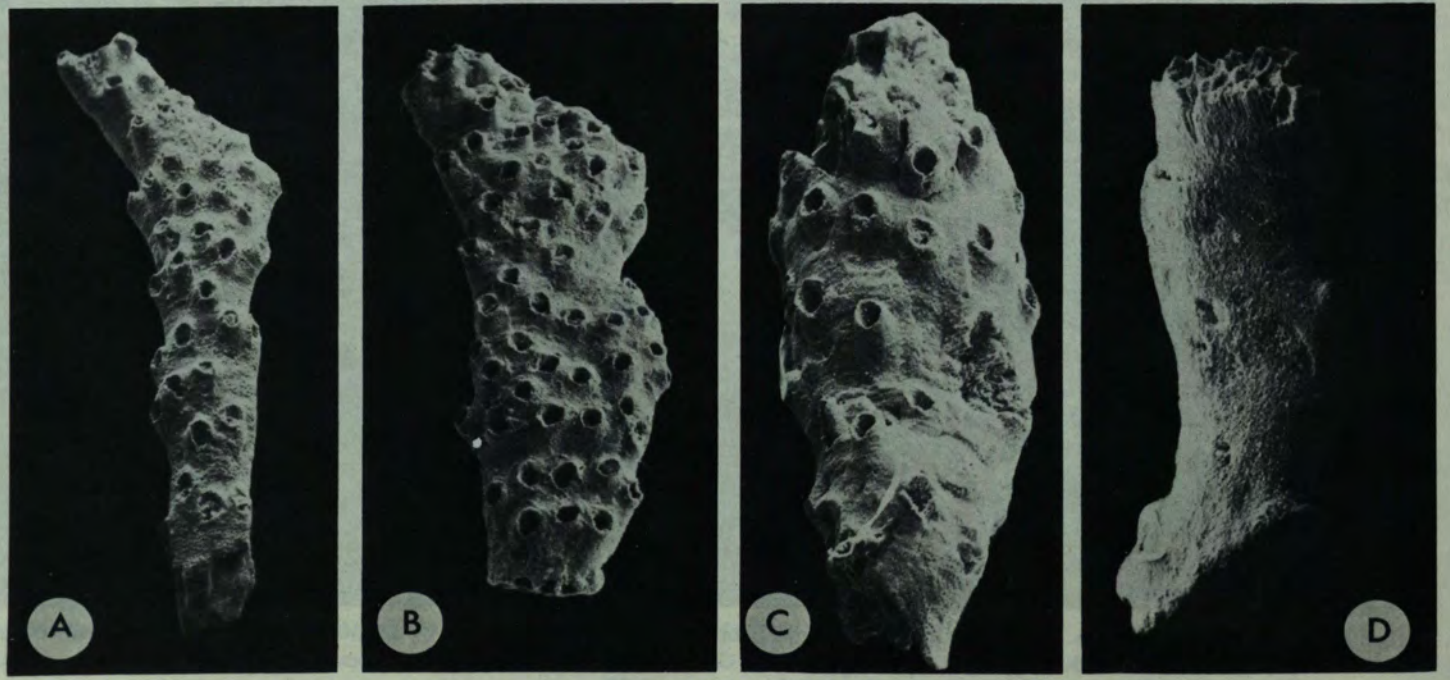


Figure 8. *Foliopora expansa* n.sp. A. Specimen seen from frontal side. RM By 23679, paratype. X 20. B. Specimen seen from frontal side. RM By 23678, holotype. X 20. C. Specimen with gonozooecium seen from frontal side. RM By 23680, paratype. X 30. D. Specimen from reverse side. RM By 23681, paratype. X 40.

Idmidronea robusta n.sp.

(figs. 11 A; 13 A)

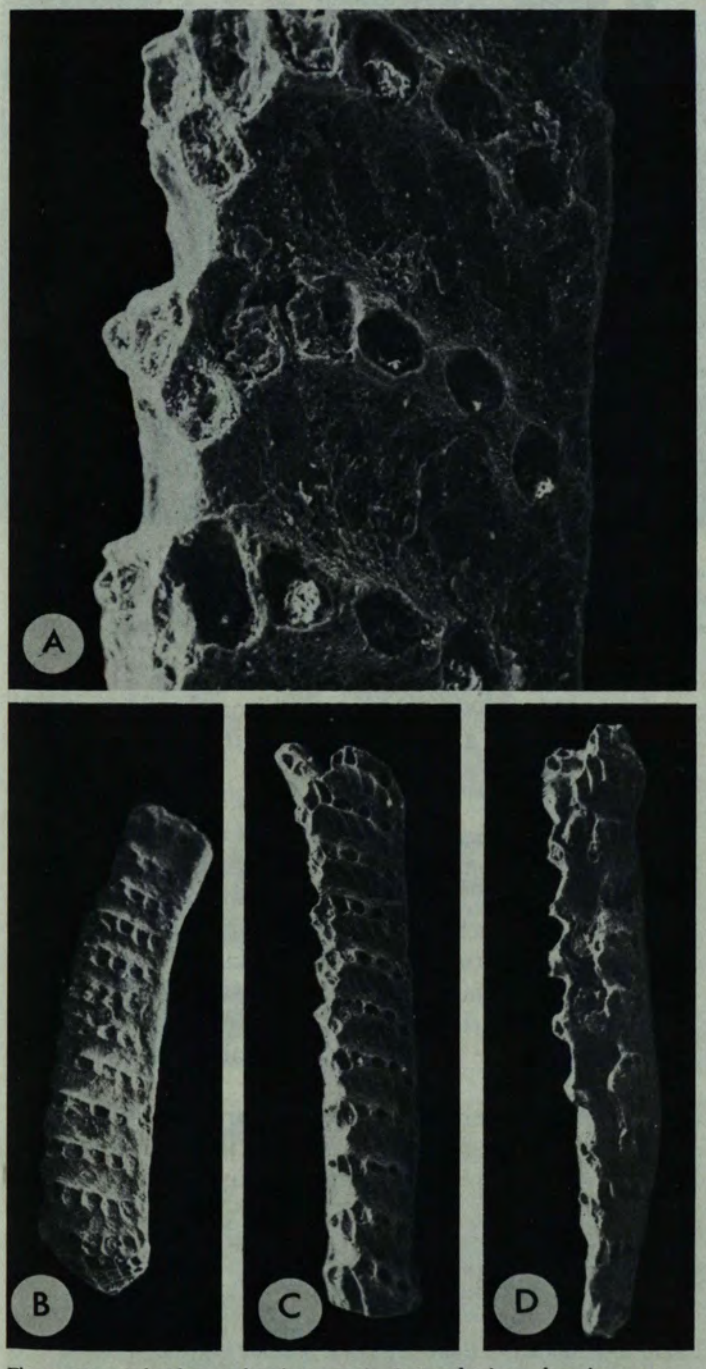


Figure 9. *Idmidronea langi* n.sp. A. Lateral view showing autozooecial rows. RM By 23658, holotype. X 80. B. Another lateral view. RM By 23659, paratype. X 17. C. Frontal view of specimen. RM By 23658, holotype. X 17. D. Specimen with broken gonozooecium seen from frontal side. RM By 23660, paratype. X 17.

Type specimens

Holotype: RM By 23638. Paratypes: RM By 23639–23641.

Diagnosis

A large *Idmidronea* with seven to eight autozooecia per fascicle.

Description

The zoarium is erect, composed of dichotomously branching triangular stems, which are on the average 1,5 mm wide. The autozooecia are large and are each arranged in alternating fascicles of seven or eight zooecia. The interfascicular space is small. The dorsal side of the stem is flat and transversely striated. Gonozooecium not observed.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
azap . . .	0,113 — 0,146	0,124 ± 0,003	7,23	0,009 0	43
azp	0,135 — 0,180	0,157 ± 0,004	7,77	0,012 2	43
daf	0,175 — 0,525	0,371 ± 0,027	23,48	0,087 5	43

Remarks

This species is characterized by its large dimensions, which separate it from other Upper Cretaceous species of *Idmidronea.*

Idmidronea africana n.sp.

(figs. 10; 11 C, E, F, H, I)

1908 *Crisina cenomana* d'Orbigny; Lang, p. 5, Pl. I, Figure 5.

1908 *Idmonea virgula* d'Orbigny; Lang, p. 4, Pl. I, Figure 4.

1908 *Crisina excavata* (d'Orbigny); Lang, p. 6, Pl. I, Figure 6.

Type specimens

Holotype: RM By 23665. Paratypes: RM By 23666–23673.

Diagnosis

An *Idmidronea* with four to eight autozooecia in each fascicle and a long gonozooecium. Dorsal side flattened. The oeciopore is adjacent to a fascicle of autozooecia and is small. Autozooecia are of moderate size.

Description

The zoarium is erect, composed of dichotomously branching stems with triangular cross section. The stems are approximately 0,8 mm wide and commonly curved dorsally. The autozooecia are of moderate size and open in alternating fascicles, each containing four to eight autozooecia. The kenozooecia are few and may form a thin layer on the dorsal side of the stem. Commonly kenozooecia are lacking. The dorsal side is flat, sometimes slightly concave, and shows growth striations. Kenozooecia may have dorsal supports.

Autozooecia are of moderate length and generally lack diaphragms.

The genozooecium is long and narrow, and placed on the mid-part of the frontal side between fascicles of autozooecia. It extends along three to seven interfascicular areas. The curved, tabular oe-

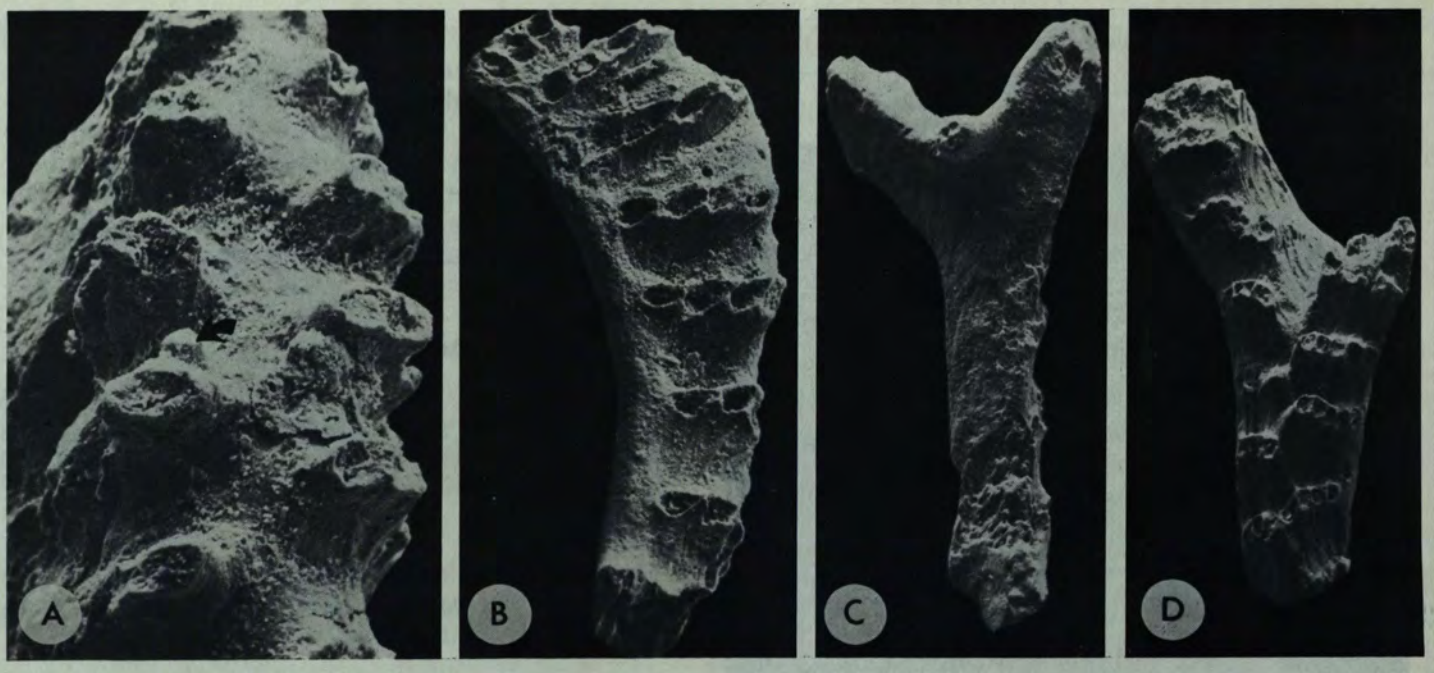


Figure 10. *Idmidronea africana* n.sp. A. Frontal view showing gonozooecium with oeciopore. RM By 23666, paratype. X 90. B. Lateral view of specimen with gonozooecium. RM By 23665, holotype. X 35. C. Dorsal view showing kenozooecial support at bifurcation. RM By 23667, paratype. X 30. D. Bifurcating specimen seen from frontal side. RM By 23669, paratype. X 30.

ciostome is placed near the middle of the gonozooecium and opens adjacent to an autozooecial fascicle. The oeciopore is circular in outline and its diameter less than an autozooecial aperture. It measures 0,040 mm and its oeciostome 0,045 mm in the holotype.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
azap	0,046 — 0,066	0,053 ± 0,001	9,19	0,004 9	46
azp	0,063 — 0,093	0,075 ± 0,002	10,89	0,008 2	46
daf	0,150 — 0,325	0,220 ± 0,012	18,35	0,040 4	46
gl	0,70 — 2,50	1,41 ± 0,039	41,49	0,587	11
gw	0,35 — 0,70	0,50 ± 0,007	20,85	0,105	11

Remarks

This species is common in the material from Need's Camp. It is characterized by relatively small dimensions, by having many autozooecia in the fascicles, and by a long gonozooecium. It differs from the contemporary European species *I. filiformis* (D'Orbigny) in having a much longer gonozooecium and more autozooecia per fascicle.

Idmidronea langi n.sp.

(figs. 9; 11 B, D)

1908 *Tervia dorsata* (von Hagenow); Lang, p. 7, Pl. I, Figure 8.

1911 *Idmonea carinata* Romer; Canu, p. 275, Pl. VI, Figures 8, 9.

Type specimens

Holotype: RM By 23658. Paratypes: RM By 23659–23664.

Diagnosis

A large *Idmidronea* with approximately five zooecia per fascicle and a long, narrow gonozooecium.

Description

The zoarium is erect, composed of triangular, dichotomously branching stems, which are approximately 1 mm in cross section. Autozooecia open in alternating fascicles, each composed of five, rarely six or four, autozooecia. The dorsal side is flat with faint growth striations. Generally there are no kenozooecia on the dorsal side, but a thin layer may be present in some specimens. The autozooecia are of moderate size.

Autozooecia are of moderate length and lack diaphragms. The gonozooecium is long and narrow. It extends along six to eight interfascicular areas.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
azap	0,065 — 0,087	0,073 ± 0,002	7,82	0,006 8	47
azp	0,085 — 0,114	0,099 ± 0,002	6,84	0,006 7	47
daf	0,150 — 0,275	0,230 ± 0,010	14,47	0,033 3	47
gl	1,80 — 2,80	2,30 ± 0,45	17,75	0,408	4
gw	0,40 — 0,80	0,64 ± 0,22	30,96	0,197	4

Remarks

This species is characterized by its triangular stems with crowded autozooecial fascicles, its long gonozooecium and moderate autozooecial size. It differs from the contemporary *I. suecica* Brood from Europe in having smaller autozooecia and a longer gonozooecium.

The species from the Rocanian of Argentine identified by Canu as *Idmonea carinata* Römer may be the

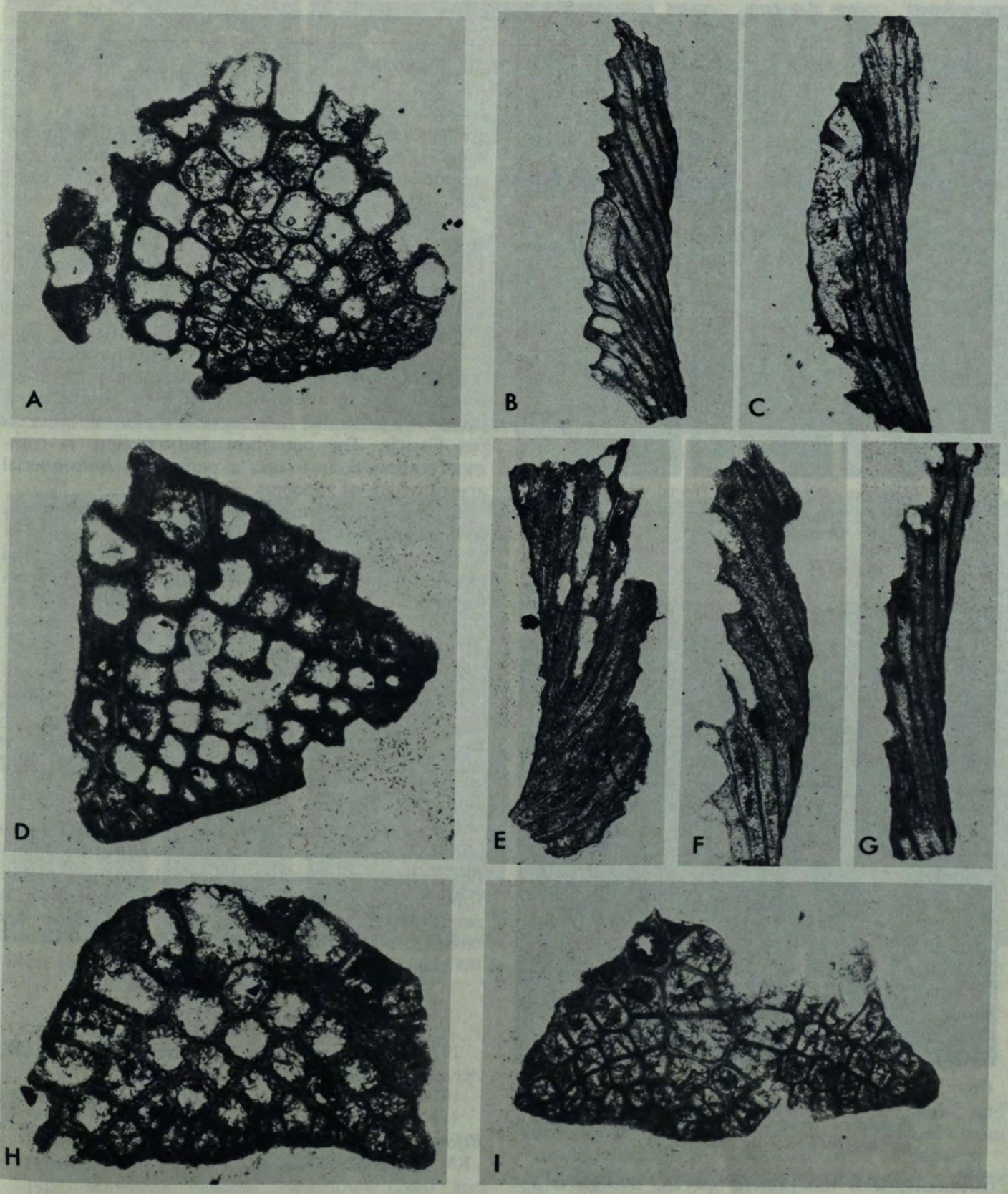


Figure 11. *Idmidronea robusta* n.sp. A. Transverse section of stem. RM By 23641, paratype. X 50. *Idmidronea langi* n.sp. B. Longitudinal section of stem with gonozooecium. RM By 23662, paratype. X 30. D. Transverse section of stem. RM By 23663, paratype. X 65. *Idmidronea africana* n.sp. C. Longitudinal section showing stem with gonozooecium. RM By 23670, paratype. X 30. E. Longitudinal section of stem. RM By 23656, paratype. X 35. F. Longitudinal section of stem. RM By 23673, paratype. X 35. H. Transverse section of stem with gonozooecium. RM By 23672, paratype. X 80. I. Transverse section of bifurcating stem. RM By 23671, paratype. X 60. *Idmidronea capensis* n.sp. G. Longitudinal section through stem showing long autozooecia. RM By 23677, paratype. X 30.

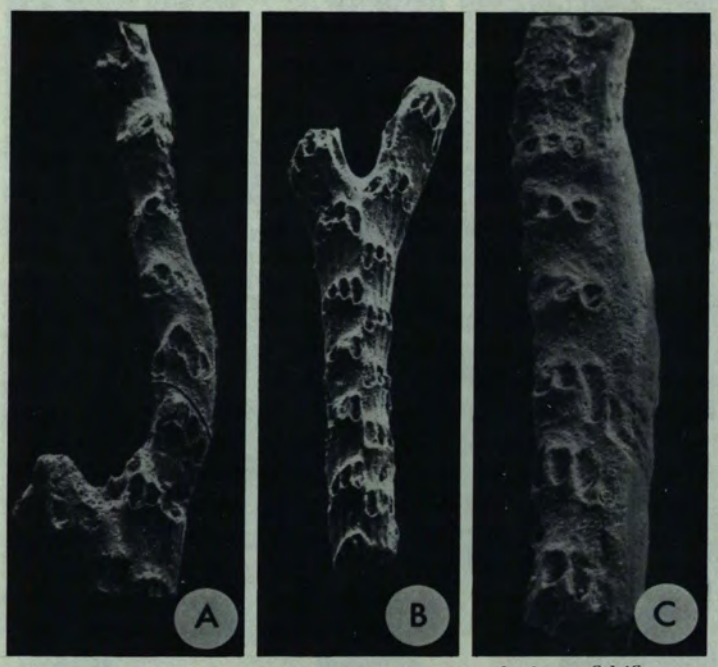


Figure 12. *Idmidronea capensis* n.sp. A. Frontal view of bifurcating specimen. RM By 23674, holotype. X 20. B. Frontal view of bifurcating specimen. RM By 23675, paratype. X 20. C. Lateral view of small specimen. RM By 23676, paratype. X 28.

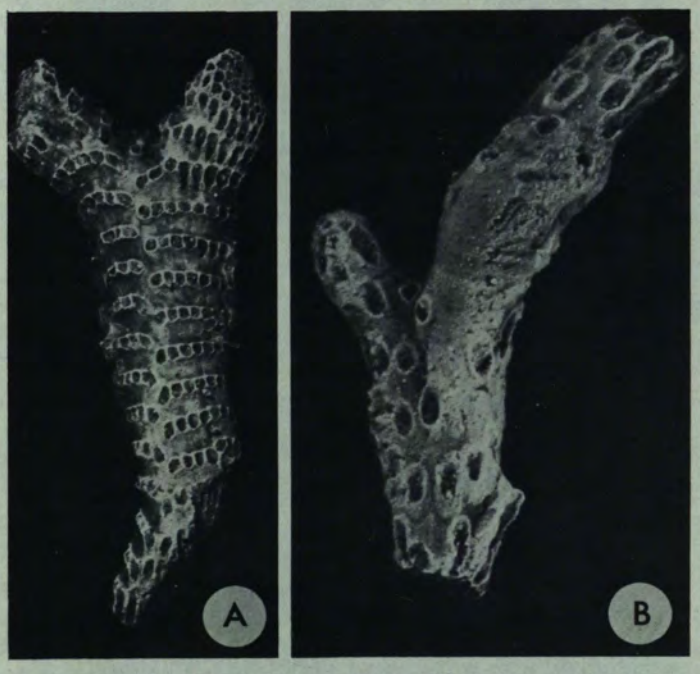


Figure 13. *Idmidronea robusta* n.sp. A. Bifurcating specimen seen from frontal side. RM By 23638, holotype. X 8. *Pustulopora variabilis* Hagenow. B. Specimen with gonozooecium. RM By 23629. X 18.

conspecific with the present species, though it appears to have slightly larger autozooecial dimensions.

Idmidronea capensis n.sp.

(figs. 11 G; 12)

1908 *Tervia gibbera* (Gregory); Lang, p. 7, Pl. I, Figure 9.

Type specimens

Holotype: RM By 23674. Paratypes: RM By 23675–23677.

Diagnosis

A medium-sized *Idmidronea* with three to four autozooecia per fascicle. The stem is smooth and rounded on the reverse. The gonozooecium is globular.

Description

The zoarium is erect, composed of dichotomously branching stems, which are subtriangular in cross section. The stems are approximately 0,5 mm wide. The reverse of the stems is rounded and shows faint growth striations. A thin layer of kenozooecia is commonly present on the dorsal side. The autozooecia open in alternating fascicles on the sides of the stem, generally with three to four autozooecia per fascicle. The outermost autozooecium is commonly aborted and lacks a peristome. Autozooecial apertures are of moderate size.

In section the autozooecia are long and generally lack diaphragms.

The gonozooecium is more or less globular and placed in the middle of the stem. In the only specimen examined it is 1,1 mm long and 0,4 mm wide.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
azap . . .	0,053 — 0,085	0,071 ± 0,003	12,04	0,008 5	43
azp	0,073 — 0,110	0,092 ± 0,003	10,12	0,009 3	43
daf	0,175 — 0,325	0,265 ± 0,009	10,95	0,029 0	43

Remarks

This species is characterized by rounded stems with approximately three autozooecia per fascicle. It differs from *I. globulosa* Brood from the Danian of Europe in its rounded stem and longer autozooecia. *I. langi* has triangular stems, more autozooecia per fascicle, and a longer gonozooecium.

Pustulopora virgula von Hagenow, 1840

(figs. 14 C, D)

1972 *Pustulopora virgula* Hagenow; Brood, p. 283 (see also for older synonyms).

1976 *Pustulopora virgula* Hagenow; Brood, p. 402.

Referred Material

RM By 23632–23633.

Remarks

This species is fairly common at Need's Camp. The specimens agree well in size and shape with those of the same age from Europe and Madagascar.

Pustulopora variabilis Hagenow, 1851

(figs. 13 B; 14 A, B)

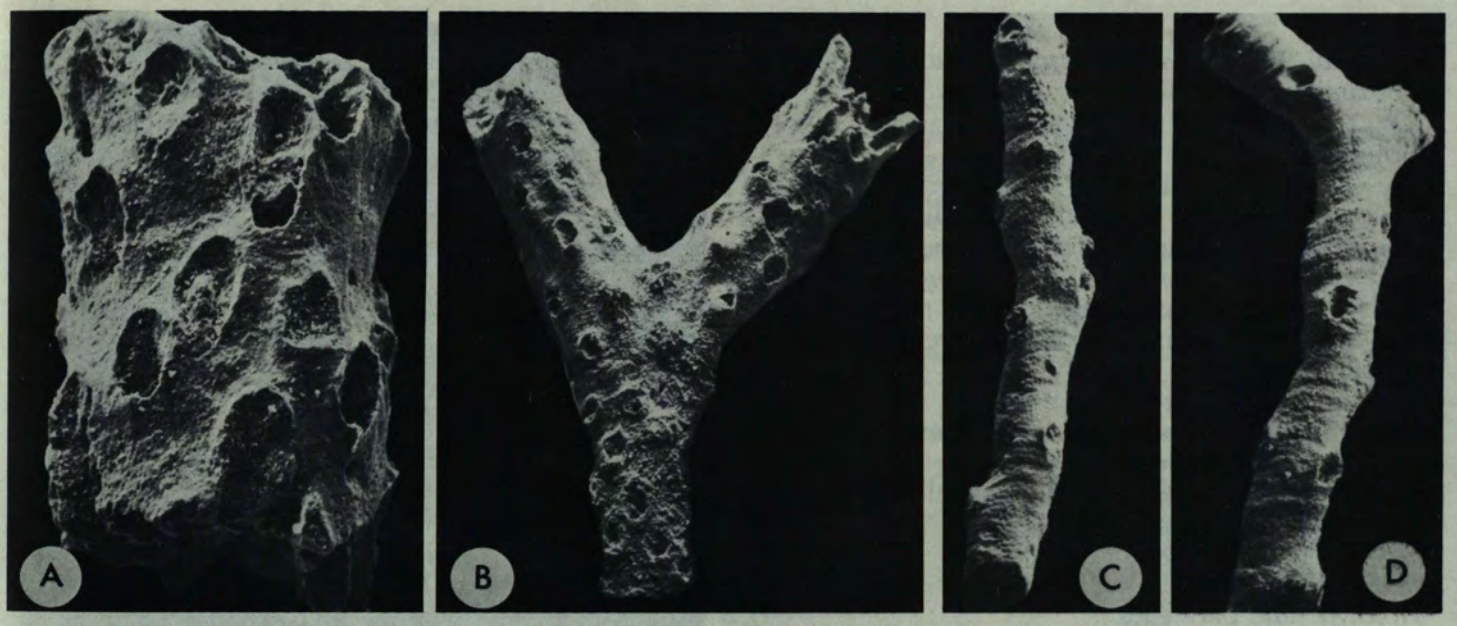


Figure 14. *Pustulopora variabilis* Hagenow. A short specimen. RM By 23630. X 40. B. Bifurcating specimen. RM By 23631. X 20. *Pustulopora virgula* Hagenow. C. Thin stem. RM By 23632. X 20. D. Bifurcating specimen. RM By 23633. X 20.

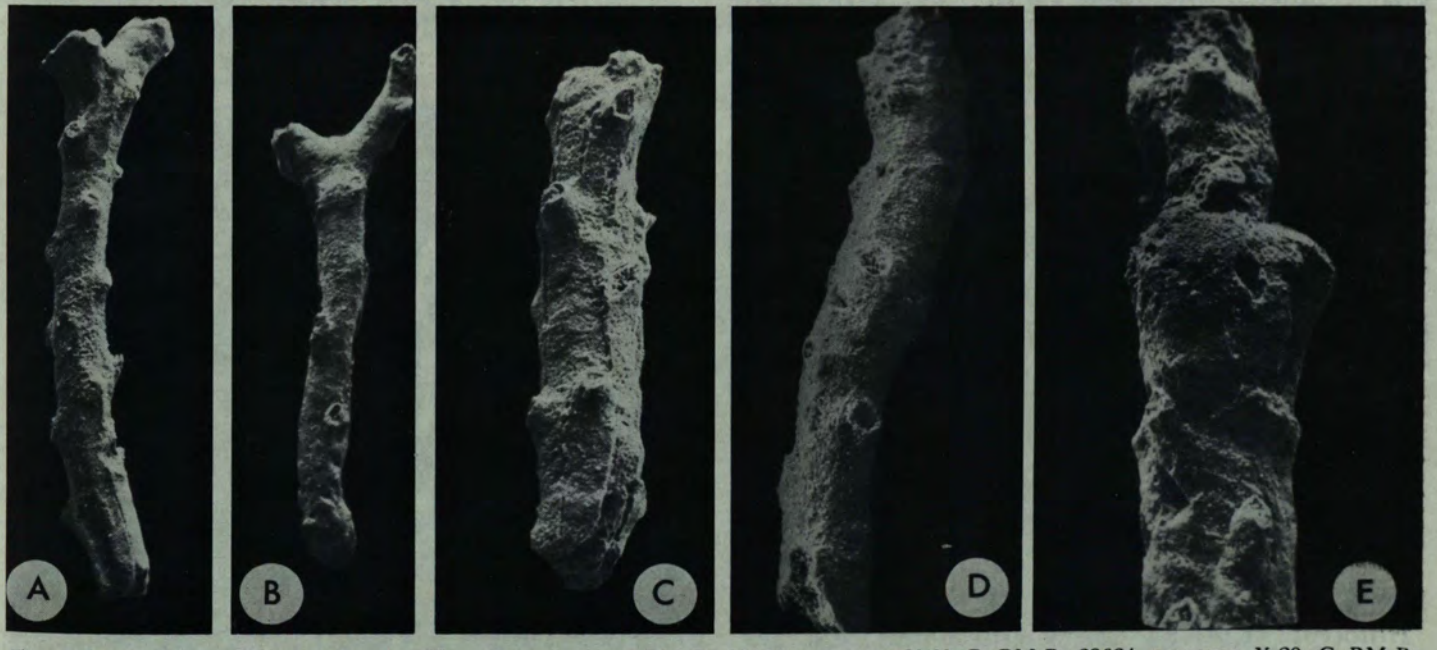


Figure 15. *Pustulopora minuta* n. sp. A. Bifurcating specimen. RM By 23623, paratype. X 20. B. RM By 23624, paratype. X 20. C. RM By 23625, paratype. X 30. D. RM By 23626, paratype. X 20. E. Specimen with gonozooecium. RM By 23622, holotype. X 30.

1840 *Pustulopora variabilis* Hagenow, p. 19, Pl. I, Figure 9.

1888 *Entalophora variabilis* Hagenow; Pergens, p. 205.

1899 *Clausa variabilis* Hagenow; Gregory, p. 417.

1908 *Entalophora echinata* (Römer); Lang, p. 9, Pl. I, Figure 12.

1922 *Mecynoecia variabilis* Hagenow; Canu and Bassler, p. 17, Pl. I, Figure 14.

1972 *Pustulopora variabilis* Hagenow; Brood, p. 289, Pl. XLI, Figures 1, 2.

1976 *Pustulopora variabilis* Hagenow; Brood, p. 403, Pl. 6, Figures 8, 9.

?1872 *Entalophora pavimentata* Stolizcka, p. 32, Pl. III, Figure 11.

Referred Material

RM By 23629–23631.

Remarks

This species is fairly common in the fauna, and corresponds well with specimens described from Europe and from the Maastrichtian of Madagascar.

Lang (1908) identified this species with *E. echinata* Römer from the European Turonian.

Pustulopora minuta n.sp.
(figs. 15; 18 B, C)

Holotype

RM By 23622. Paratypes: RM By 23620–23621, 23623–23625.

Diagnosis

A small *Pustulopora* with long autozooecia and a globular gonozooecium.

Description

The zoarium consists of thin, erect, cylindrical stems approximately 0,4 mm wide which bifurcate dichotomously. Autozooecia are long with well marked zooecial boundaries. The autozooecial apertures are directed transversely towards the stem surface. The peristome is short with a circular aperture of small diameter.

The autozooecia are long in section and generally lack diaphragms. New zooecia are generally budded from the centre of the stem.

The gonozooecium is small and globular. It is 0,4 mm long and 0,35 mm wide in the holotype.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
apaz	0,043 — 0,055	0,046 ± 0,001	8,07	0,003 7	49
azp	0,058 — 0,073	0,064 ± 0,001	7,76	0,005 0	49
azw	0,067 — 0,094	0,073 ± 0,002	8,22	0,006 0	49
fwl	0,450 — 1,000	0,708 ± 0,032	15,11	0,107	49

Remarks

This species is characterized by its small dimensions. It resembles *P. pulchra* Brood from the Campanian of Scandinavia in general shape, but differs in having smaller autozooecia.

P. bonamaryi Brood from the Palaeocene of Madagascar differs in having larger autozooecial dimensions.

Spiropora irregularis n.sp.

(figs. 18 D–F; 19)

1908 *Spiropora verticellata* (Goldfuss); Lang, p. 10, Pl. I, Figure 13.

Type specimen

Holotype: RM By 23615. Paratypes: RM By 23613–23614, 23616–23619.

Diagnosis

A *Spiropora* with thick stems, large autozooecial apertures and incompletely developed verticells.

Description

The zoarium is erect, composed of dichotomously branching cylindrical stems, which are 0,5 — 1,5 mm wide. Autozooecial apertures open in annular cycles around the stems. The rings are commonly not fully developed and can be replaced by ascending spirals or rarely by an irregular arrangement of autozooecial apertures. The frontal walls of autozooecia are flat with well-marked zooecial boundaries. The autozooecial aperture is circular in outline.

Autozooecia are long in section, generally without diaphragms. The interzooecial walls are thick, approximately 0,030 mm at the distal end. The exterior walls are approximately 0,040 mm thick. The gonozooecium is not known.

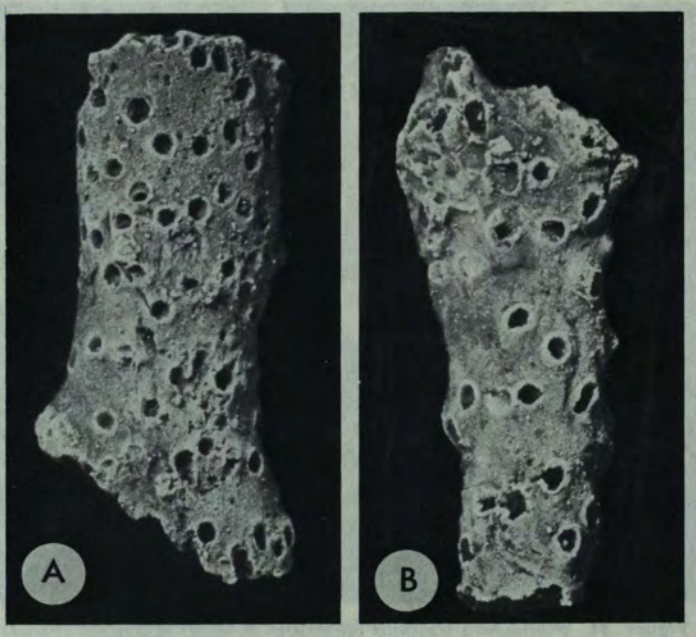


Figure 16. *Clausa crassa* n.sp. A. Short specimen. RM By 23611, paratype. X 13. B. Thin specimen. RM By 23612, paratype. X 15.

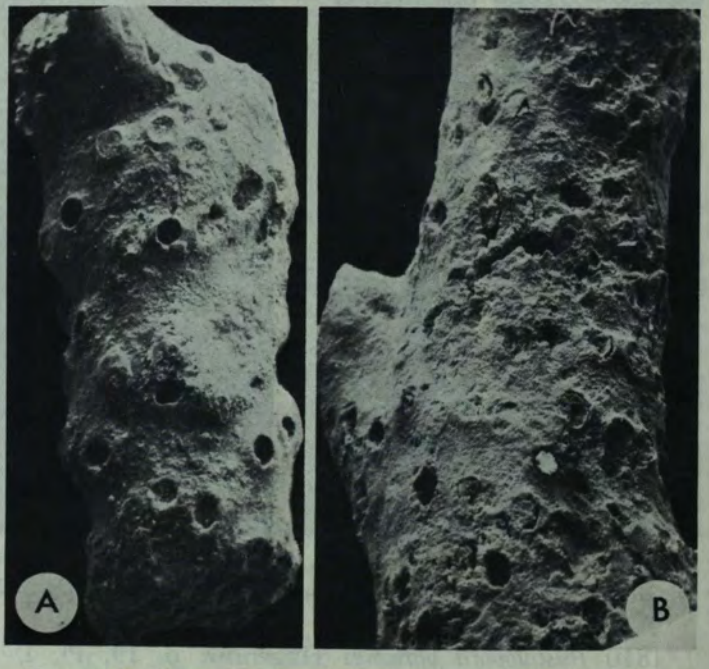


Figure 17. *Clausa crassa* n.sp. A. Small specimen. RM By 23610, paratype. X 20. B. Bifurcating specimen. RM By 23609, holotype. X 20.

Dimensions

Holotype and paratypes.

	O.R.	x	V	s	N
azap	0,080 — 0,120	0,103 ± 0,003	10,14	0,010 5	46
azp	0,110 — 0,160	0,137 ± 0,004	9,63	0,013 2	46
fwl	0,650 — 1,050	0,828 ± 0,034	13,18	0,131	46

Remarks

This species is characterized by its tendency to have incomplete verticells so that the apertures of autozooecia are commonly arranged in spirals. It differs from the contemporary *S. verticellata* (Goldfuss) from Europe in the arrangement of autozooecia and in having smaller autozooecial dimensions. *S. ingens* Voigt from the Santonian of Europe is a larger species.

Clausa crassa n.sp.
(figs. 16; 17; 18 A)

1908 *Entalophora madreporacea* (Goldfuss); Lang, p. 10, Pl. I, Figure 14.

Referred specimens

Holotype: RM By 23609. Paratypes: RM By 23607, 23608, 23610–23612.

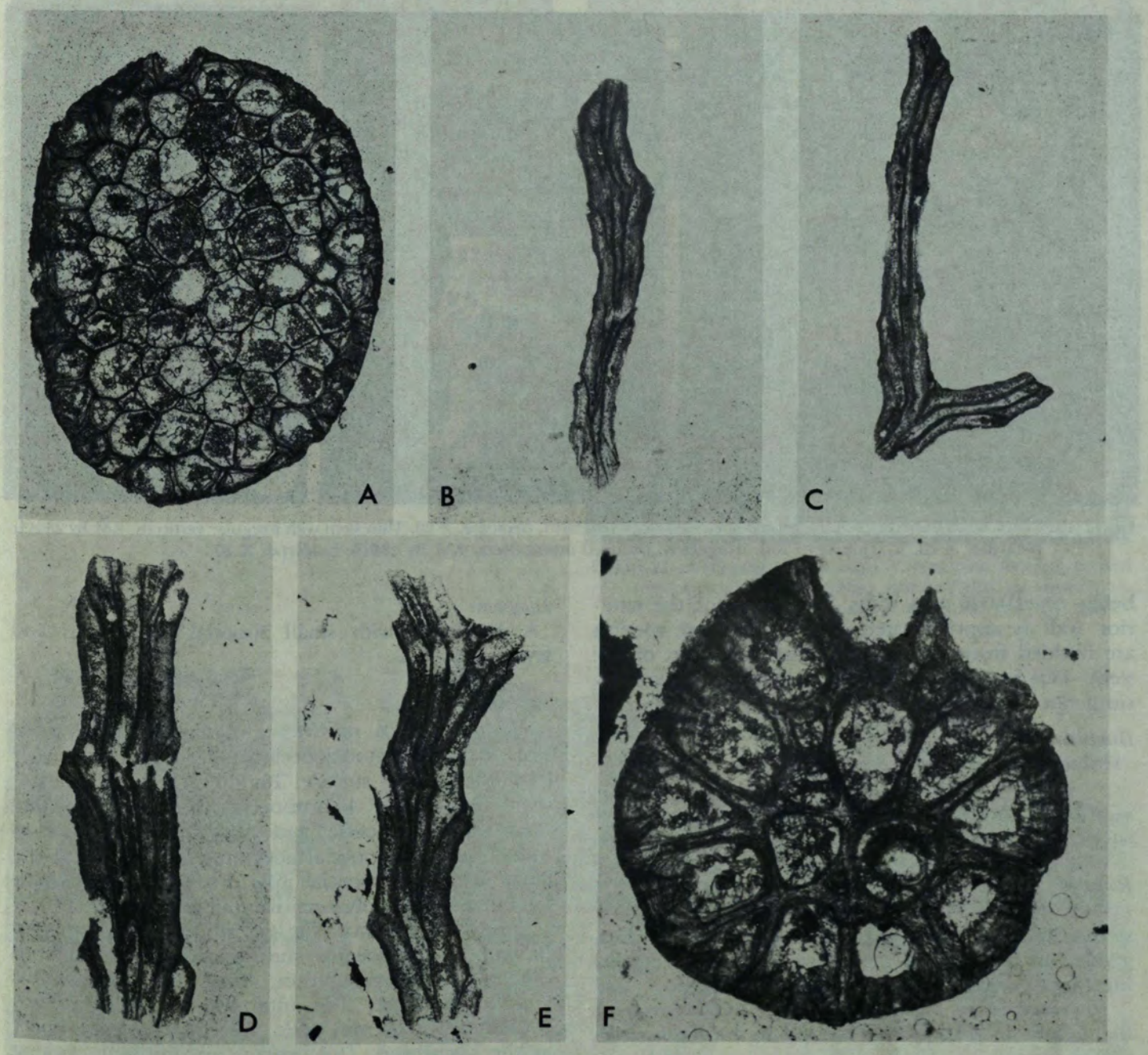


Figure 18. *Clausa crassa* n.sp. A. Transverse section of stem showing thin interzooecial walls and small kenozooecia in the exozone. RM By 23608, paratype. X 30. B. *Pustulopora minuta* n.sp. B. Longitudinal section of stem. RM By 23620, paratype. X 25. C. Longitudinal section of bifurcating stem. RM By 23621, paratype. X 25. *Spiropora irregularis* n.sp. D. Longitudinal section of stem. RM By 23616, paratype. X 20. Longitudinal section of stem. RM By 23618, paratype. X 20. F. Transverse section of stem showing granular middle layer within interzooecial walls and flanking laminar layers. Note thick zooecial walls. RM By 23619, paratype. X 95.

Diagnosis

A large *Clausa* with few kenozooecia and large, crowded autozooecia. Interzooecial walls are very thin.

Description

The zoarium consists of dichotomously branching, cylindrical stems, approximately 2 mm wide. The autozooecia are irregularly arranged on the stem surface. Their peristomes are short with large, circular apertures. Box-like kenozooecia are present between the autozooecia. Young stems may lack kenozooecia.

The interzooecial walls are comparatively thin, being only 0,010 mm wide. The width of the exterior wall is approximately 0,050 mm. New zooecia are budded from the whole of the axial part of the stem. Diaphragms are generally lacking. Gonozooecium not observed.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
azap . . .	0,107 — 0,147	0,122 ± 0,003	8,67	0,010 5	46
azp	0,147 — 0,168	0,168 ± 0,003	6,88	0,011 5	46

Remarks

C. crassa has comparatively few kenozooecia in the stems, and some young stems may lack them altogether. In this respect this species resembles the living *Clausi (Bientalophora regularis* MacGillivray).

C. crassa differs from *C. globulosa* D'Orbigny from the Upper Cretaceous of Europe in having smaller autozooecia.

Lichenopora betsibokensis Brood, 1976

1976 *Lichenopora betsibokensis* Brood, p. 407, Pl. 4, Figures 1, 2, 4.

Type Material

RM By 23642.

Remarks

This species is common in the samples from Need's Camp, the specimens agreeing well with contemporary material from the Maastrichtian of Madagascar.

Multicavea rotunda n.sp.

(figs. 21; 22)

Type specimens

Holotype: RM By 23600. Paratypes: RM By 23601–23606.

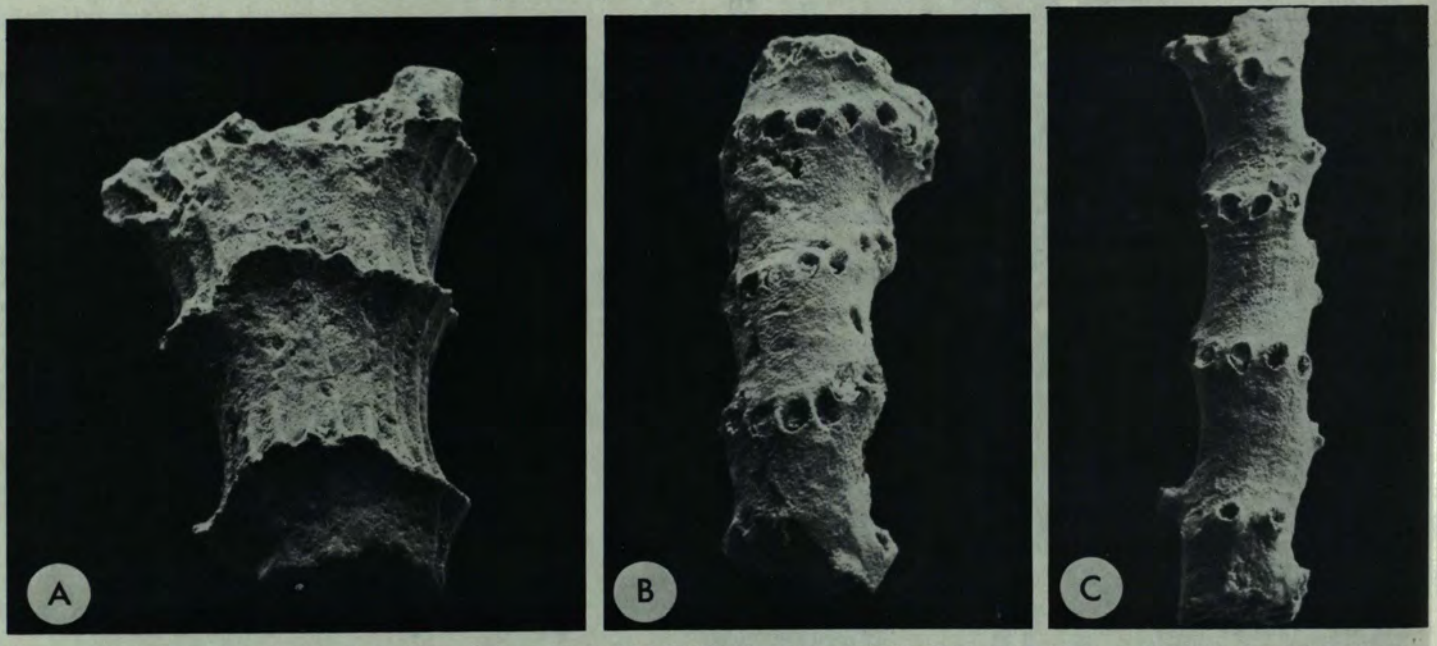


Figure 19. *Spiropora irregularis* n.sp. A. Corroded specimen. RM By 23613, paratype. X 20. Thin stem with irregular verticells. RM By 23614, paratype. X 20. C. Thin stem with irregularly arranged autozooecia. RM By 23615, holotype. X 20.

Diagnosis

A *Multicavea* with small zooecial dimensions and few diaphragms.

Description

The zoarium is massive, globular or forms erect stout branches. Autozooecia are grouped irregularly over the zoarial surface. Rarely, a stellate arrangement is present. Kenozooecia are slightly smaller than the autozooecia and approximately twice as numerous. Autozooecial apertures are small and circular. The kenozooecial aperture is generally circular but may be polygonal in younger zooecia.

Thin sections show the growth of the zoarium to be episodic. Generally autozooecia are continuous through the regeneration areas, but overgrowths commonly occur. The interzooecial walls are approximately 0,04 mm wide, but may be even wider at the distal end. Diaphragms are generally lacking except for terminal ones. Several stout longitudinal rods occur within the zooecial walls. These are built by laminar crystals and apparently lack a central rod; they are similar to the pseudolunaria of the dis-



Figure 20. *Lichenopora betsibokensis* Brood. Specimen with zoarial brood-chambers. RM By 23684. X 20.

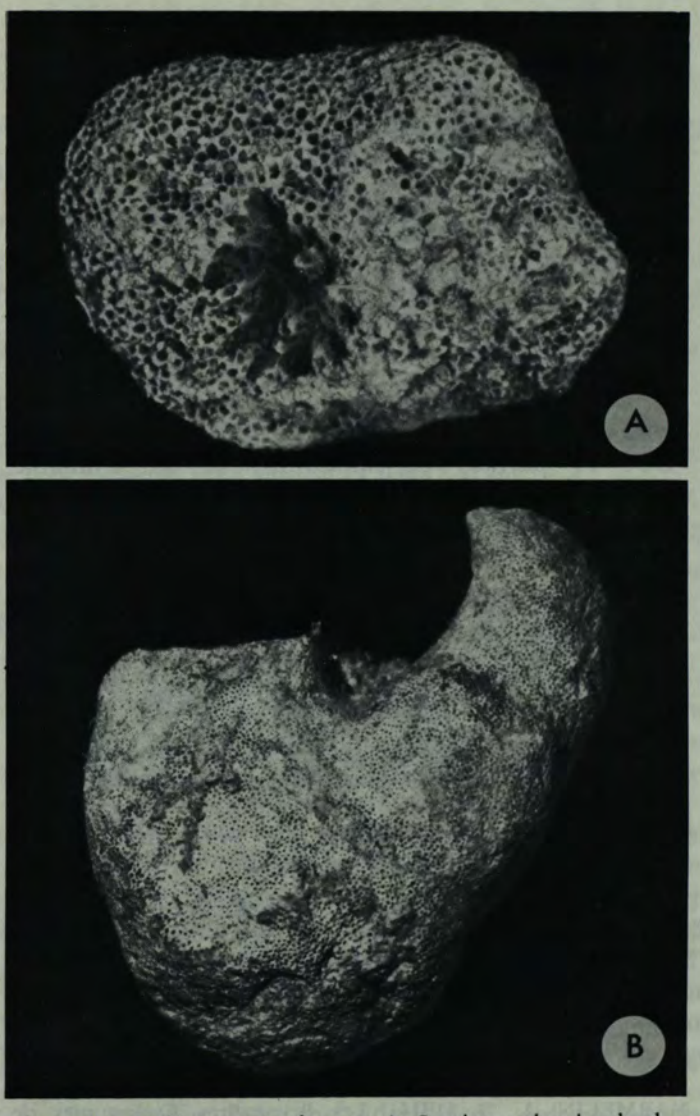


Figure 21. *Multicavea rotunda* n.sp. A. Specimen showing broken zoarial brood-chamber. RM By 23601, paratype, X 15. B. Bifurcating, massive zoarium. RM By 23600, holotype.

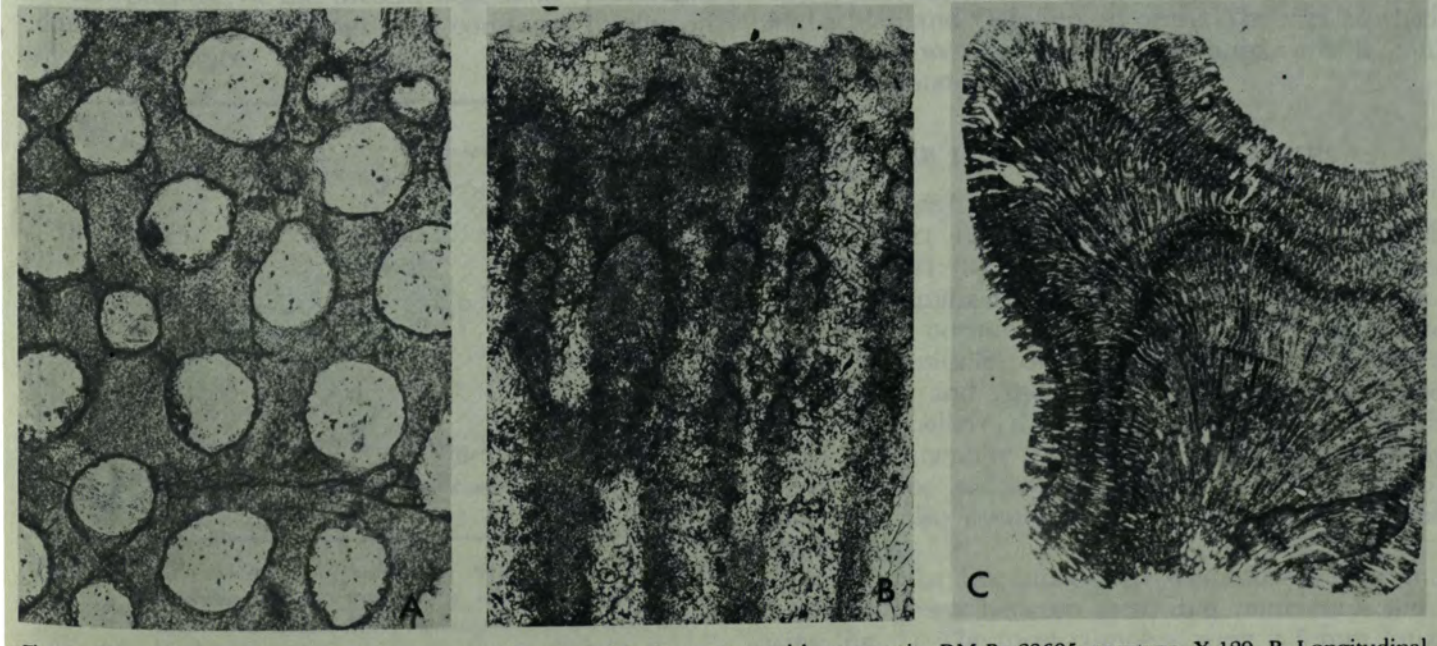


Figure 22. *Multicavea rotunda* n.sp. A. Tangential section showing auto- and kenozooecia. RM By 23605, paratype, X 120. B. Longitudinal section showing club-shaped growth units of zooecial walls. Specimen partly recrystallized. RM By 23604. X 100. C. Longitudinal section of colony showing growth lines. RM By 23602, paratype. X 6.

porellids but are placed deeper within the zooecial walls and are smaller.

The zoarial brood-chamber is small and placed near the zoarial surface.

Dimensions

Holotype and paratypes.

	O.R.	$\bar{x}$	V	s	N
azap . . .	0,053 — 0,070	0,061 ± 0,001	7,59	0,004 6	48
kzap . . .	0,045 — 0,053	0,049 ± 0,001	5,63	0,002 8	48
z/mm² . .	45,000 — 62,000	55,1 ± 1,9	11,55	6,371	48

Remarks

Due to partial recrystallization of the available specimens the exact microstructure cannot be determined with accuracy. However, the structure appears to be very similar to that of *Multicavea (Canuella),* and the present species is tentatively referred to that genus. It differs, however, in having the autozooecia irregularly placed, and the tendency to form clusters and radiating lines seems to be lacking in the specimens examined except around an ovicell.

M. rotunda differs from the Danian species *M. danica* Levinsen in having larger autozooecia. It differs from the Maastrichtian *M. pustulosa* Hamm in having smaller autozooecia.

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