Some remarks on *Miogypsina (Miogypsina) socini* Drooger, 1954 (Foraminifera) from northern Italy

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In spite of the generally poor preservation of the specimens, it could be observed that in many specimens the large, often somewhat trochoid spiral out of PA-I, surrounding I and II, passes the small spiral out of PA-II without forming a closing chamber. In several specimens the vertical section shows that the embryonic-nepionic apparatus forms an angle with the equatorial plane. This makes it difficult to distinguish in a horizontal thin section a spiral chamber from an equatorial or lateral chamber.
The sample used contained numerous microspheric specimens, which are markedly different from the megalospheric specimens both externally and internally. The difference between the subgenera *Miogypsina* and *Miolepidocyclina* is discussed.

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Introduction

The purpose of this paper is to redescribe *Miogypsina (Miogypsina) socini* from northern Italy. *Miogypsina (Miogypsina) socini* strongly resembles some species of *Lepidocyclina*. It seems justified to consider *Miogypsina (Miogypsina) socini* together with *Miogypsina (Miolepidocyclina) burdigaliensis* and *Miogypsina (Miolepidocyclina) negrii* as a local stock of the main lineage of Miogypsinidae. In contrast to the generally scarce occurrence of microspheric specimens, a rather large quantity of these microspheric specimens was present in the sample studied.

TERMINOLOGY AND PARAMETERS OF *Miogypsina*

The terms used most frequently are defined below, other terms are described in the text.

Apex (A, Figs. 2, 3). In specimens with an eccentric embryonic apparatus, the apex is generally the area where the embryonic apparatus is situated. Externally this is the pointed part of the usually trigonal test of the Miogypsinidae; in *Miogypsina (Miogypsina) socini* it is the point where the marginal fringe (part of the flange-like collar) of the circular specimen is curved or interrupted.

First and second primary auxiliary chambers (PA-I, PA-II, Fig. 4). In *Miogypsina socini* both primary auxiliary chambers on either side of I and II are present. PA-II, which in this species is generally small, is situated near the protoconchal stolon. Both auxiliary chambers lie in the equatorial plane.

Embryonic-nepionic apparatus (juvenarium, Fig. 2). In *Miogypsina socini* the embryonic-nepionic apparatus consists of the protoconch (I), the deuteroconch (II), PA-I, PA-II (if present) and the two or more whorls which surround I and II and originate from PA-I and PA-II.

Protoconchal stolon (Fig. 4). The protoconchal stolon is a stolon between I and II. In an equatorial section the protoconchal stolon is not located in the centre of the wall between I and II, but lies close to PA-II. The stolon forms a lip.

Transverse and vertical sections (Fig. 4). A vertical section in the present paper is an apical-frontal section through the protoconch perpendicular to the equatorial plane. Any other section perpendicular to the equatorial plane is a transverse section.

Protoconchal and deuteroconchal spirals

(PI, PII, DIII and DIV, Fig. 2). PI = the spiral chambers originating from PA-I and surrounding I, PII = the spiral chambers originating from PA-II and surrounding I, DIII = the spiral chambers originating from PA-I and surrounding II, DIV = the spiral chambers originating from PA-II and surrounding II. When the number of spiral chambers in any of the spirals is mentioned, the primary auxiliary chamber is also included.
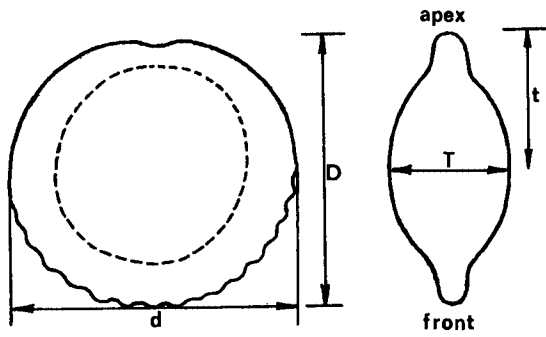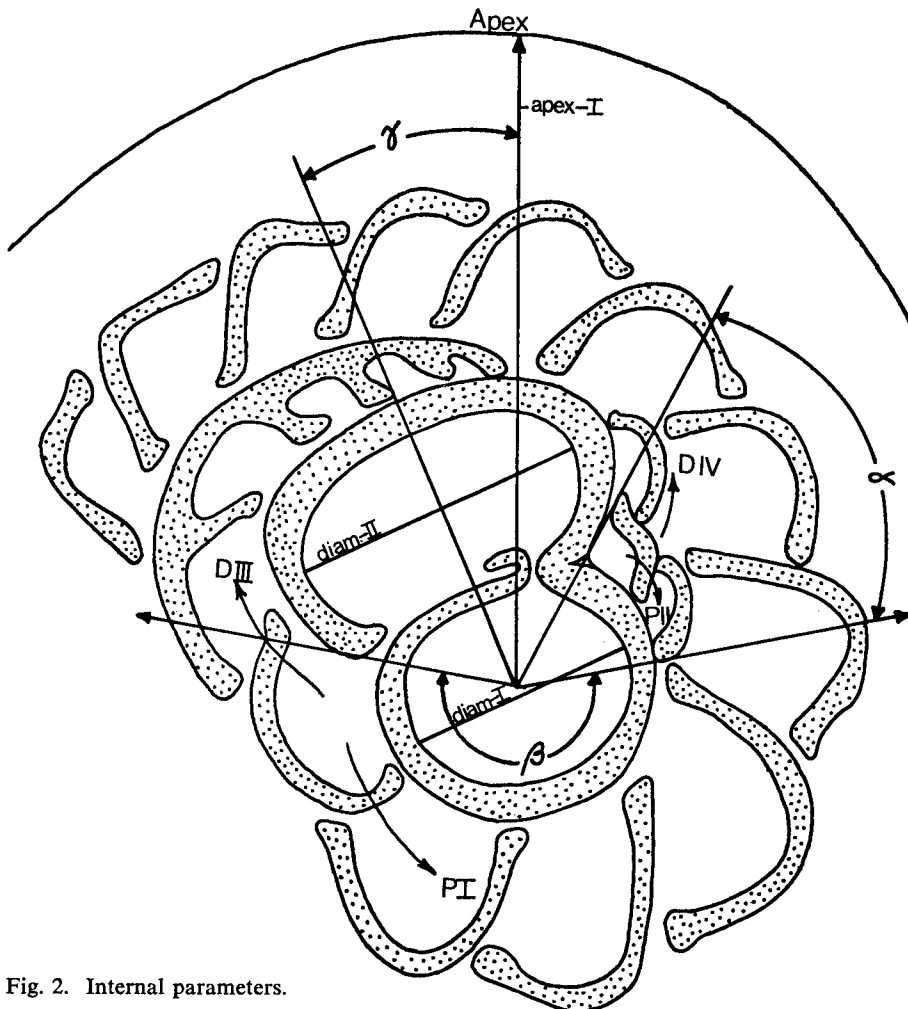
Fig. 1. External parameters.

Fig. 2. Internal parameters.

Parameters of *Miogypsina*

External (Fig. 1).
Before the specimens were sectioned, several features were described and the following measurements were made: Length (D) = the distance from the apex to the front, width (d) = the greatest diameter perpendicular to D, thickness (T) = the thickest part perpendicular to the equatorial plane, (t) = the distance from the apex to the thickest part (T) of the test.

Internal (Fig. 2)
X = the number of spiral chambers in the first whorl (PI) around the protoconch, including the first primary auxiliary chamber (PA-I). Diam. I = the diameter of the protoconch. Diam. II = the diameter of the deuteroconch; actually it is the largest diameter of II parallel to the line taken as the diameter of the protoconch. Apex-I = the distance from the apex to the centre of the protoconch. γ = the angle between the line from the apex to the front and the line connecting the centres of I and II (Drooger & Amato, 1969). V (= $200\alpha/\beta$) = a measure of the degree of symmetry of the protoconchal nepionic spirals (PI and PII) in specimens with PA-I and PA-II. α = the arc length of the circumference of the protoconch section underneath the smaller spiral extending from PA-II. β = the arc length of the circumference of the protoconch underneath both protoconchal spirals. The specimens of *Miogypsina socini* have a small V, but have a relatively high value for X since the first spiral (PI) does not always form a closing chamber with either DIII of PII.

MATERIAL

In 1973 the author visited the University of Turin and had the opportunity to inspect and sample the well-known *Miogypsina*-bearing localities near Turin. A sample was taken near Drooger's localities 3 and 4 (Drooger, 1954) along the road from Superga to Baldissero on the southern flank of the Gassino anticline (see E56 della Carta Geologica d'Italia, 1:25.000). The sample corresponds stratigraphically with Drooger's sample 13 from which the holotype and other specimens of *Miogypsina socini* were collected; Drooger's sample 13 is from the Rio Torello Valley (a southern tributary of the Po River) at the altitude of Cascina Fratelli, south of Tetti Rossi, on the northern flank of the Gassino anticlina. The type level for Drooger's sample 13 is the lower Miocene 'Langhiano' (probably upper Aquitanian). Holotype and type material are deposited in the collections of the Geological Institute of the University of Utrecht, the Netherlands; holotype no. S366.
     The sandy sample contains abundant quartz and serpentine grains, generally up to 3-4 mm in diameter although the latter may be as large as 2.5 cm in some instances. The abundant *Miogypsina* are associated with some poorly preserved benthonic Foraminifera (Amphistiginidae, *Operculina* and some other Rotaliidea) as well as fragments of spines of Echinodermata and fragments of Bivalvia (Pectinidae, Ostreidae) and of Crustacea (Cirripedia). The sample used (M13, de Bock; RGM 230 100) contained about 2000 megalospheric specimens and 200 microspheric specimens, from which 190 sections were made. The specimens are generally filled with sandy or calcareous material, and are often recrystallized.

Only a few S.E.M. (Scanning Electron Microscope) micrographs could be made of those specimens which were not filled with secondary material. Because there is hardly any contrast between the secondary material and the chamber walls, it is impossible to determine precisely the shape and position of the nepionic chambers in specimens which are only half-sectioned. In addition a half-sectioned specimen can only be enlarged about 100 times. Furthermore the oblique position of the embryonic-nepionic apparatus of the specimens of this locality with respect to the equatorial plane cannot be observed in half sections. In fact it proved impossible to compare the characteristics of the half-sections of specimens described by Drooger (1954), including the holotype of *Miogypsina socini,* with the characteristics seen in thin sections made for the present study.

Taxonomy

Miogypsina (Miogypsina) socini and *Miogypsina (Miolepidocyclina) burdigaliensis* are considered to belong to the same stock.

FAMILY MIOGYPSINIDAE VAUGHAN, 1928
GENUS *Miogypsina* SACCO, 1893
SUBGENUS *Miogypsina* SACCO, 1893

Miogypsina (Miogypsina) socini Drooger, 1954

1954 *Miogypsina (Miogypsina) socini* n.sp. — Drooger, pp. 233-235, fig. 2; pl. 2: figs. 20-24.

Diagnosis — Populations of *Miogypsina* s.s. which possess distinctly developed lateral chambers and a peripheral embryonic-nepionic apparatus (which may be slightly removed from the periphery in only a minority of the individuals of the population). The value of M_x is greater than 7, that of M_v smaller than 45, while at least 50 per cent of the total number of sectioned specimens possess a second primary auxiliary chamber (PA-II).

Remarks — Drooger (1954) also described a population from his samples 3, 14 and 15 which is intermediate between *Miogypsina (Miogypsina) socini* and *Miogypsina (Miolepidocyclina) burdigaliensis,* with the embryonic apparatus in a central or subcentral position. The subgenus *Miolepidocyclina* is similar to *Miogypsina* s.s., but the embryonic apparatus is situated near the centre of the test in both megalospheric and microspheric forms. The central or subcentral position of the embryonic apparatus seems to be dependent on the size of the test (Fig. 15).

DESCRIPTION OF *Miogypsina (Miogypsina) socini* DROOGER, 1954

External appearance

The description of the exterior is given according to Drooger (1954, p. 233), with some additional remarks. Drooger's description: 'Test about rounded in outline; usually strongly and often unequally biconvex, occasionally planoconvex; greatest

thickness situated eccentrically between the centre and the periphery, commonly closest to the centre. In many individuals the test consists of a strongly inflated subcentral portion and a rather thin, flange-like marginal part. These individuals strongly resemble representatives of some species of *Lepidocyclina*. The early portion of the test, though usually not protruding, is often discernible from the pustulation of the surface combined with the position of the thickest part of the test. The pustules are rather uniformly scattered on the surface with the larger ones near the subcentral knob.'

Remarks: the flange-like collar, which is barely seen in Drooger's pictures, borders the whole test (Pls 1, 2). At the apex the collar (marginal fringe) is smooth to granular, towards the front the rectangular sutures of the equatorial chambers become visible. At the apex the marginal fringe is often curved or interrupted (Fig. 3). The pustules mentioned by Drooger are often tubercles formed by the pillars, i.e. pillar heads (Pls 2, 3, 7). The adult microspheric specimens are planoconvex and are about twice as large as the megalospheric specimens (Fig. 5). The drawings of the holotype of *Miogypsina socini* (Drooger, 1954: fig. 2, p. 233), are based on a rather damaged specimen.

Fig. 3. The flange like collar is at the apex often curved or interrupted.

Internal appearance

Drooger's description: 'In most specimens protoconchal and deuteroconchal nepionic spirals are all well-developed. The embryonic-nepionic apparatus is situated directly at the periphery; in some specimens it is sligthly removed from the border by a collar-like structure, which is formed by the bending of closely-set lateral layers. Only in two out of 20 sectioned individuals some equatorial chambers (one row or less) are intercalated between the nepionic chambers and the periphery. In 8 out of 20 specimens the presence of a second principal auxiliary chamber could not be ascertained, which absence may sometimes be due to the moderate state of preservation of the individuals. The equatorial chambers are arcuate, mainly ogival and occasionally rhombic in shape. In transverse sections the lateral chambers cover one another imbricately: they are often arranged in irregular layers, occasionally in tiers. Up to eight lateral chambers were observed in vertical succession at the most convex side of the test on top of the median layer. The bad sections, made of some microspheric specimens (diameter up to 7 mm) show that the early chambers are situated at the periphery, as far as could be ascertained from the arrangement of the equatorial chambers.'

Remarks: The present horizontal sections differ somewhat from those described by Drooger as far as the nepionic arrangement of some specimens is concerned. This discrepancy might be attributed to the fact that a different sample was used; it is however mainly caused by the greater number of specimens sectioned and the quality of the sections. The discrepancy in the position and the number of spiral chambers is often due to the oblique position of the embryonic-nepionic apparatus with respect to the equatorial plane, as may be observed in vertical sections. Vertical sections (Pl. 3) show that the embryonic-nepionic appa-

ratus may form an angle with the equatorial plane. The angle varies from 0° (parallel) to 22°. In such specimens the last spiral chambers of PI end in the equatorial plane, i.e. the spiral is slightly trochoid. When a thin section is cut through the equatorial plane of these specimens, either the chambers around the deuteroconch (II) or around the protoconch (I) are cut away. These sections may show equatorial chambers or lateral chambers near I or II which causes some confusion as far as the configuration of the spiral chambers is concerned. An equatorial chamber cut near I or II may erroneously be mistaken for a closing chamber (Pl. 10).

In 95% of the sectioned specimens there is a lip around the protoconchal stolon; 75% of the specimens have a second primary auxiliary chamber (PA-II, Pls 4, 5, 10). The small PA-II is easily lost in sectioning. From PA-I two spirals have developed (PI and DIII). Two small spirals may extend from PA-II (PII and DIV, Figs. 2, 4; Pls 4-8, 10). In two specimens a closing chamber was formed between PI and PII. In 18 specimens there is a clear closing chamber between PI and DIII. In 44 other specimens PI covers and passes PA-II and at least two or more spiral chambers have developed on the deuteroconch (II). In 20 of these (44) specimens the long PI passes the spiral chambers of DIII without forming a closing chamber (Fig. 4, Pls 6-8, 10). They generally have a subcentrally located embryonic-nepionic apparatus, sometimes with equatorial chambers intercalated between the apex and the embryonic-nepionic apparatus. In specimens, which either have no closing chamber between PI and DIII or have a few or no chambers around II, the embryonic-nepionic apparatus is located near the apex.

In vertical (or transverse) sections lateral chambers were observed in up to 14 layers (Pl. 3). Several specimens showed a clear difference in the number of
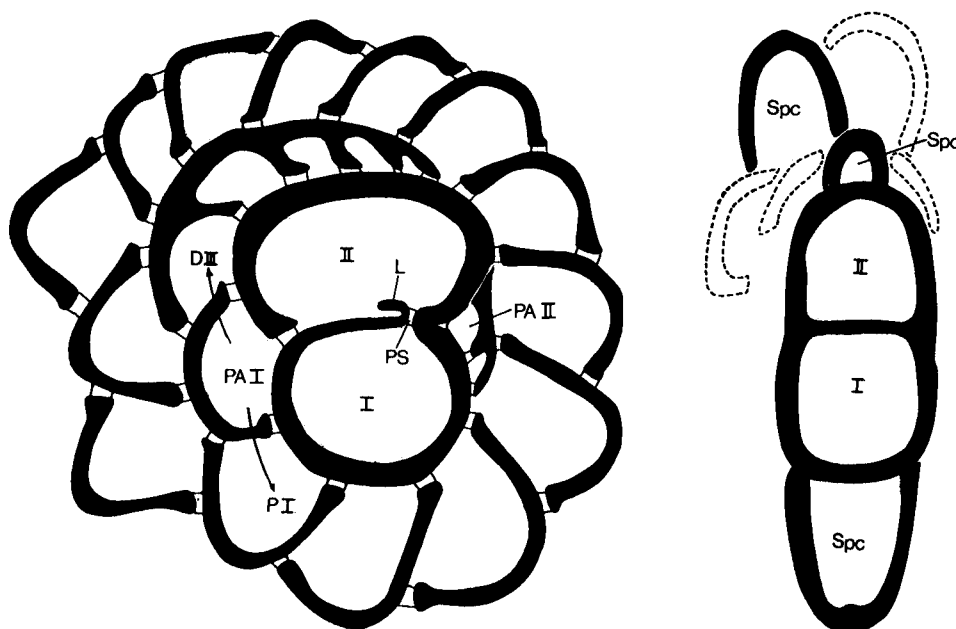

Fig. 4. A schematic horizontal and vertical drawing of *Miogypsina socini*, showing the trochoid spiral (PI). It could not be ascertained whether a stolon (proximal) exists at the base of the last spiral chamber of DIII. I = protoconch; II = deuteroconch; PA-I = first primary auxiliary chamber; PA-II = second primary auxiliary chamber; Spc = spiral chamber; PI = protoconchal spiral; DIII = deuteroconchal spiral; PS = protoconchal stolon; L = lip.

layers of lateral chambers on either side of the equatorial plane. Generally large pillars extend from the equatorial plane to the external surface, forming distinct pillar heads (Pls 2, 3, 7).

Thin sections of microspheric specimens show that the embryonic-nepionic apparatus is situated near the apex (Pl. 11). The microspheric specimens possess an uniserial embryonic-nepionic apparatus; $M_x = \pm 15$. In transverse sections the microspheric specimens show only a few - up to 4 - layers of lateral chambers.

In several thin sections one of the two funnel-shaped deuteroconchal stolons (de Bock, 1976) around the protoconchal stolon is visible (Pl. 9). The S.E.M. micrographs of transverse 'sections' of the equatorial chambers show that the stolons forming the inlet for protoplasm to the equatorial chambers are arranged in groups of three; the vertical stolons forming the inlet for protoplasm to the lateral chambers have developed in opposite corners on the apical side of the equatorial chambers. In several thin sections a dark line is seen in the septa of the equatorial chambers. Needles (de Bock, 1976) in the equatorial chambers were not encountered.

MEASUREMENTS

In Table 1 the mean and range for several parameters are shown.

Table 1.   Some measurements of *Miogypsina socini*.

	X	V	$\gamma°$
N	73	57	81
Mean $\pm \sigma_m$	8.9 $\pm$ 0.14	30.5 $\pm$ 1.1	-22.9 $\pm$ 4.3
Range	3-13	0-52.2	-119- + 86
	Diam. I in μ	Diam. II in μ	Apex-I in μ
N	99	96	96
Mean $\pm \sigma_m$	186.4 $\pm$ 2.9	217.3 $\pm$ 3.3	469.4 $\pm$ 3.9
Range	113-302	124-348	190-1230

The difference in size between the microspheric specimens and the megalospheric specimens is shown in Figs. 5, 6 and 7. The adult microspheric specimens are about twice as large as the megalospheric specimens. The smaller specimens were not found, probably as a result of selective sedimentation.

In the microspheric specimens T remains fairly constant as D increases (Fig. 6). In the megalospheric specimens T increases together with D (Fig. 6). The thickness of the microspheric specimens is therefore fairly constant. In both the microspheric and the megalospheric specimens, t increases only slightly as d increases (Fig. 7). Because d differs for the microspheric specimens and the megalospheric specimens, we find a clear separation in the diagrams of Figs. 6 and 7.

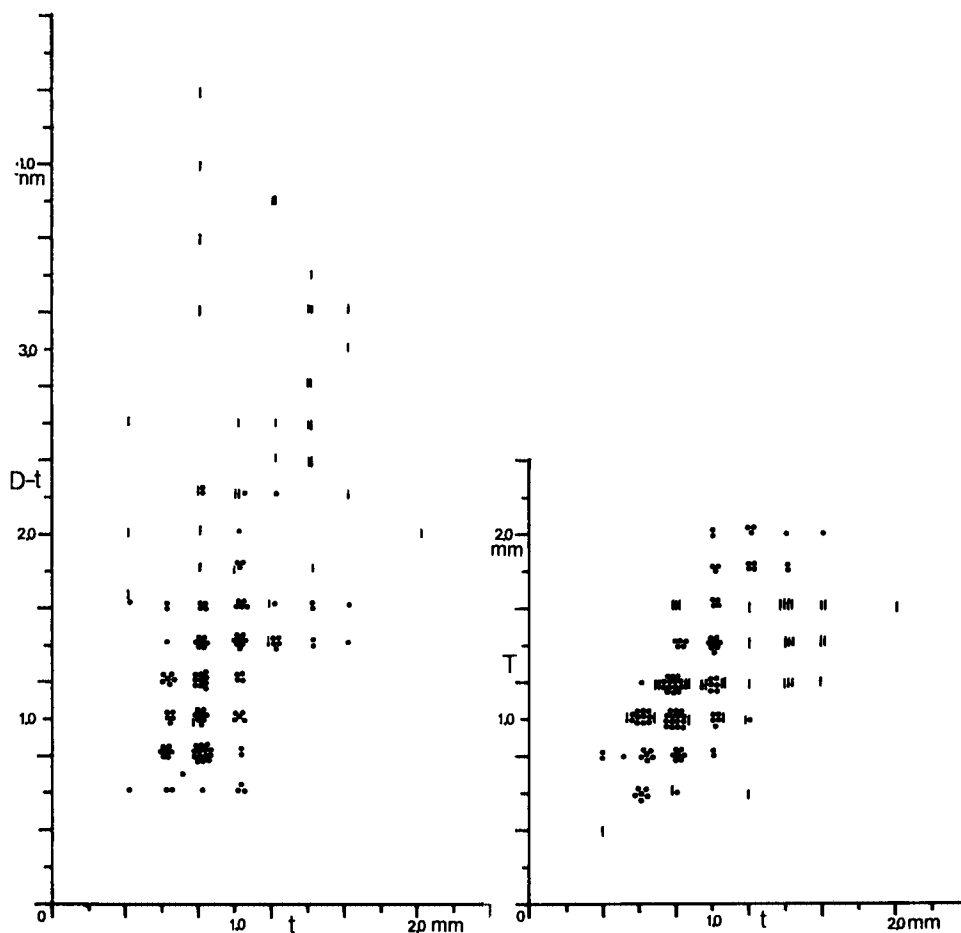Figure 8 shows the scatter diagram for the distance from the thickest part to the front (D-t) plotted against the distance from the thickest part to the apex (t). The diagram shows that the distance t barely changes as the distance D-t increases. Thus the thickest part (T) already has a rather fixed position with respect to the apex in the juvenile stage. Figure 9 shows that there is some correlation between the thickest part (T) and the distance from the apex to the thickest part (t). In thick individuals, the distance from the thickest part to the apex is generally larger.

The parameters X and γ generally show a distinct correlation. Because it often is difficult to determine the number of spiral chambers in PI(X), the corre-

lation between these parameters in *Miogypsina socini* appears to be rather poor (Fig. 13).

The parameters V and γ do not show any correlation (Fig. 14). The size of the angle α (Fig. 2) is limited because it is dependent upon the small PA-II, sometimes with a small spiral chamber (PII) which has developed from PA-II.

Fig. 15 illustrates that the subcentral position of the embryonic-nepionic apparatus is dependent upon the size of the test (Pls 4, 5), i.e. in juvenile specimens the position is relatively more central than in adult ones. To distinguish between *Miolepidocyclina* and *Miogypsina* s.s., it is preferable to use either the presence of equatorial chambers intercalated between the apex and the embryonic-nepionic apparatus or a fixed distance apex-I. A combination of both features should also be possible. Equatorial chambers between embryonic-nepionic apparatus and apex occurred in 25% of the specimens, whereas 50% had no equatorial chambers intercalated between apex and embryonic-nepionic apparatus. Small closely-set 'equatorial chambers' (Drooger's 'collar-like' structure formed by bending of closely-set lateral chambers) were seen between the apex and the embryonic-nepionic apparatus in 25% of the specimens sectioned (not indicated in Fig. 15).

The scatter diagrams made for (apex-I) versus γ, diam. I versus γ, length (D) versus γ and X versus D or V (not published) did not show any correlation.
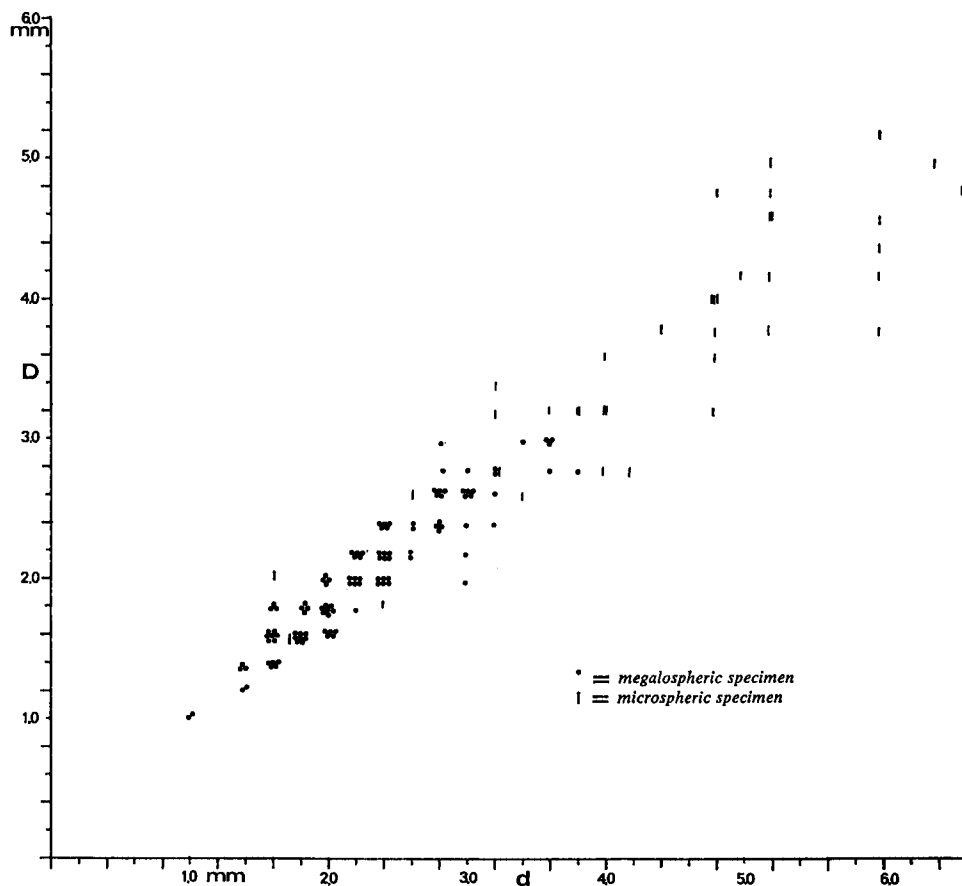
Fig. 5. Length (D) plotted against width (d).
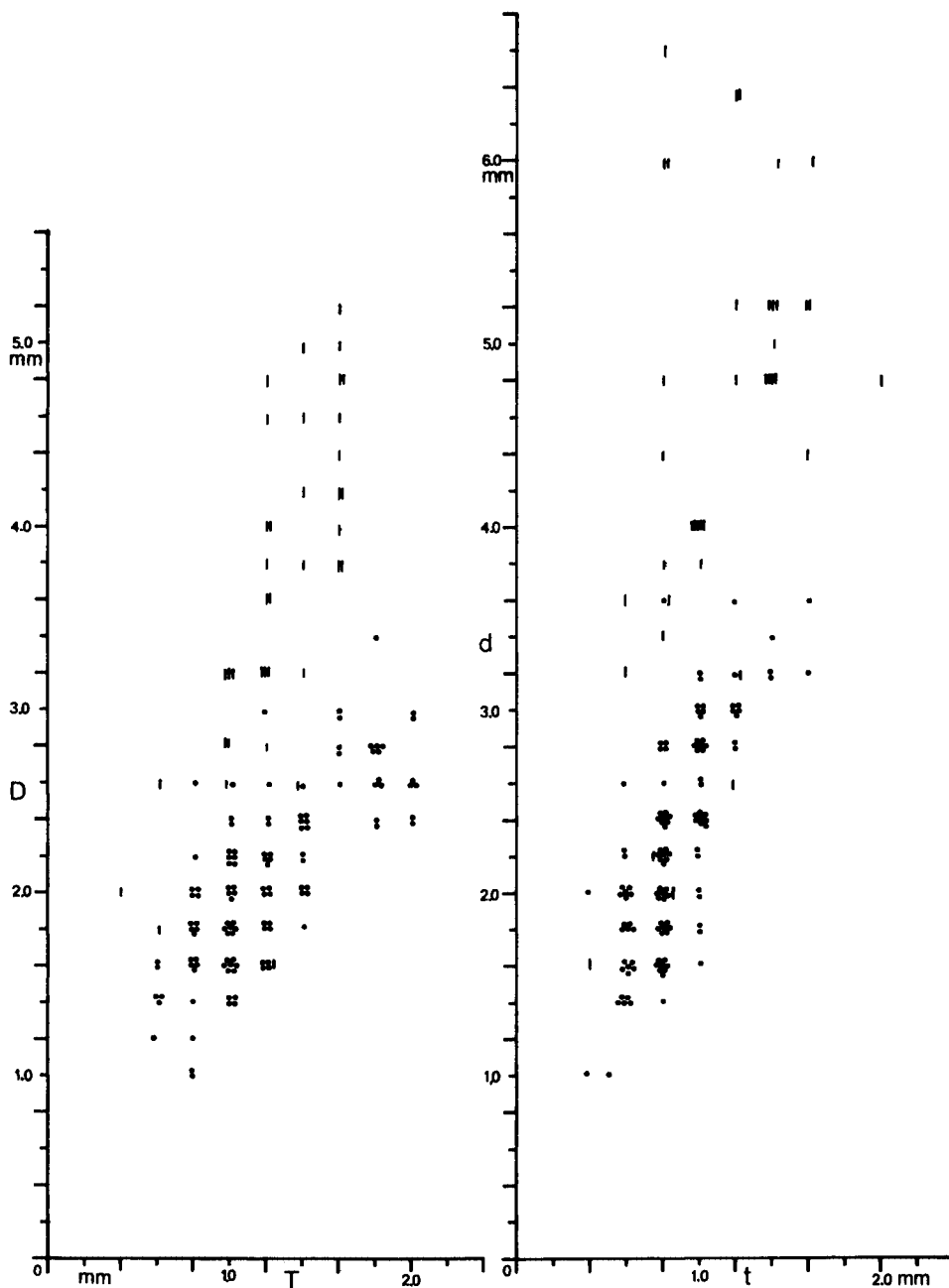
Fig. 6. Length (D) versus (T). For symbols see Fig. 5.

Fig. 7. Width (d) versus thickest part (t). For symbols see Fig. 5.

Fig. 8. The distance from the thickest part to the front (D-t) plotted against the distance from the thickest part to the apex (t). For symbols see Fig. 5.

Fig. 9. Thickest part (T) versus the distance from the apex to the thickest part (t). For symbols see Fig. 5.
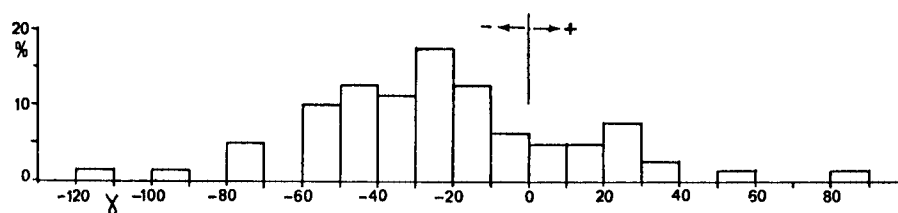
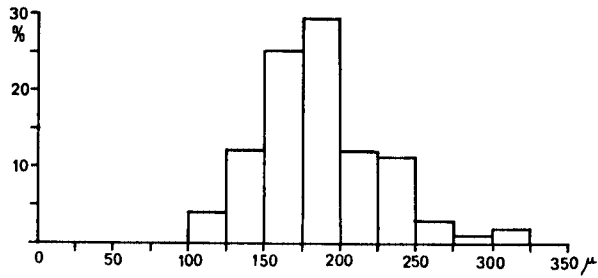Fig. 10.   Histogram of γ. In the majority of the specimens γ is negative although a positive γ also occurs. N = 81.

Fig. 11. Histogram of the diameter of the protoconch in the megalospheric specimens. N = 99.
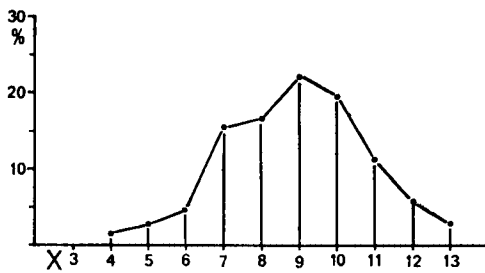
Fig. 12. Histogram of the parameter X. N. = 73.
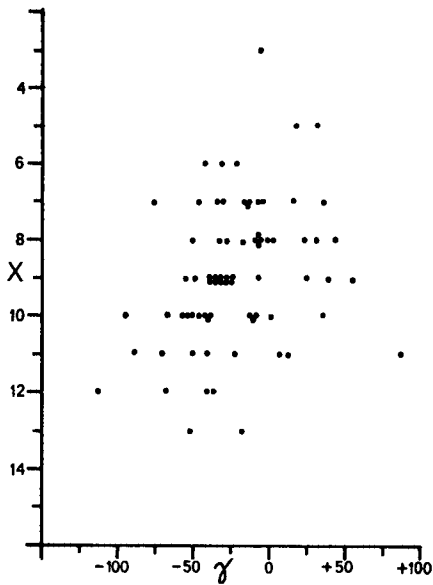
Fig. 13. X versus γ. N = 73.
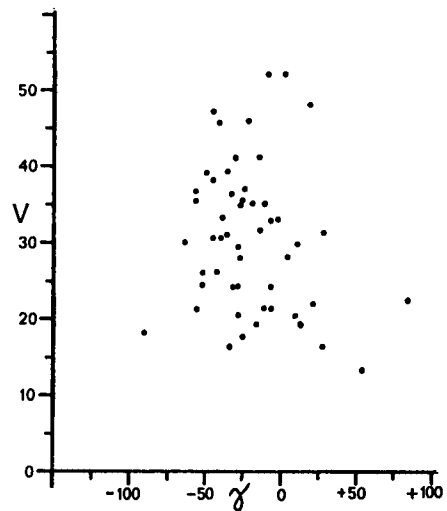
Fig. 14. V versus γ. N = 50.
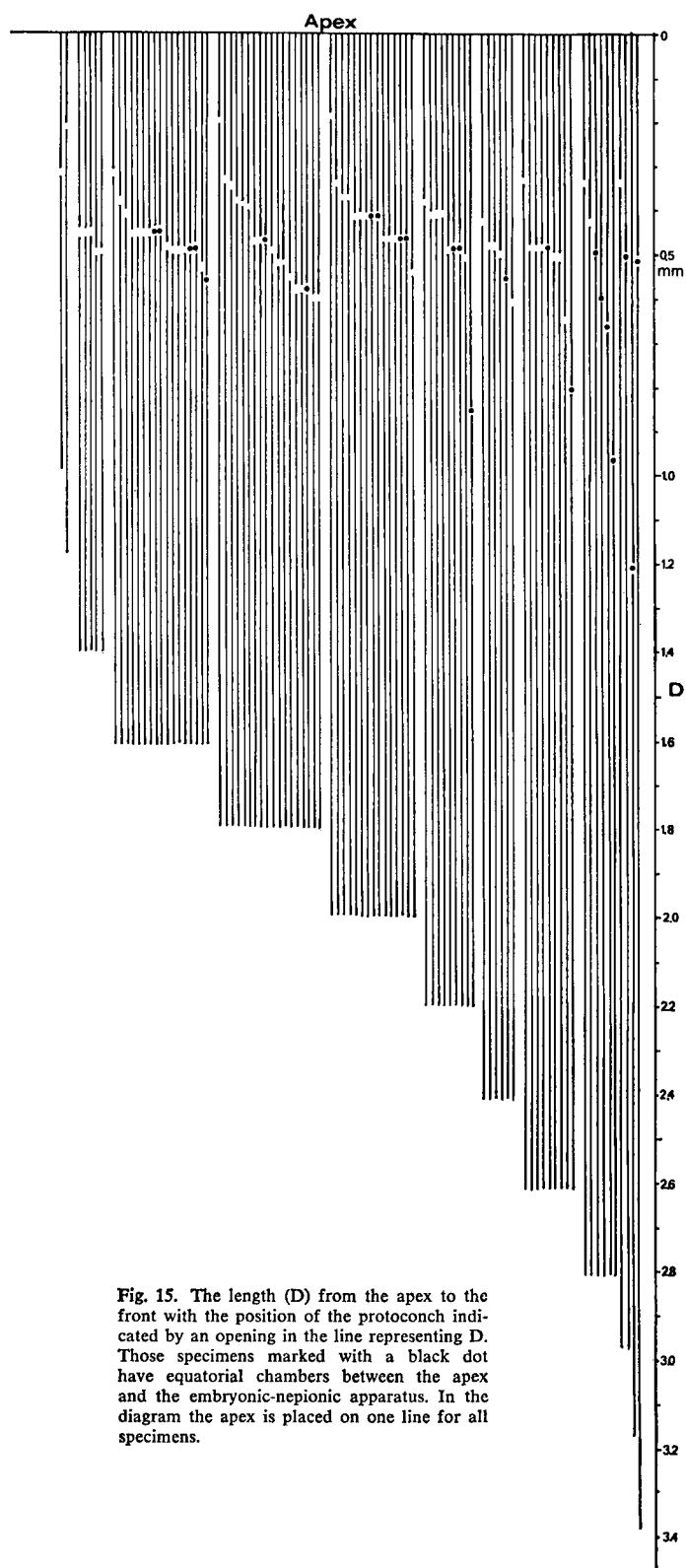
Fig. 15. The length (D) from the apex to the front with the position of the protoconch indicated by an opening in the line representing D. Those specimens marked with a black dot have equatorial chambers between the apex and the embryonic-nepionic apparatus. In the diagram the apex is placed on one line for all specimens.

Phylogeny

The crossing of spirals PI and DIII 'above' the deuteroconch seen in the specimens of *Miogypsina socini* is probably not only a local development. Such a nepionic arrangement has also been drawn for a specimen of *Miogypsinoides complanata* (Drooger, Kaasschieter & Key, 1955, pl. I:22), for the American species *Miolepidocyclina bronnimanni* and *Miolepidocyclina ecuadorensis* (Drooger, 1952, pl. I: resp. 35 and 16-29) and for a specimen of *Miolepidocyclina burdigaliensis* from Cameroon (Küpper, 1960, pl. 7:5).

Drooger (1963) described the north Italian lineage as a nearly radial development from *M. gunteri* via *M. socini* and *M. burdigaliensis* to *M. negrii* in which the embryonic-nepionic apparatus moved from the periphery to the centre. The flange-like collar may be regarded as a feature of local importance only.

M. burdigaliensis is believed to have its origin in northern Italy, since *M. burdigaliensis* is found in France and Morocco without a distinct local predecessor (Drooger, 1963). Although Drooger stated that in the *Miolepidocyclina* series of northern Italy the centripetal trend was not gradual, this was not confirmed nummerically. The parameters apex-I (ε of Souaya, 1961) is evidently correlated with the diameters of the protoconch and the deuteroconch; however it was not shown that apex-I would depend on the degree of development of the median layer of the individuals, i.e. the size of the test, as Drooger (1963) suggested. In *Miogypsina* s.s. the distance apex-I is already fixed in an early stage of growth (Fig. 15). In the *Miolepidocyclina* series a correlation between apex-I and the size (D) of the test exists only when the chambers (or collar), even in an adult growth stage, grow gradually between apex and the embryonic-nepionic apparatus.

Conclusions

The nepionic arrangement of the embryonal chambers in *Miogypsina socini,* as described in this paper (PI passes DIII without forming a closing chamber), may be regarded as a particular development in the Miogypsinidae. In this species the embryonic-nepionic apparatus often forms an angle with the equatorial plane.

The parameter apex-I might be useful for the *Miolepidocyclina* lineage in particular; a distinction must be made between juvenile and adult specimens: in juvenile (small) specimens the position of the embryonic apparatus is relatively more central than in adult (large) specimens. Therefore a distinction between the subgenera *Miogypsina* and *Miolepidocyclina* on the basis of the position of the embryonic apparatus only, is not useful. The presence of equatorial chambers intercalated between apex and embryonic apparatus, or a fixed distance apex-I, is a better criterion to distinguish *Miolepidocyclina* from *Miogypsina* s.s. A study in other Mediterranean countries such as Egypt, Morocco and France could possibly confirm the transport of the *Miolepidocyclina* stock from northern Italy to these areas, as was supposed by Drooger (1963).

References

Bock, J. F. de, 1976. Studies on some *Miogypsinoides-Miogypsina* s.s. associations with special reference to morphological features. — Scripta Geol., 36: 1-137.

Drooger, C. W., 1952. Study of American Miogypsinidae. — Doctor's Thesis Univ. Utrecht: 1-80.

——, 1954. *Miogypsina* in Northern Italy. — Proc. Kon. Ned. Akad. Wet., B, 56: 104-123.

——, 1963. Evolutionary Trends in the Miogypsinidae. In 'Evolutionary Trends in Foraminifera'. — Elsevier, Amsterdam: 315-349.

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

Drooger, C. W., J. P. H. Kaasschieter & A. J. Key, 1955. The microfauna of the Aquitanian-Burdigalian of Southwestern France. — Verhandel. Kon. Ned. Akad. Wet., 21, 2:1-136.

Küpper, I., 1960. Miogypsinen aus Britisch West-Afrika (Cameroon). — Tôhoku Univ., Sci. Repts., Sendai, Japan, 2, 4: 56-69.

Souaya, F. J., 1961. Contribution to the study of *Miogypsina* s.l. from Egypt, parts I-III. — Proc. Kon. Ned. Akad. Wet., B, 64, 5: 665-705.

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Plate 1

Miogypsina (Miogypsina) socini.

Figs. 1-3. Three megalospheric specimens. The flange-like collar is clearly shown. X20.

Fig. 4. Horizontal view of a microspheric specimen. At the front (below) the rectangular sutures of the equatorial chambers are seen. X20.

Figs. 5, 6. A horizontal and a vertical view of a megalospheric specimen. X20.

Plate 1
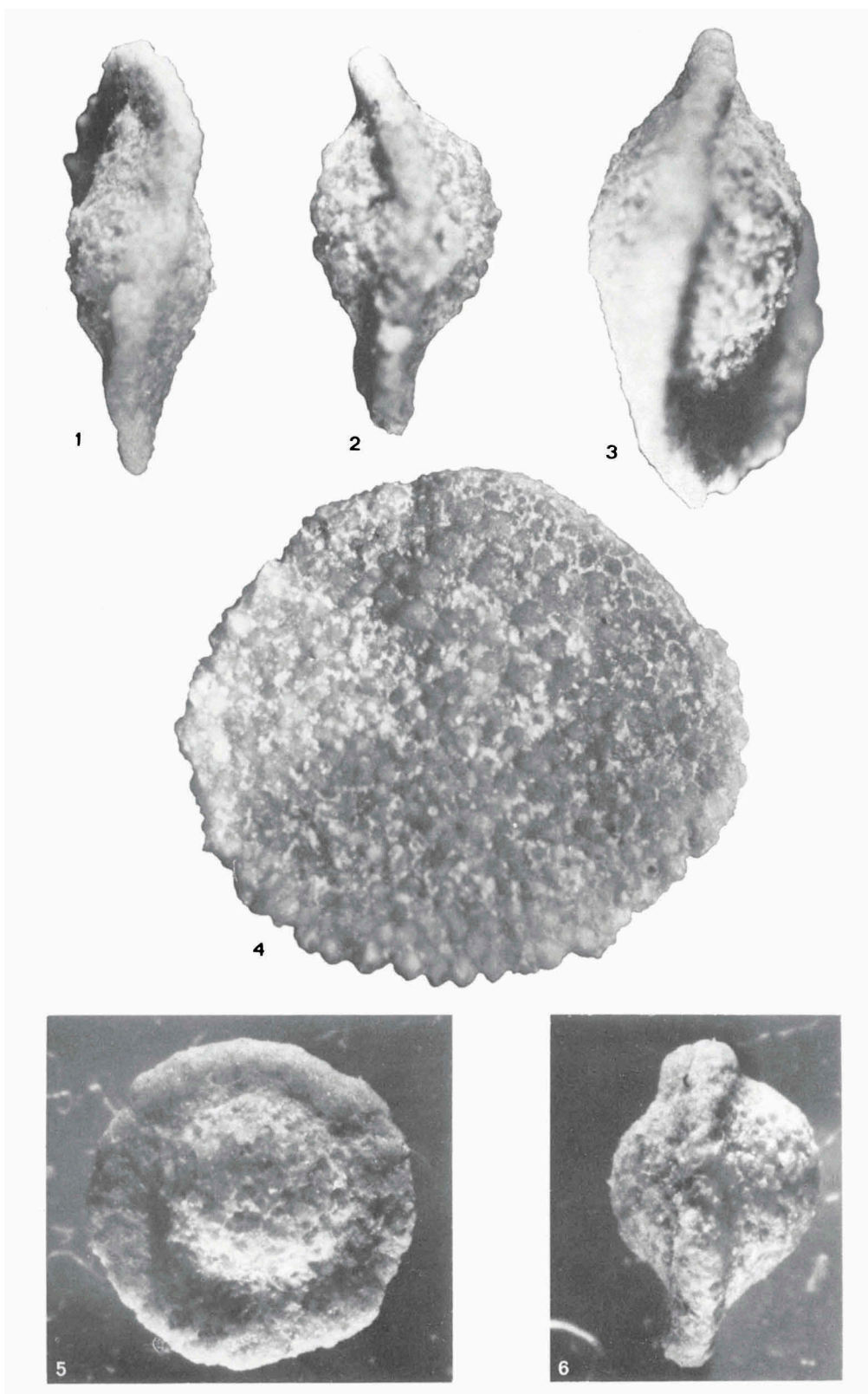
Plate 2

Two megalospheric specimens of *Miogypsina (Miogypsina) socini.*

Fig. 1. This specimen does not show distinct pillar heads on the surface. The flange-like collar is somewhat curved at the apex. X30.

Fig. 2. This specimen clearly shows the pillar heads on the surface, formed by pillars extending from the equatorial plane. X30.

Plate 2
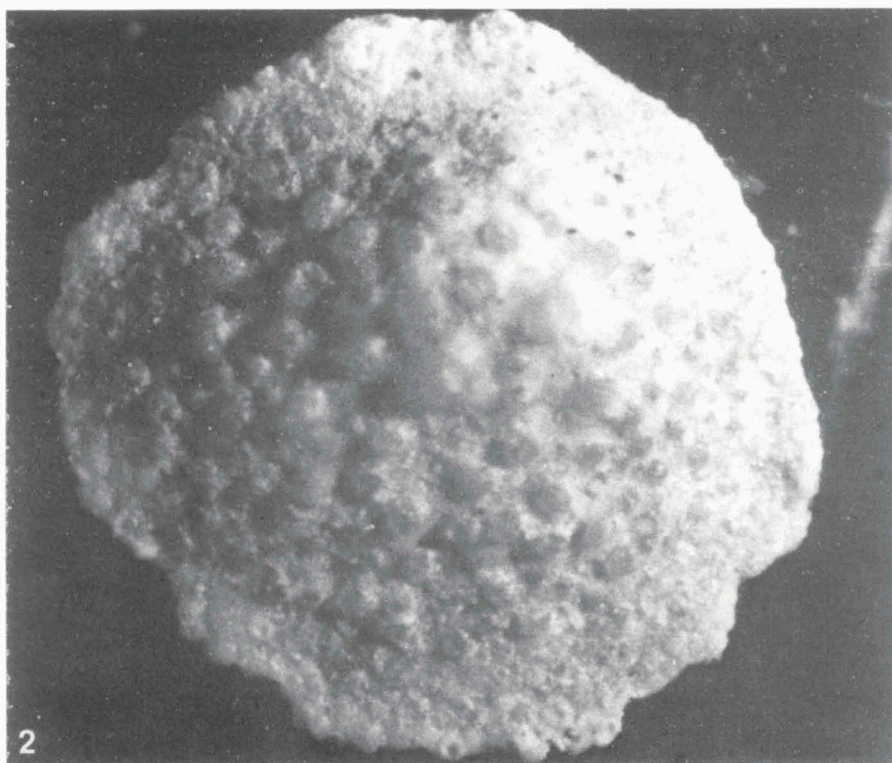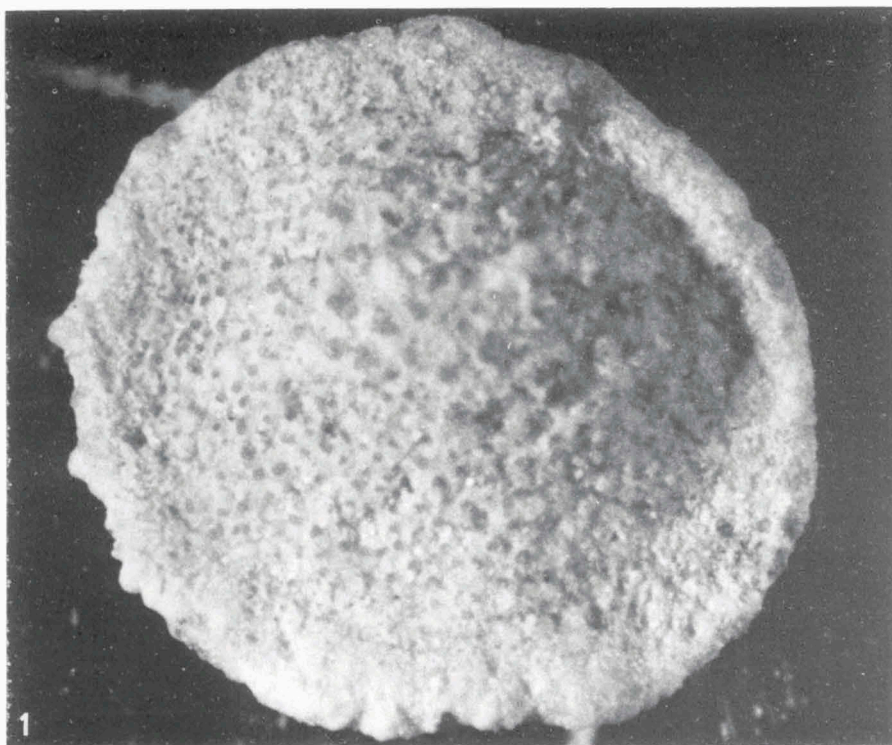
Plate 3

Three vertical sections of *Miogypsina (Miogypsina) socini.*

Fig. 1. The embryonic-nepionic apparatus is parallel to the equatorial plane. On each side of the equatorial plane are 11 rows of lateral chambers. Large pillars extend from the equatorial plane, forming a tubercle (pillar head) on the surface. M13, RGM 230 242, X70.

Fig. 2. A specimen with only a few rows of lateral chambers. The position of the embryonic-nepionic apparatus is oblique with respect to the equatorial plane. Pillars are present. M13, RGM 230 284, X100.

Fig. 3. The angle between the embryonic-nepionic apparatus and the equatorial plane is 22°. On both sides of the equatorial plane there are 11 rows of lateral chambers. M13, RGM 230 248, X100.

Fig. 4. An enlargement of the embryonic-nepionic apparatus in fig. 3. The spiral chambers (Spc) are not in the same plane as the protoconch (I) and the deuteroconch (II). X180.

Plate 3
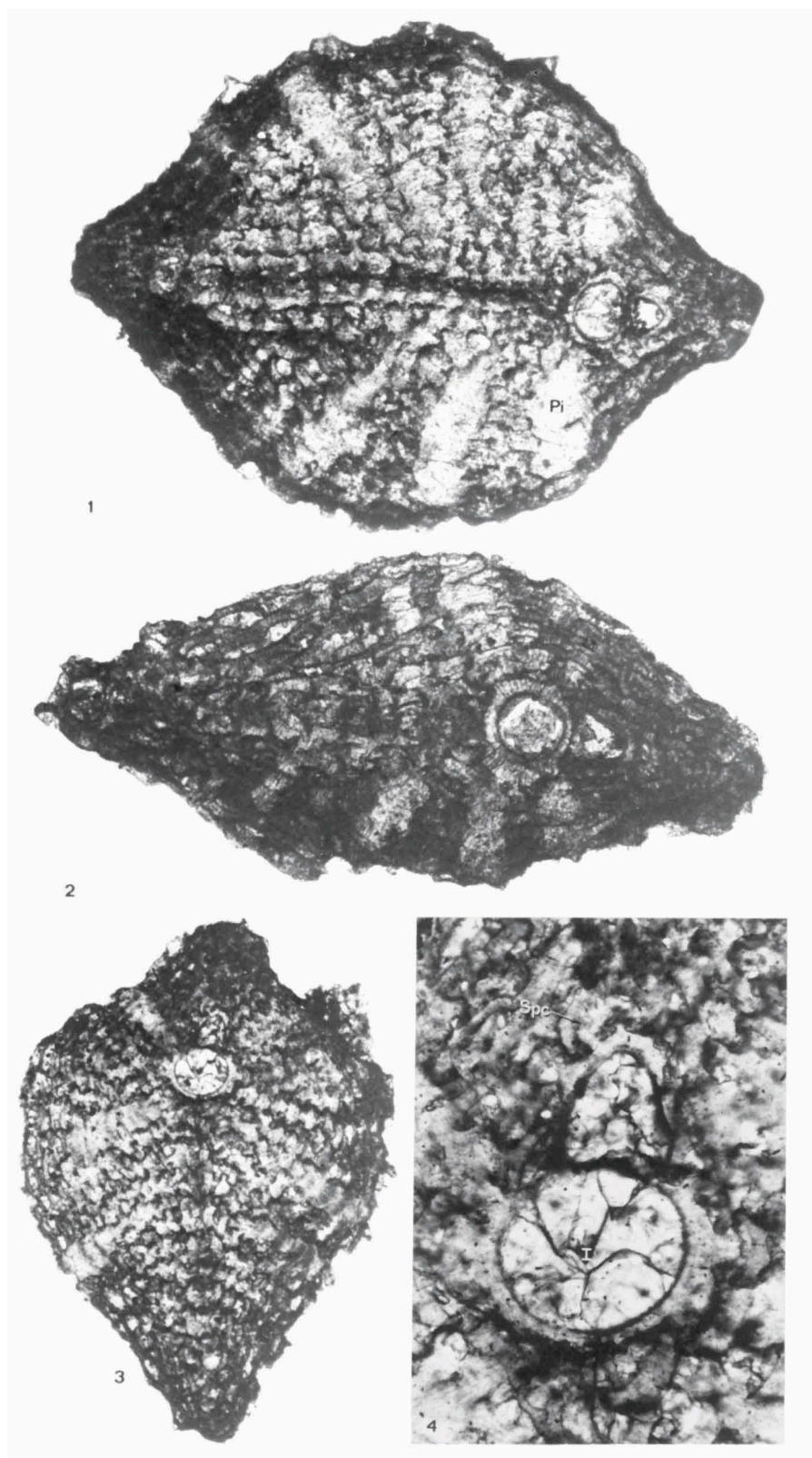
Plate 4

Miogypsina (Miogypsina) socini, megalospheric specimens. The spiral chambers are apparent in both micrographs.

Fig. 1. A large specimen with an apical embryonic-nepionic apparatus. The striated marginal fringe is shown; no equatorial chambers have developed between embryonic-nepionic apparatus and apex. M13, RGM 230 181, X20.

Fig. 2. A large specimen with a central embryonic-nepionic apparatus. No marginal fringe is seen at the apex. The position of the apex could be determined from the exterior by an interruption of the flange-like collar. M13, RGM 230 125, X20.

Plate 4
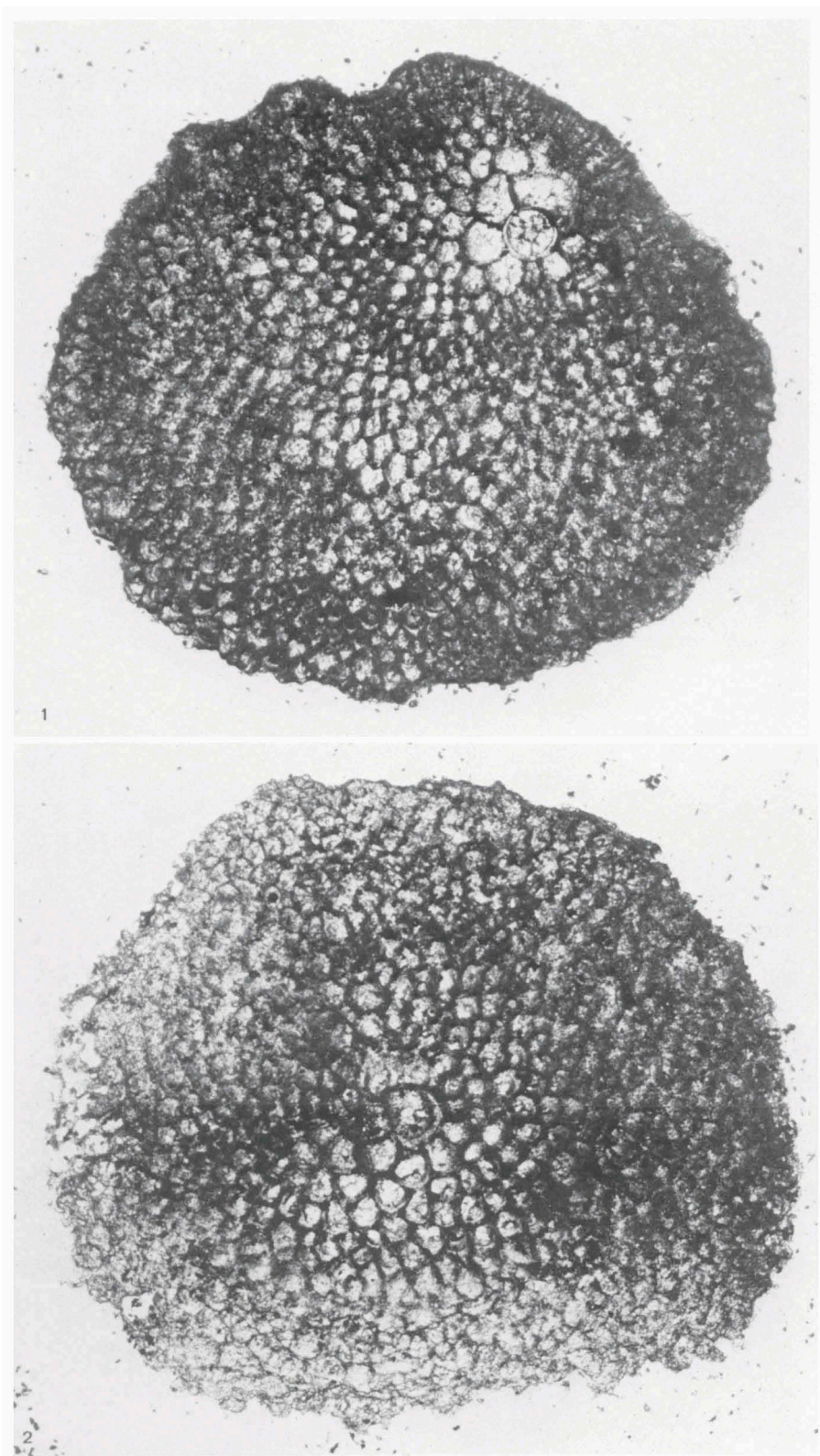
Plate 5
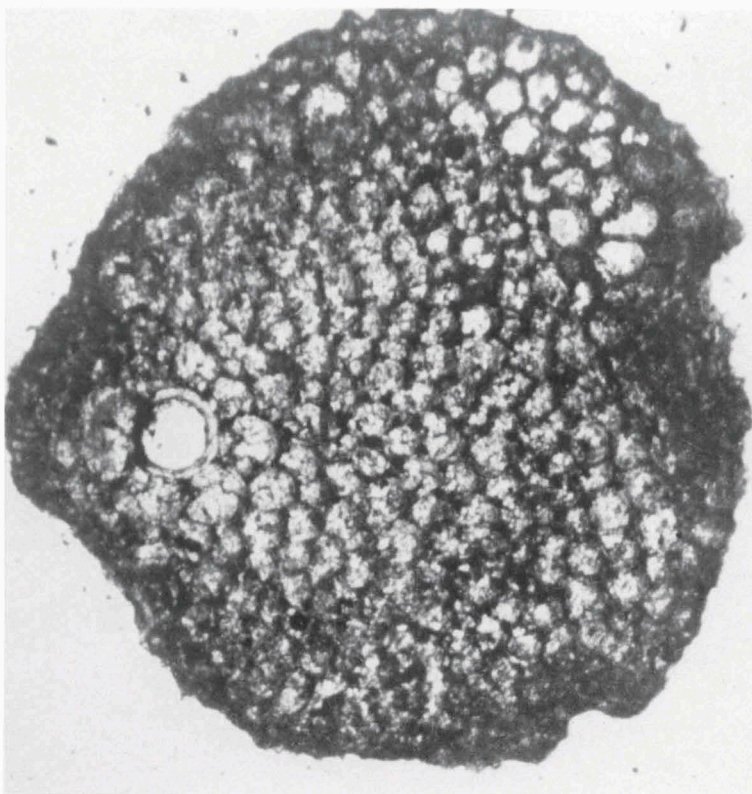
Fig. 1. *Miogypsina (Miogypsina) socini*, megalospheric specimen. The marginal fringe at the apex is probably lost in sectioning. Equatorial chambers (partly sectioned away) have developed between the embryonic-nepionic apparatus and the apex. It is difficult to ascertain whether the embryonic-nepionic apparatus of this juvenile specimen is situated apically or sub-centrally. A closing chamber has formed 'above' the deuteroconch between the two spirals originating from the first primary auxiliary chamber. M13, RGM 230 146, X38.
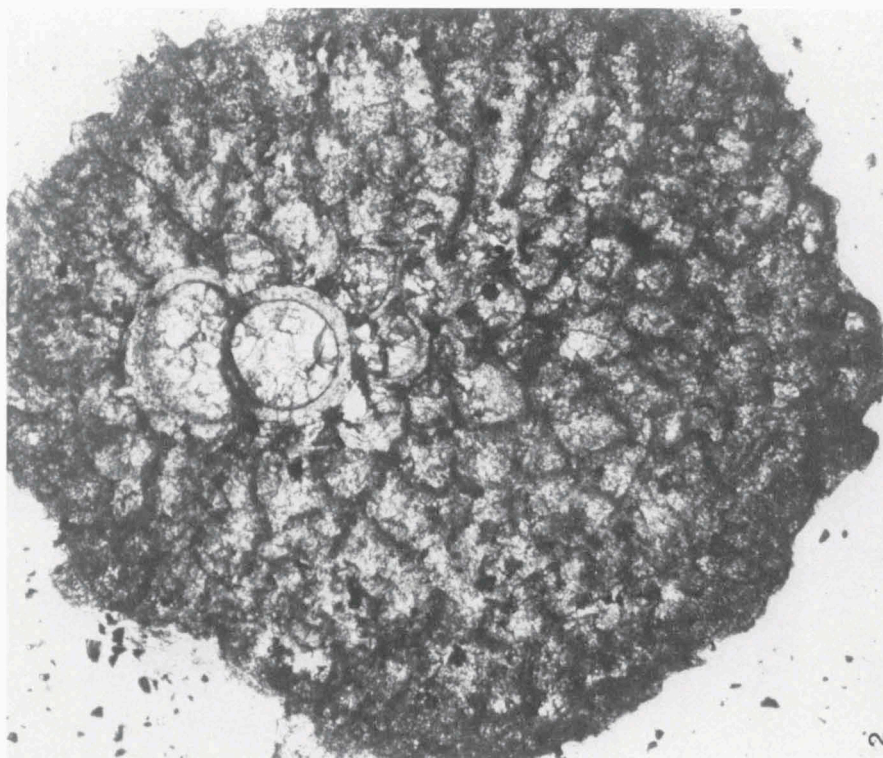
Fig. 2. *Miogypsina (Miogypsina) socini*, a megalospheric specimen with an apical embryonic-nepionic apparatus. The embryonic-nepionic apparatus lies in a somewhat protruding part of the test. M13, RGM 230 166, X24.

Plate 6
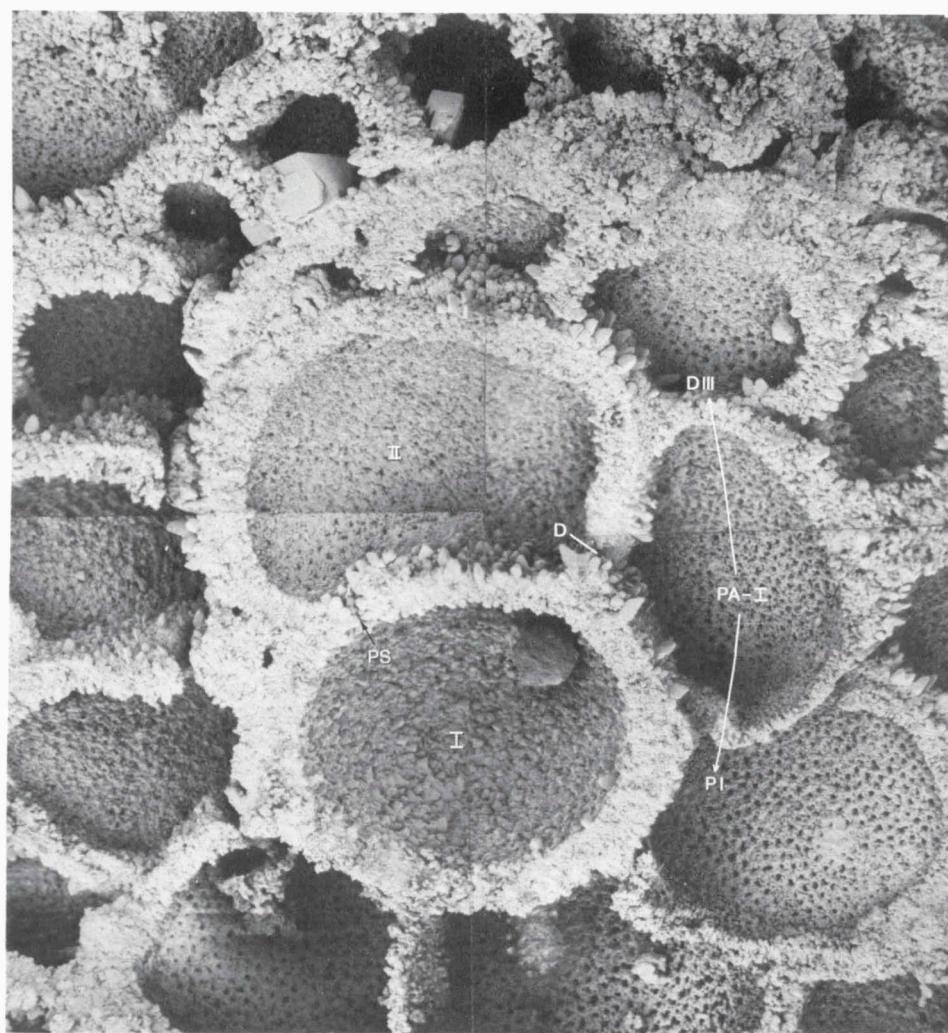
Miogypsina (Miogypsina) socini.

Two spirals originate from the first primary auxiliary chamber (PA-I): one (PI) around the protoconch (I) and one (DIII) around the deuteroconch (II). PI and DII do not form a closing chamber above the deuteroconch (II). The size of the spiral chambers of DIII decreases; there is no connection with spiral PI. The decrease in size of the 8th spiral chamber of PI, where PI passes DIII, is not a common occurrence. It can also be seen that PI is slightly trochoid: the last spiral chambers of PI above II are deeper in the plane of the 'section'. The protoconchal stolon (PS) on the PA-II side is distinct. It can be seen that a second primary auxiliary chamber is beginning to form (compare also fig. 1 of Pl. 7). Some cement has formed in the chambers. M13, RGM 230 827, X330.

Plate 7

Miogypsina (Miogypsina) socini.

Fig. 1. The other half of the specimen of Plate 6. Spiral PI distinctly overlaps spiral DIII. M13, RGM 230 827, X200.

Fig. 2. The lateral chambers in *Miogypsina socini*. A pillar (Pi) forms a large tubercle (pillar head) on the surface. Lc = Lateral chamber. M13, RGM 230 827, X200.
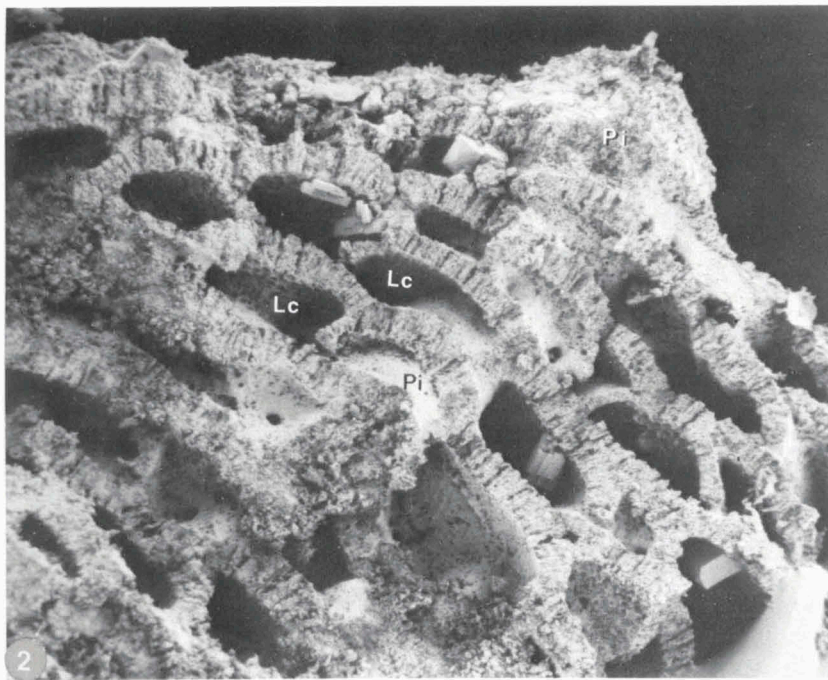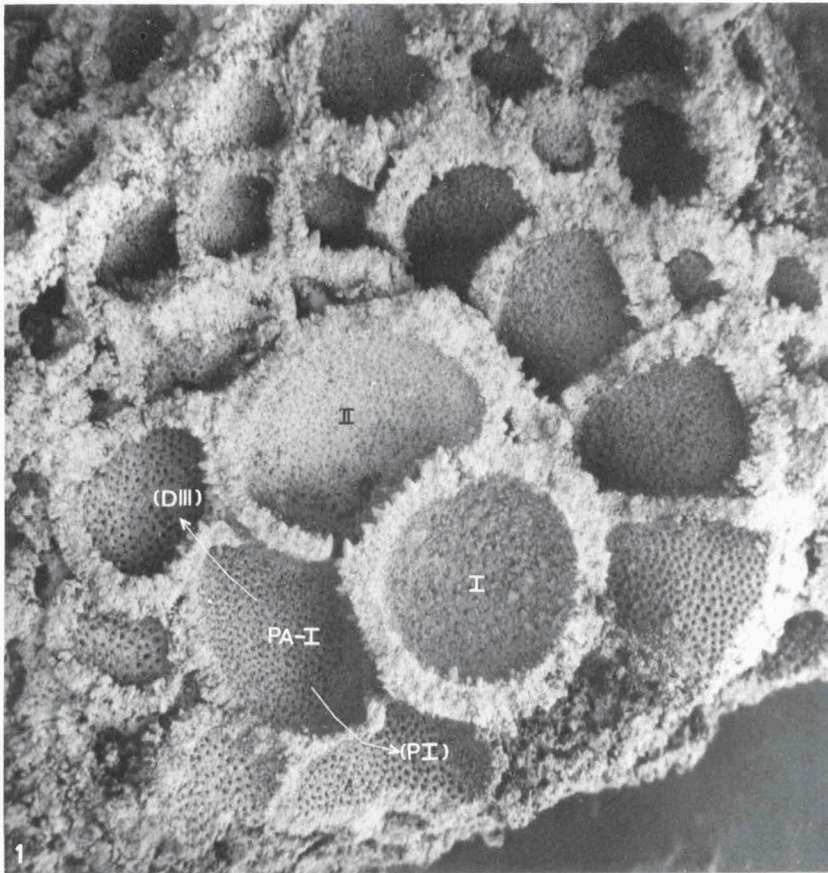
Plate 7

Plate 8

Miogypsina (Miogypsina) socini.

Fig. 1. The embryonic-nepionic apparatus in this specimen is subcentrally located; equatorial chambers are intercalated between apex and the nepionic chambers. Two spirals originate from the first primary auxiliary chamber (PA-I): one around the protoconch and one around the deuteroconch. The long spiral passes the shorter without forming a closing chamber; compare Plates 6 and 7. M13, RGM 230 194, X84.

Fig. 2. Detail of the two spirals crossing each other above the deuteroconch (II). X210.

Plate 8
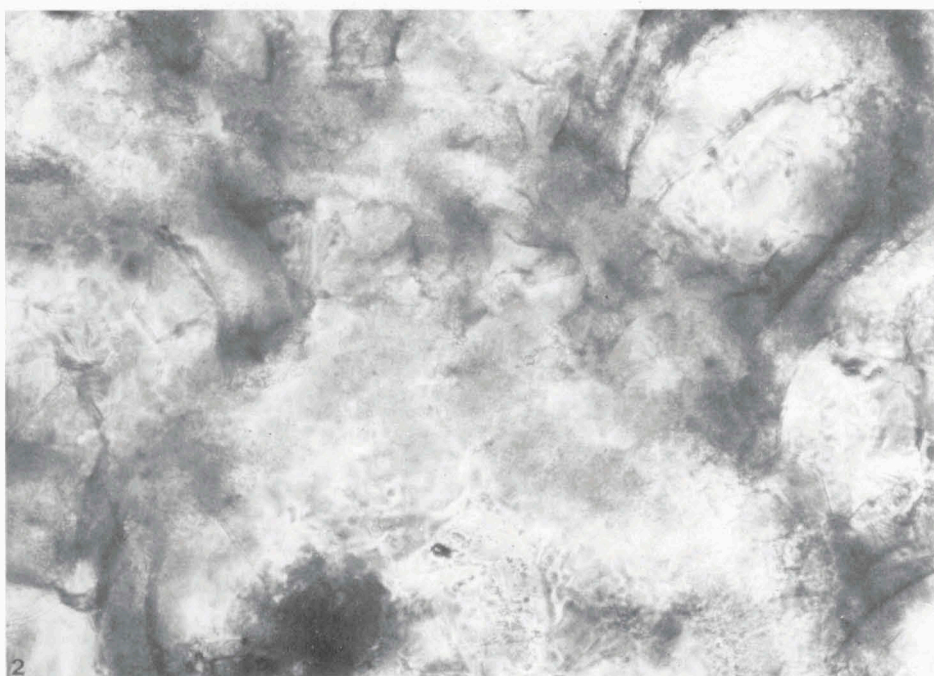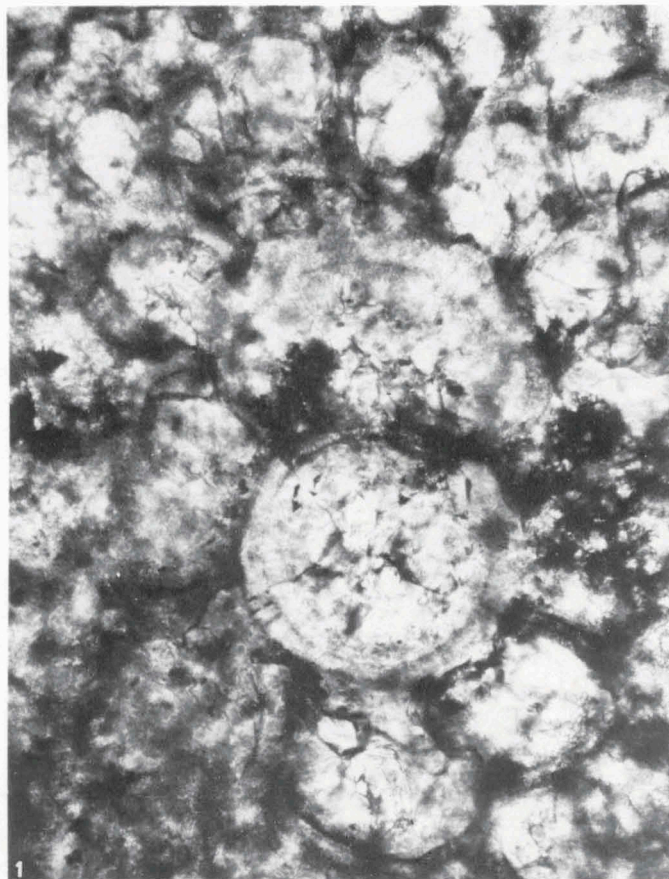
Plate 9

Miogypsina (Miogypsina) socini.

Fig. 1. 75% of the sectioned specimens show a PA-II; sometimes two spirals have developed out of this chamber. In this specimen there are two spiral chambers (Spc), one around the protoconch (I) and one around the deuteroconch (II). In a number of the other 25%, PA-II was probably lost during sectioning. The lip (L) near the protoconchal stolon (PS) is distinct. W is the wall between I and II. M13, RGM 230 182, X230.

Fig. 2. 95% of the sectioned specimens show a lip (L) on the PA-II side. Between the lip and the wall (W) between I and II are the funnel-shaped deuteroconchal stolons (FSD), forming the inlet for protoplasm into PA-II. M13, RGM 230 180, X230.
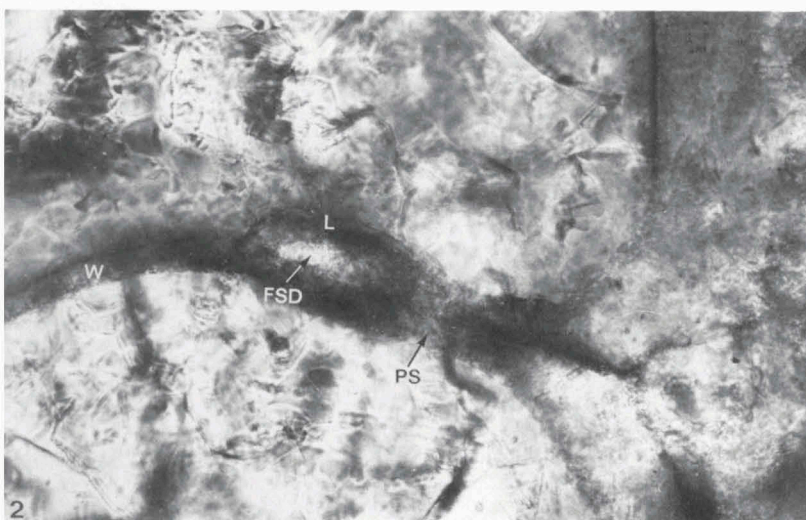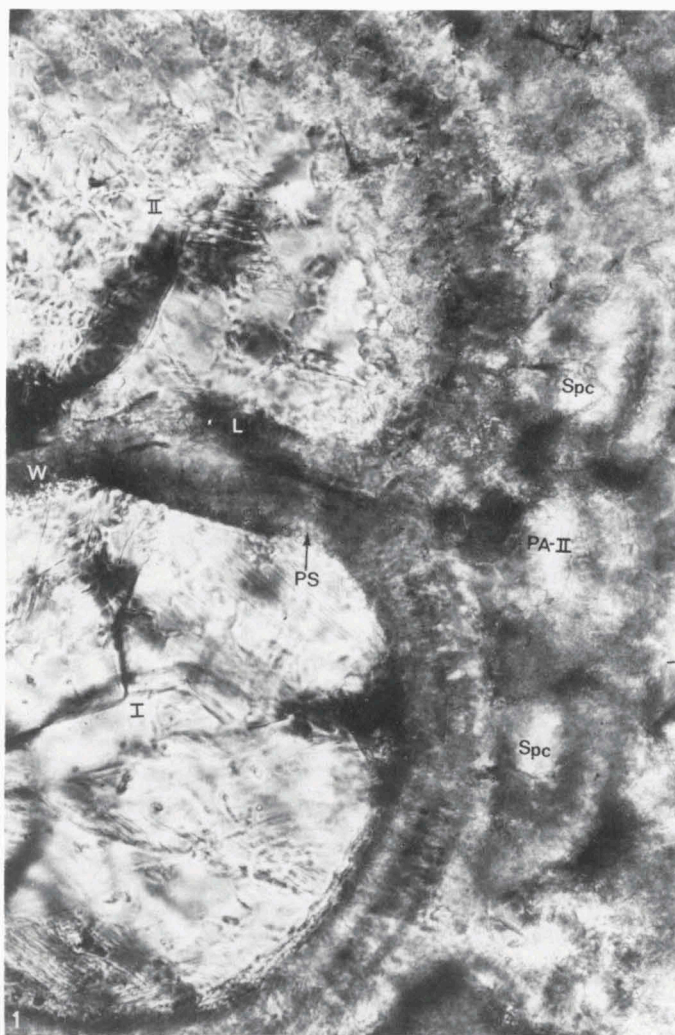
Plate 9

Plate 10

Miogypsina (Miogypsina) socini.

Fig. 1. The 'chaotic' arrangement of the spiral chambers above the deuteroconch (II) is caused by the crossing of the two spirals (PI and DIII) originating out of the first primary auxiliary chamber (PA-I). DIII crosses and lies behind PI in this micrograph. This becomes evident when the thin section is enlarged 400 times and both sides are examined. The lip (L) around the protoconchal stolon (PS) is shown as well as a small second primary auxiliary chamber (PA-II). M13, RGM 230 230, X80.

Fig. 2. In this micrograph it seems as if a closing chamber has formed between the 8th spiral chamber of PI and the 4th spiral chamber of DIII. In reality the spirals cross one behind the other. On the micrograph the 9th spiral chamber of PI and the 5th spiral chamber of DIII are indistinct. When enlarged 400 times, however, this feature is very distinct. The large chamber between PI and DIII is in fact an equatorial chamber (Ec) and not a closing chamber. This example shows clearly the mistake which could be made when a specimen is only half-sectioned. PA-II is rather large. The lip (L) around the protoconchal stolon (PS) is well-developed. M13, RGM 230 238 X80.
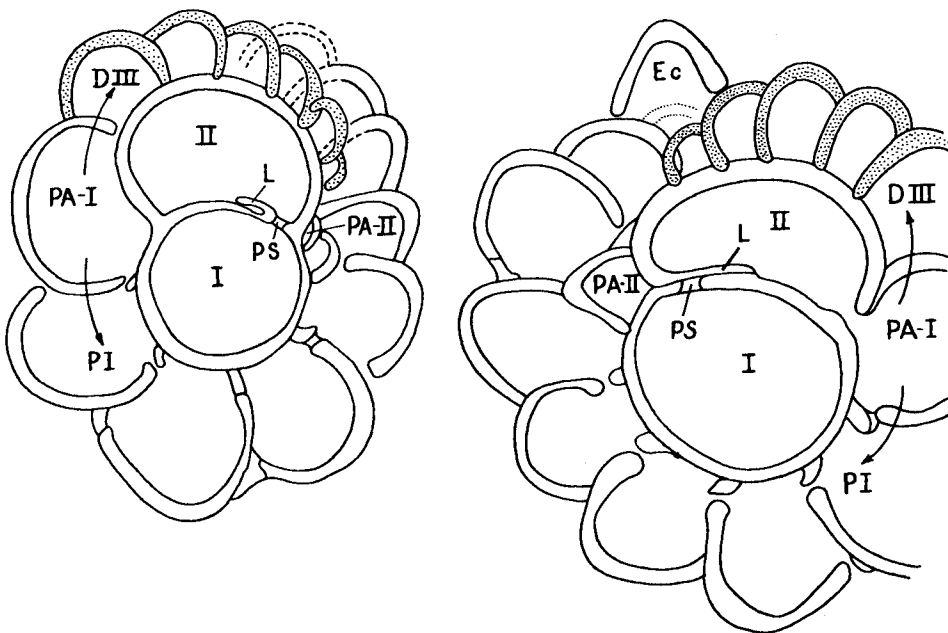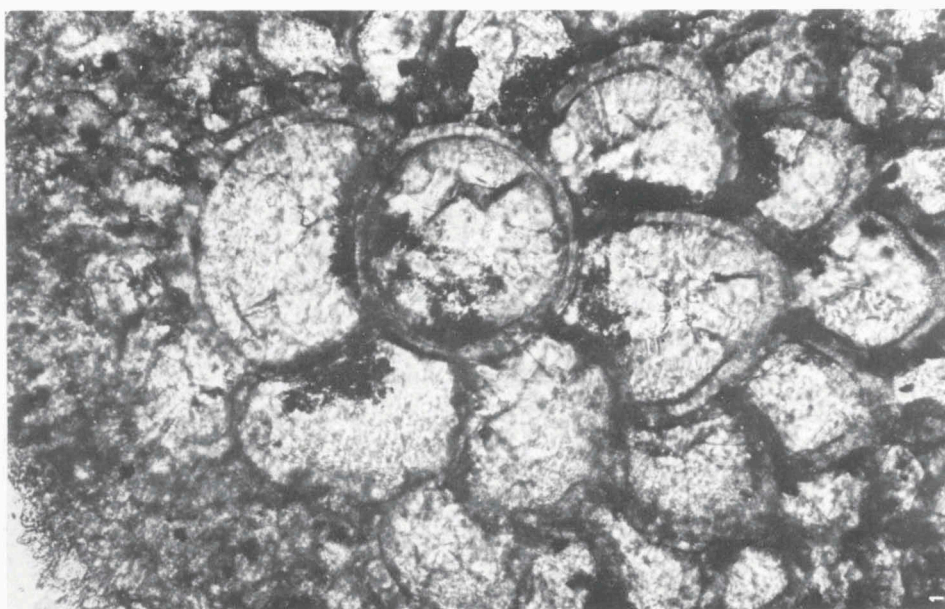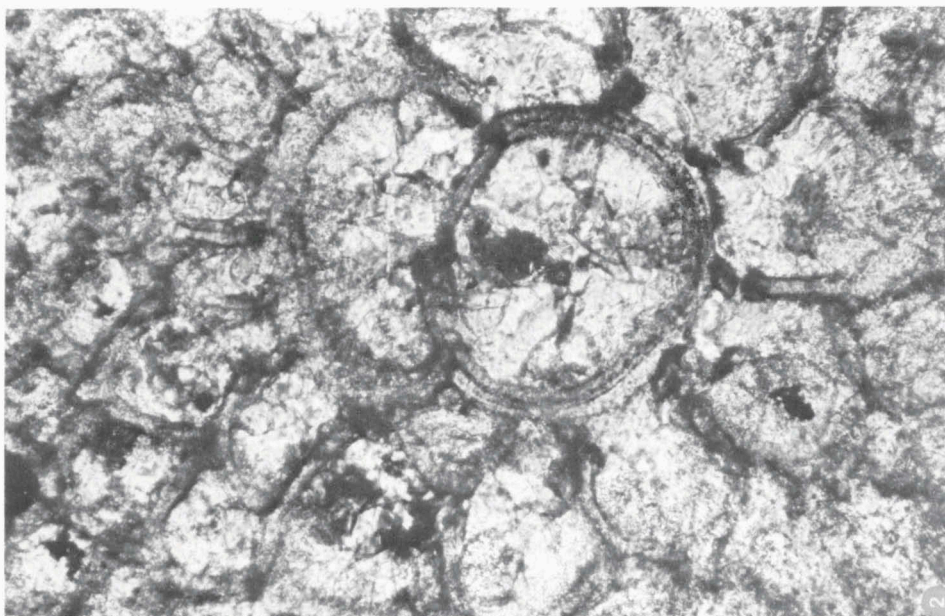
Plate 10

Plate 11

Figs. 1, 2. Microspheric specimens of *Miogypsina (Miogypsina) socini.*
The uniserial embryonic-nepionic apparatus of the microspheric specimens is situated at the periphery. The enlargement of the embryonic-nepionic apparatus clearly shows 15 spiral chambers. The adult microspheric specimens are twice as large as the adult megalospheric specimens. M13, RGM 230 101, Fig. 1: X17; Fig. 2: X84.

Plate 11