Embryonal structures of *Miogypsina*

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Excellent scanning electron micrographs of embryonal structures of bispiral *Miogypsina's* were made, which solve a number of problems raised by details seen in thin sections. Special attention has been paid to the stolon-system near the second primary auxiliary chamber (PA-II). From the deuteroconch to the PA-II two funnel-shaped stolons cross the cylindrical protoconchal stolon on both sides. Once a 'lip' around the protoconchal stolon was discovered, it turned out to exist in nearly all the bispiral specimens.

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Introduction

In biometrical research on bispiral forms of *Miogypsina*, it is important to know which of the two principal auxiliary chambers is the PA-II when measuring Drooger's factor γ (Drooger & Amato, 1969). Generally the PA-II is smaller than the PA-I. However, in the more 'symmetrical' specimens in which the spirals from PA-I and PA-II are equal in length, the size of PA-I and PA-II hardly differs.

A second criterion which has often been used to determine the PA-II is the fact that the wall of the deuteroconch on the side of the PA-II is pointing slightly inwards.

While establishing the nepionic growth-pattern in the material available, attention was also paid to the origin and development of certain structural details.

In studying the structure of the embryonic apparatus in particular, a number of features were observed requiring an accurate examination. In unravelling these features, the Scanning Electron Microscope (S.E.M., Cambridge Scientific Instruments Ltd.) proves to be indispensable.

Acknowledgements

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Method of preparation

In examining *Miogypsina* with the aid of the S.E.M., it is essential to obtain specimens in which the chambers are devoid of secondary material. For studying the interior of the embryonic chambers, the embryont should be split into two halves. It is known that *Nummulites,* when suddenly cooled after heating, splits up easily along the equatorial plane. With *Miogypsina* this is hardly the case; moreover, it is unknown how the structures are affected by heating. The best results were obtained by breaking the specimens with a fine needle. When a specimen is sectioned, the test is often more or less damaged and the chambers become clogged, making all finer structures invisible. A number of good preparations were finaly obtained which show the inner structures excellently.

Material

The material consists of Indonesian specimens of *Miogypsina,* which were collected partly by Prof. Dr W. Leupold and partly by the Shell. The samples were placed at the writers disposal by Prof. Dr I. M. van der Vlerk, at the Rijksmuseum van Geologie en Mineralogie, Leiden.
Collection Leupold: L 393, S. Menkrawit Beds, Tertiary-f. N. E. Borneo (see van der Vlerk, 1929).
Collection Shell: Bg 316 and Bg 296, E. Java, Madura, Kombangan (see van der Vlerk, 1967).

Results

The best material available for this study consisted of *Miogypsina thecideaeformis,*

M. bifida and *M. indonesiensis*. These species belong to the so-called bispiral *Miogypsina's* of which Fig. 1 is a generalized drawing.

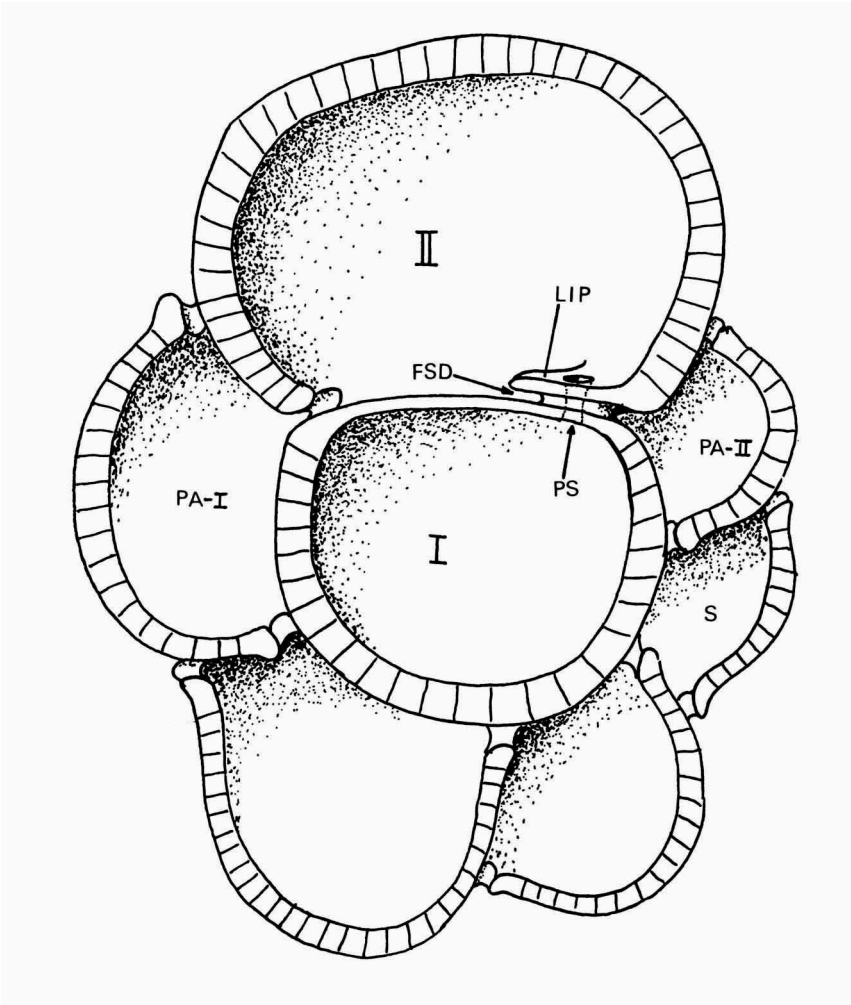


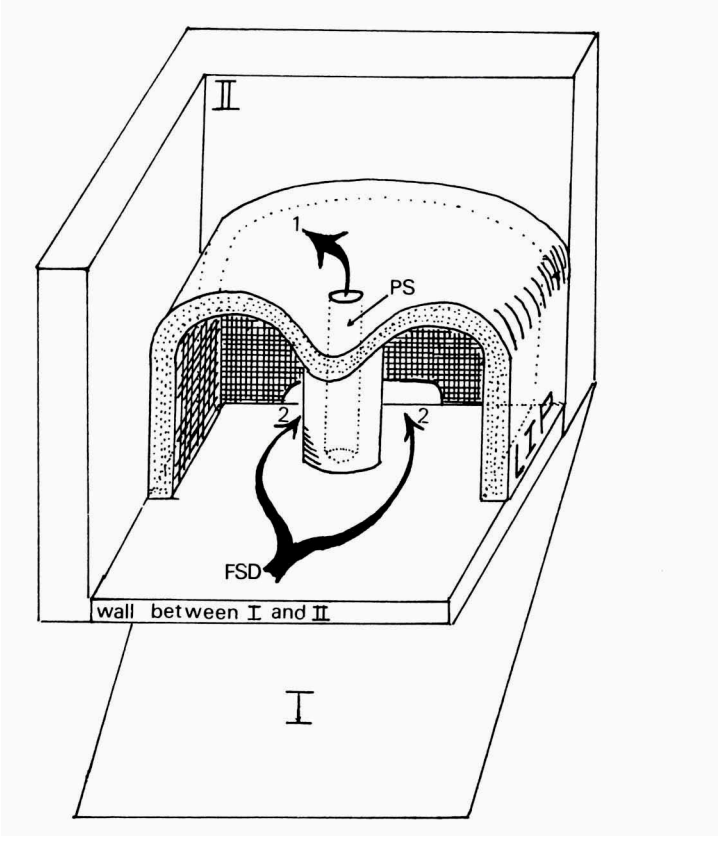
Fig. 1. A generalized drawing of the embryont of a bispiral *Miogypsina*. The protoconchal stolon is situated on the PA-II side, near the wall of the deuteroconch. It is difficult to determine whether the lip forms part of the wall between I and II, or of the deuteroconchal wall. Under this lip two funnel-shaped stolons run on both sides of the cylindrical protoconchal stolon to the PA-II.

I = protoconch
II = deuteroconch
PA-I = first primary auxiliary chamber
PA-II = second primary auxiliary chamber
S = symmetrical chamber
PS = protoconchal stolon
FSD = funnel-shaped deuteroconchal stolon

The oldest forms of *Miogypsina* show one protoconchal spiral exclusively, i.e. from the PA-I. During evolution, a small PA-II is developed from which a smaller second protoconchal spiral originates. In *Miogypsina indonesiensis* two protoconchal spirals of the same length, are developed, whereas PA-I and PA-II are almost equal in size.

Central horizontal sections, exactly through the middle of the embryonic chambers, show that the protoconchal stolon is situated on the PA-II side, near the wall of the deuteroconch (Plate 1, figs. 1, 2). This feature was already mentioned by Tan Sin Hok (1937). Tan also described a funnel-shaped deuteroconchal stolon to the PA-II. This complex stolon-system, on the PA-II side, will be described first.

The protoconchal stolon is cylindrical and a little raised above the wall between I and II (Figs. 2 and 3). At the top a 'collar' or 'lip' extends. The term lip is used, because of its arrow-point shape (Plate 2). On the PA-II-side, the lip is connected with the wall of the deuteroconch, which gave Tan the impression that the lip was formed by the deuteroconch.



Fir. 2. A schematical drawing of the stolon-system near the PA-II. The funnel-shaped deuteroconchal stolons, which in reality are very narrow, are formed by down-curving of the lip to the wall between I and II (I = protoconch; II = deuteroconch; PS = protoconchal stolon; FSD = funnel-shaped deuteroconchal stolon; 1 = direction of the protoplasm stream from I to II; 2 = direction of the protoplasm stream through the funnelshaped deuteroconchal stolons to the PA-II).

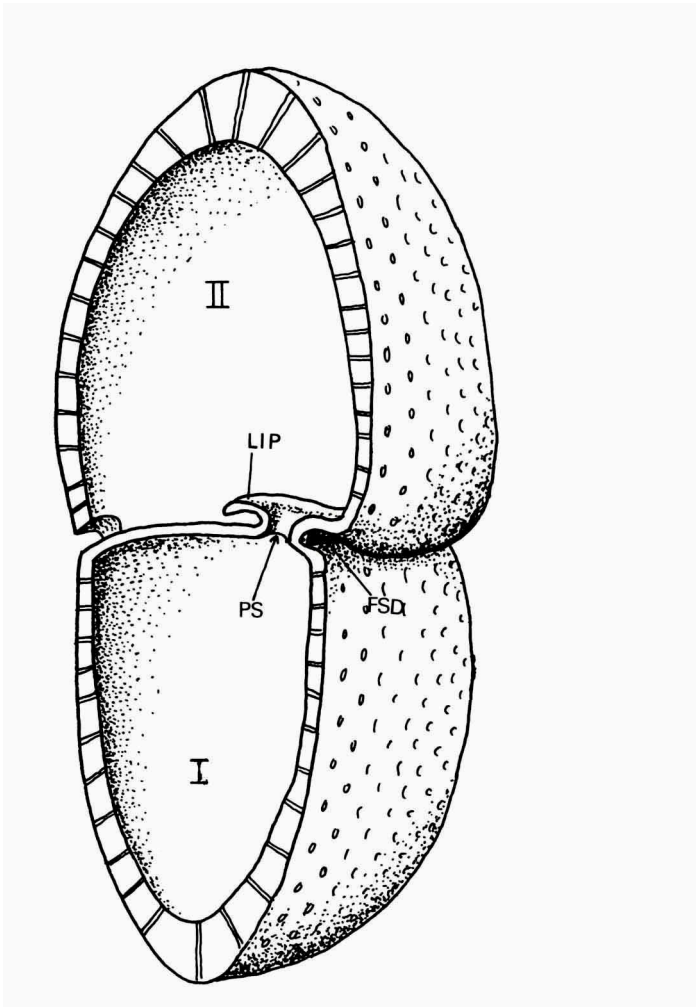


Fig. 3. A three-dimensional view of half a miogypsinid embryont, sectioned parallel to the equatorial plane and exactly through the protoconchal stolon (see also Plate 3). In this figure the funnel-shaped deuteroconchal stolon runs behind and around the cylindrical protoconchal stolon (I = protoconch; II = deuteroconch; PS = protoconchal stolon; FSD = end of the funnel-shaped deuteroconchal stolon).

Both 'sides' of the lip bend upwards at first, and down again at the most inner point (Plate 2, fig. 2). Thus together with the wall between I and II two openings are formed which are the beginning of the two funnel-shaped deuteroconchal stolons. These two canals run on either side of the protoconchal stolon, forming a stolon-system for the protoplasm stream to the PA-II. Though not confirmed numerically yet, the diameter of the funnel-shaped deuteroconchal stolons seems to be directly proportional to the size of the PA-II; the larger the diameter of the stolon, and thus the capacity of the stream, the larger the resulting PA-II.

The shape of the lip differs in the various types of *Miogypsina*. In thin sections of one type, the stolon-system near the PA-II may show different forms, depending on the orientation of the section (compare Fig. 4).

Many authors have mentioned the 'doubling' of the wall between I and II near the PA-II. This results from sectioning next to the protoconchal stolon and

next to the funnel-shaped deuteroconchal stolon (Fig. 4b, c). From the specimens studied, and from illustrations in other publications the presence of the lip could be established in the following species (compare Ellis & Messina, 1965):

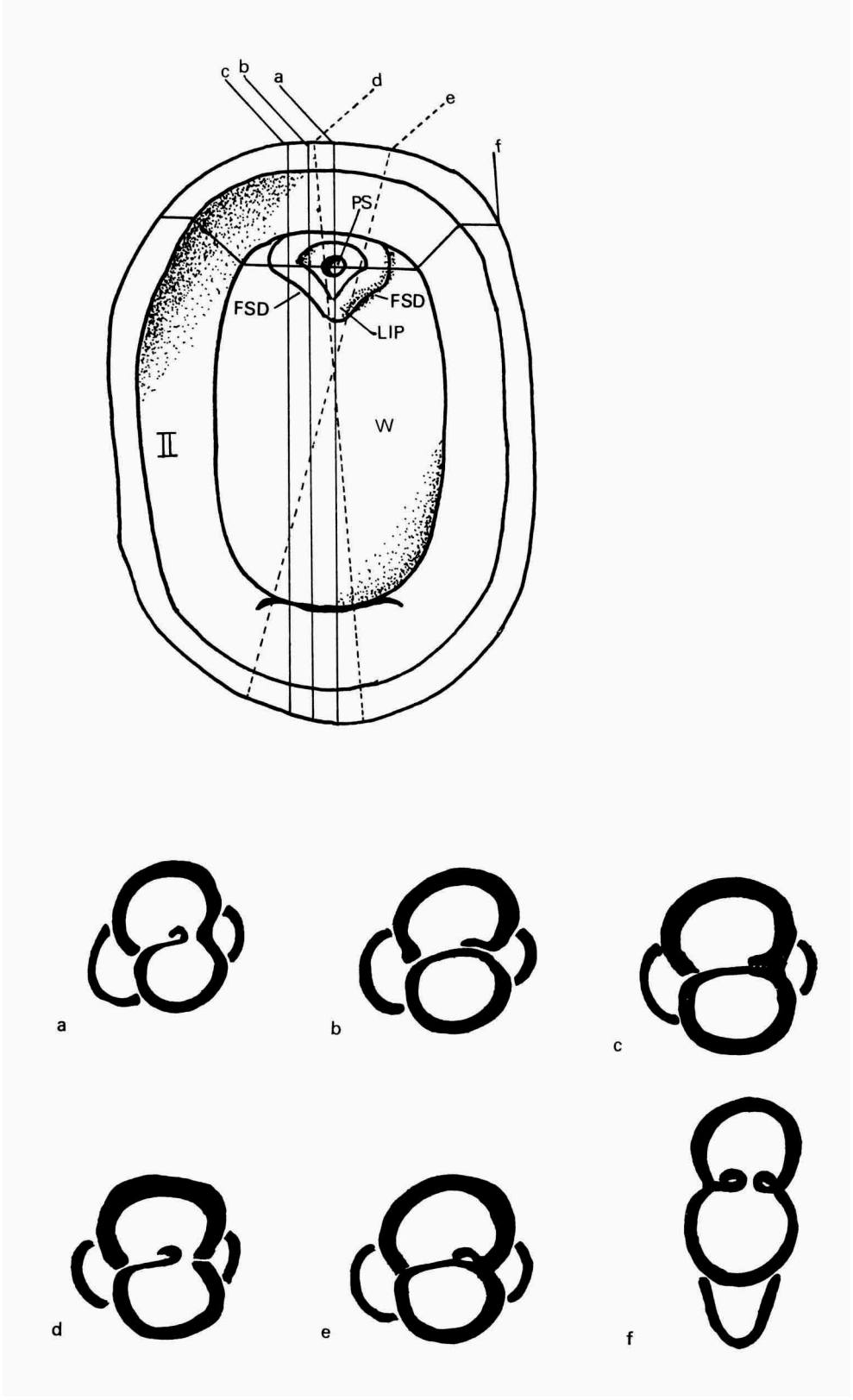
Miogypsina antillea (Cushman, 1919)
Miogypsina bifida Rutten, 1912
Miogypsina borneensis Tan, 1936
Miogypsina droogeri Mohan & Tewari, 1958
Miogypsina hawkinsi Hodson, 1926
Miogypsina indonesiensis Tan, 1936
Miogypsina irregularis (Michelotti, 1841)
Miogypsina kotoi Hanzawa, 1931
Miogypsina tani Drooger, 1952
Miogypsina thecideaeformis (Rutten, 1911)
Miogypsinoides dehaarti (van der Vlerk, 1924)
Miolepidocyclina exentrica (Tan, 1937)
Miolepidocyclina musperi (Tan, 1936)
Miolepidocyclina staufferi (Koch, 1926)
Miolepidocyclina venezuelana (Hodson, 1926)

Additional remarks

The wall between I and II is not perforated and is generally thinner than the wall of either I of II. This is also observed in S.E.M. micrographs of the embryo of several lepidocyclinids. We may conclude that the lip is part of the wall between I and II because of the following two reasons: 1) the lip is of the same thickness as the wall, and 2) the lip is pointing inwards, along the direction of the supposed protoplasm stream which formed the deuteroconch (see Plate 3).

The pores in all chambers are arranged in honeycomb-structures (see Plate 4). The rugged inner surface shown is covered by a smooth thin layer. This layer occurs in all embryonal and lateral chambers, and is often observable in thin sections.

Fig. 4. Variously orientated thin sections through the embryont of a bispiral *Miogypsina*. The funnel-shaped deuteroconchal stolons run under the lip on either side of the protoconchal stolon.
a) Parallel to the equatorial plane and exactly through the middle of the protoconchal stolon. The funnel-shaped deuteroconchal stolon is not visible.
b) Parallel to the equatorial plane, just next to the protoconchal stolon. This section clearly shows the funnel-shaped deuteroconchal stolon (see also Plate 1).
c) Parallel to the equatorial plane and next to the funnel-shaped deuteroconchal stolon. The lip touches the wall between I and II, causing 'doubling' of the wall.
d) Oblique section through the protoconchal stolon. In the deuteroconchal wall the opening of the funnel-shaped stolon is visible.
e) Oblique section through the funnel-shaped deuteroconchal stolon. This section often gives the impression that a little canal runs through the 'double' wall between I and II.
f) Vertical section through the protoconchal stolon. Both sides of the lip bend downward thus forming the two funnel-shaped deuteroconchal stolons.
II = deuteroconch; W = wall between I and II; PS = protoconchal stolon; FSD = beginnings of the funnel-shaped deuteroconchal stolons.


c
b
a
d
e
f
PS
FSD
FSD
LIP
W
II
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b
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References

Ellis, B. F. & A. R. Messina, 1965. Catalogue of Index Foraminifera. Vol. 1. Lepidocyclinids and Miogypsinids — Dept. Micropaleontology, Am. Mus. Nat. Hist., New York.

Drooger, C. W. & V. Amato, 1969. How to measure the angle γ in the Miogypsinidae. – Rev. Española Micropaleontología, 1, 1,: 19-24.

Tan Sin Hok, 1937. Note on *Miogypsina kotôi* Hanzawa. – Ingenieur Ned. Indië, 4,2: 31-32.

Vlerk, I. M. van der, 1929. Groote Foraminiferen van N.O. Borneo. — Wetensch. Meded., Dienst Mijnbouw Ned. Indië, 9: 1-44.

——, 1967. Oligo-Miocene Lepidocyclina's and planktonic Foraminifera from East Java and Madura, Indonesia. – Proc. Kon. Ned. Akad. Wet., B, 70,4: 391-398.

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Plate 1

Miogypsina thecideaeformis (Rutten, 1911)

1. Thin section parallel to the equatorial plane, exactly through the protoconchal stolon (corresponding with the section of Fig. 5a). Because of the thickness of the thin section, the cylindrical protoconchal stolon is visible. Sample Bg 316, specimen no. 7393 (100x).
2. Thin section just next to the protoconchal stolon (corresponding with the section of Fig. 5b). The funnel-shaped deuteroconchal stolon runs between the lip and the wall between I and II. This stolon runs around the protoconchal stolon. Sample Bg 316, specimen no. 7325 (100x).

I = protoconch
II = deuteroconch
PA-I = first primary auxiliary chamber
PA-II = second primary auxiliary chamber
PS = protoconchal stolon
L = lip
FSD = funnel-shaped deuteroconchal stolon

PLATE 1

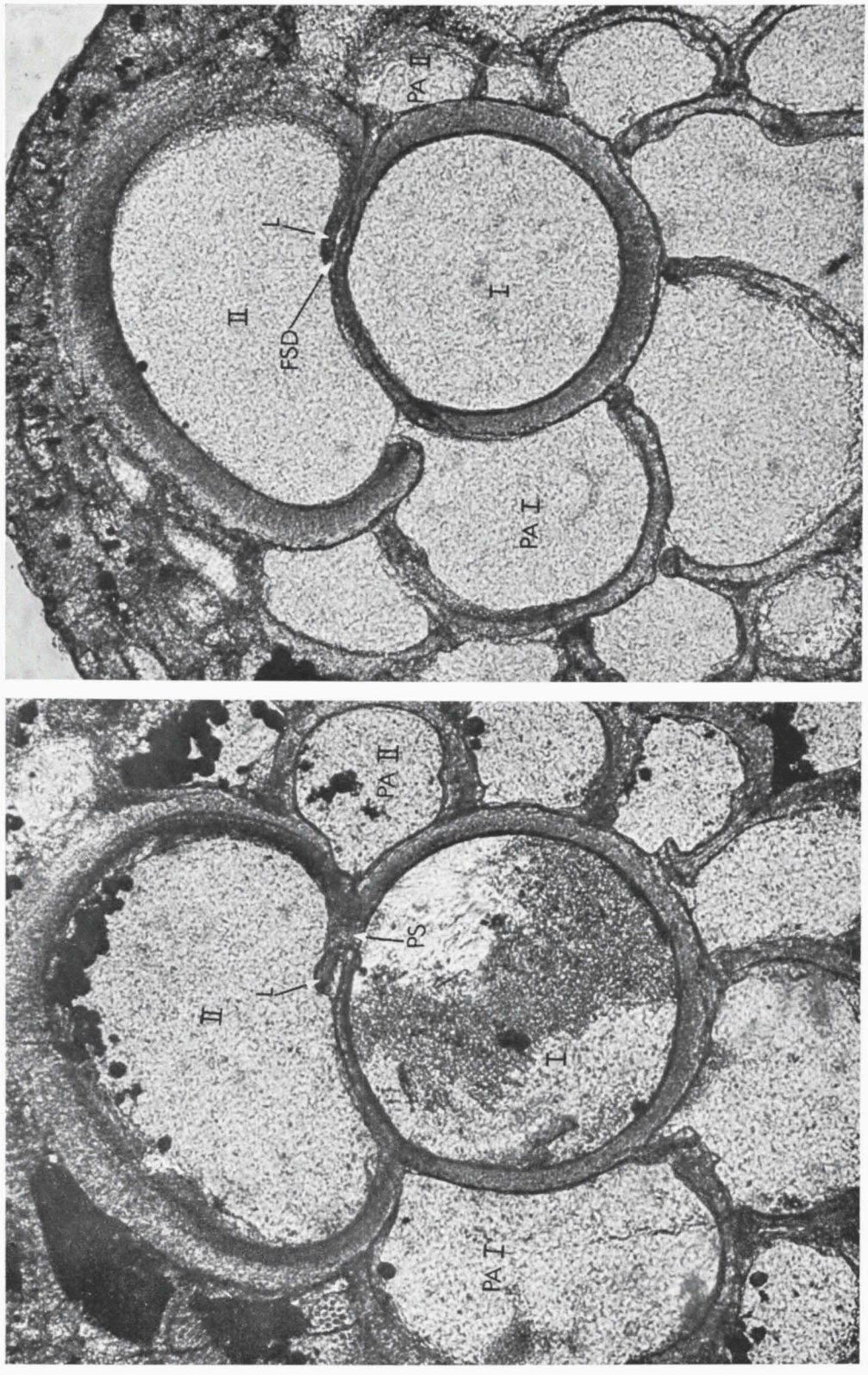


PLATE 2

Miogypsina thecideaeformis (Rutten, 1911), sample L 393, S.E.M. micrograph no. 280-15 (220x).

The deuteroconch is opened at the top and we look into the deuteroconch, at the wall between I and II. The lip has an 'arrow-point' form. Under the lip, on either side of the protoconchal stolon, the two funnel-shaped deuteroconchal stolons run to the PA-II.

I = protoconch
II = deuteroconch
L = lip
PS = protoconchal stolon
FSD = openings of the two funnel-shaped deuteroconchal stolons
D = deuteroconchal stolon to the PA-I

PLATE 2

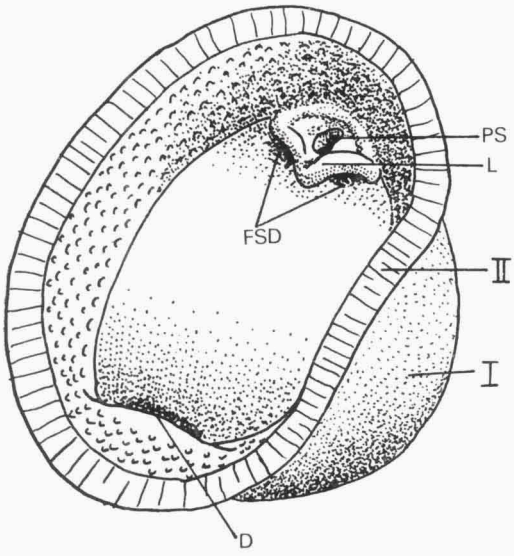


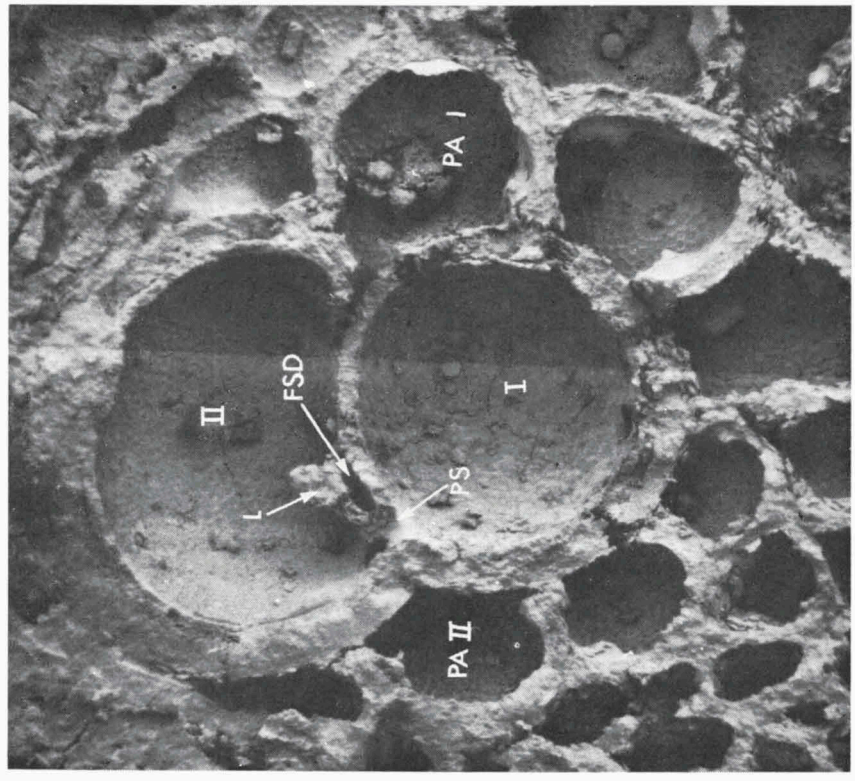
PLATE 3

Miogypsina indonesiensis Tan, 1936, sample Bg 316, S.E.M. micrograph no. 281-3 and 281-6 (210x).

The specimen had been split up in two halves exactly through the protoconchal stolon. The protoconchal stolon is situated at the PA-II side. The lip is pointing inwards, along the direction of the supposed protoplasm stream, which formed the deuteroconch. Behind and around the protoconchal stolon, between the lip and the wall between I and II, run the funnel-shaped stolons.

I = protoconch
II = deuteroconch
PA-I = first primary auxiliary chamber
PA-II = second primary auxiliary chamber
PS = protoconchal stolon
FSD = opening of the funnel-shaped deuteroconchal stolon
L = lip

PLATE 3



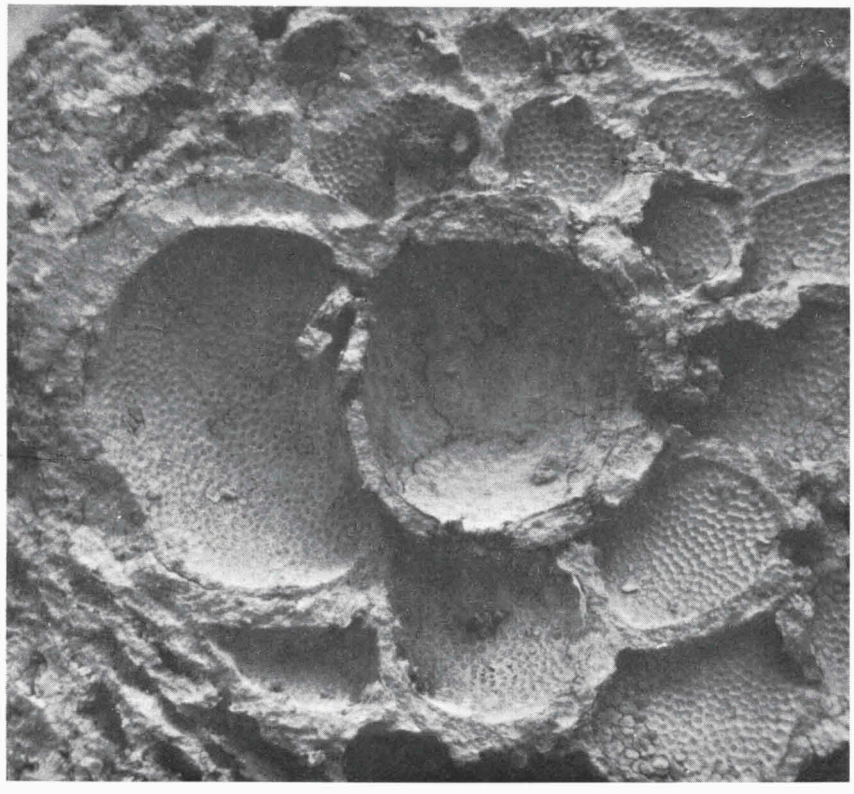


PLATE 4

Lateral chambers of *Miogypsina indonesiensis* Tan, 1936. All pores in all chambers are arranged in honeycomb-like structures. This rugged inner surface is covered by a smooth thin layer. The two large perforations in fig. 2 are stolons to other lateral chambers.

1. Sample Bg 296, S.E.M. micrograph no. 268-8 (200x).
2. Sample Bg 296, S.E.M. micrograph no. 268-22 (1000x).

PLATE 4