# 34. LAPIDEACASSIS AND SCAMPANELLA, CALCAREOUS NANNOFOSSILS FROM THE PALEOCENE AT SITES 354 AND 356, DSDP LEG 39, SOUTHERN ATLANTIC

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## ABSTRACT

Seven new species of the genera *Lapideacassis* Black and *Scampanella* Forchheimer and Stradner are described from the Paleocene at Site 354 on the Ceará Rise and Site 356 on São Paulo Plateau: *L. blackii*, *L. multispinata*, *L. trispina*, *S. asymmetrica*, *S. bispinosa*, *S. magnifica*, and *S. wisei*. A new terminology is applied to describe the forms of the two genera, and illustrations of all forms of the genera known to date are given.

## INTRODUCTION

During the stratigraphic work on Leg 39 samples using a light microscope, K.P.N. noted the presence of rare to very rare forms similar to the genera *Lapideacassis* and *Scampanella* in one Upper Cretaceous and several Paleocene and even Eocene samples. The genera had previously only been described with electronmicroscopy. Such forms were also found at Sites 330 and 327 in the Albian and at Site 329 in the Maestrichtian of Leg 36 on the Falkland Plateau (Wind and Wise, 1977). H.F. therefore made a special effort to find and illustrate specimens from the Paleocene of Sites 354 and 356 of Leg 39 (Figure 1). To our surprise, we discovered that the specimens, found after long searches, could be assigned to the two genera described by Black (1971) and Forchheimer and Stradner (1973). Most, however, belong to new species rather than to species previously described.

The unusual shape and construction of these nannoliths makes it difficult to describe them accurately without a specialized terminology. The terms applied here in the description of the various species on hand are shown on a theoretical nannolith (Figure 2).

## SYSTEMATIC PALEONTOLOGY

The genera *Lapideacassis* Black and *Scampanella* Forchheimer and Stradner have not yet been assigned to a family. Wind and Wise (1977) considered the two genera to be synonymous, a view not supported by the present authors.

Generally, all named species consist of a body built of a proximal column, a proximal tier, one or more distal tiers and can have an apical cone, an apical—central or asymmetrical—process, and/or apical spines. In *Scampanella*, only the first distal tier is present which constitutes more than half of the length of the body. In *Lapideacassis*, the number of distal tiers is greater than one. The species in both genera are defined by the presence or absence, number, shape, and orientation, of the apical cone, apical spines, and apical process, and in *Lapideacassis* also by the number of distal tiers. Table 1 shows the presence or absence of these characteristics in all species in the two genera thus far described. All species are shown in Figure 3.

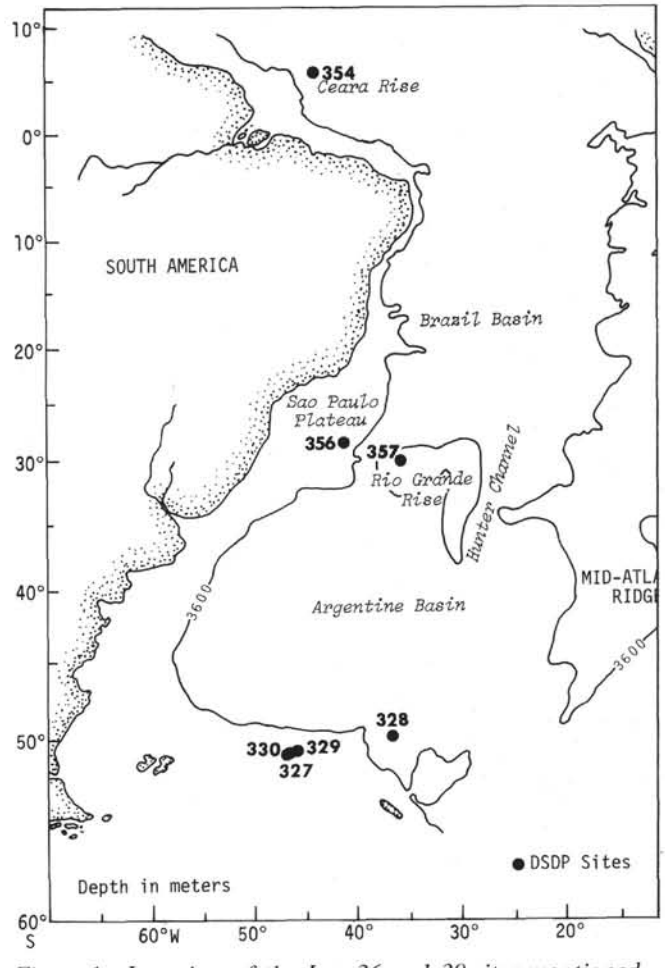


Figure 1. *Location of the Leg 36 and 39 sites mentioned in the text.*

### Lapideacassis Black, 1971

**Type Species:** *L. mariae* Black, 1971.

Black described *Lapideacassis* as "bell-shaped" microfossils with walls composed of vertically elongated plates arranged in several

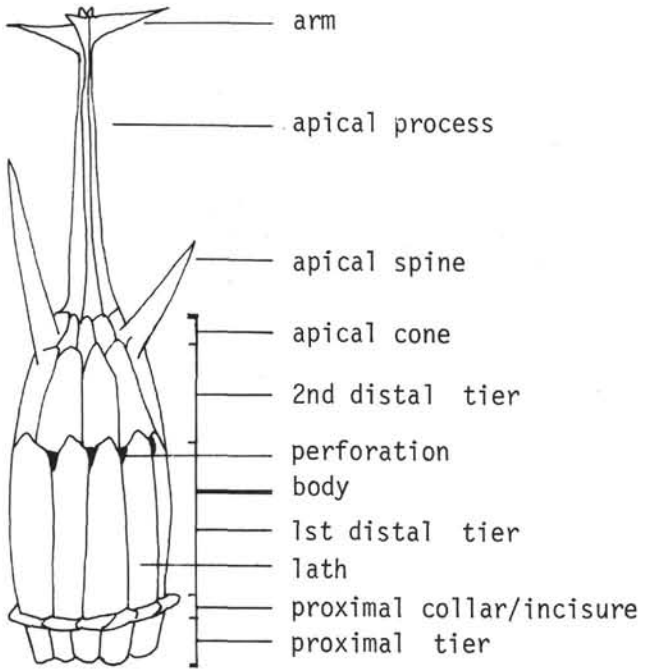


Figure 2. *Hypothetical form to show terms applied to describe specimens of Scampanella and Lapideacassis.*

tiers." Thus *Lapideacassis* differs from *Scampanella* by the presence of more than one tier and consequently we do not include *Scampanella* in *Lapideacassis*, as suggested by Wind and Wise (1977).

**Lapideacassis blackii Perch-Nielsen, n. sp.**
(Plate 2, Figures 7, 8; Text figure 3:5)

**Holotype:** Plate 2, Figure 7.

**Type level:** Early Paleocene (NP3, *Chiasmolithus danicus* Zone). (possibly reworked from the Cretaceous).

**Type locality:** DSDP Site 356, São Paulo Plateau.

**Diagnosis:** Nannolith with proximal tier, two distal tiers, and an apical cone extending into an apical, central process.

**Description:** The proximal tier is short and no proximal collar is present. The first distal tier is higher than the second one and builds a parallel-sided body. The second distal tier is conical. The apical cone is short and supports the central apical process which seems to consist of four laths, all continuations from elements of the apical cone. The apical process is incomplete in both specimens shown on Plate 2. In the holotype, a row of elongated perforations occurs between the apical cone and the second distal tier and signs of perforations are visible between the latter and the first distal tier.

**Remarks:** *L. blackii* differs from other species of *Lapideacassis* in having a central apical process. The type species of *Lapideacassis*, *L. mariae* has a well developed proximal collar but whether the holotype had an apical process or spine, or any apical structures above the low apical cone cannot be determined.

**Occurrence:** *L. blackii* was found in Sample 356-28-3, 70 cm, of Paleocene age.

**Lapideacassis glans Black, 1971**
(Text figure 3:1)

1971 *Lapideacassis glans* Black, p. 326, 327, pl. 1c, not 1d.
1977 *Lapideacassis glans* Black *in* Wind and Wise, p. 301, pl. 47, fig. 5; not pl. 46, fig. 5, 6, and pl. 47, fig. 6.

**Description:** Hemispherical nannolith with a prominent proximal tier and a well-developed proximal collar. The first and second distal tiers are of about equal height; the reduced apical cone is rounded. Remains of apical spines are extremely indistinct on the holotype.

**Remarks:** Black (1971) described *L. glans* as "a species of *Lapideacassis* with roughly sculptured calcite plates having no visible perforations", and thus included in the species a higher form with three distal tiers and an apical cone (Plate 1d). This specimen is here considered to be a different form, *Lapideacassis* sp. 1. Wind and Wise (1977) have figured three specimens assigned to *L. glans*. Only the specimen in their pl. 47, fig. 5, might, according to the present authors, belong to *L. glans*. The others belong to *Lapideacassis* sp. 2 (pl. 46, fig. 5, 6) and *Lapideacassis* sp. 1 (pl. 47, fig. 6).

**Occurrence:** The holotype of *L. glans* was described from the Upper Gault of Kent, England. The specimen figured by Wind and Wise (1977) and here left in *L. glans* was found in the Albian of Site 330 on the Falkland Plateau.

**TABLE 1**
**Stratigraphic Occurrence of *Scampanella* and *Lapideacassis* (from Black, 1971; Forchheimer and Stradner, 1973; Wind and Wise, 1977; and this report) and the Presence of Structural Elements in the Different Species and Specimens of the Two Genera**

| Age | *Lapideacassis blackii* | *L. glans* | *L. mariae* | *L.* cf. *L. mariae* | *L. multispinata* | *L. tricornus* | *L. trispina* | *L.* sp. 1 | *L.* sp. 2 | *Scampanella asymmetrica* | *S. bispinosa* | *S. cornuta* | *S. magnifica* | *S. wisei* | *S.*? sp. 1 | *S.* sp. 2 | *S.* sp. 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Middle Eocene | | | | X | | | | | | | X | ? | | | | | X |
| Late Paleocene | | | | | X | | | | | | X | | | X | | | |
| Early Paleocene | X | | | | X | | X | | | X | X | | X | X | X | | |
| Cretaceous | | X | X | | | X | | X | X | | | X | X | | | X | |
| Proximal column | ? | X | X | X | X | X | X | X | X | ? | X | X | X | X | ? | X | X |
| Proximal collar | ? | X | X | X | X | X | X | X | X | ? | X | X | X | X | ? | X | X |
| Distal tier 1 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | ? | X | X |
| Distal tier 2 | X | X | X | X | X | X | X | X | X | – | – | – | – | – | ? | – | – |
| Distal tier 3 | – | – | – | ? | – | – | – | X | X | – | – | – | – | – | ? | – | – |
| Apical cone | X | X | X | | X | X | X | X | X | X | – | X | X | X | X | X | ? |
| Apical process | X | ? | ? | | – | – | – | ? | – | X | – | – | X | – | X | ? | |
| Apical spines | | ? | ? | | >3 | 3 | 3 | ? | – | – | 2 | 2 | – | 3 | – | ? | ?1 |
| Cylindrical | X | | X | | X | X | X | X | | X | X | X | X | X | | X | |
| Hemispherical | | X | | | | | | | X | | | | | | | | ± |

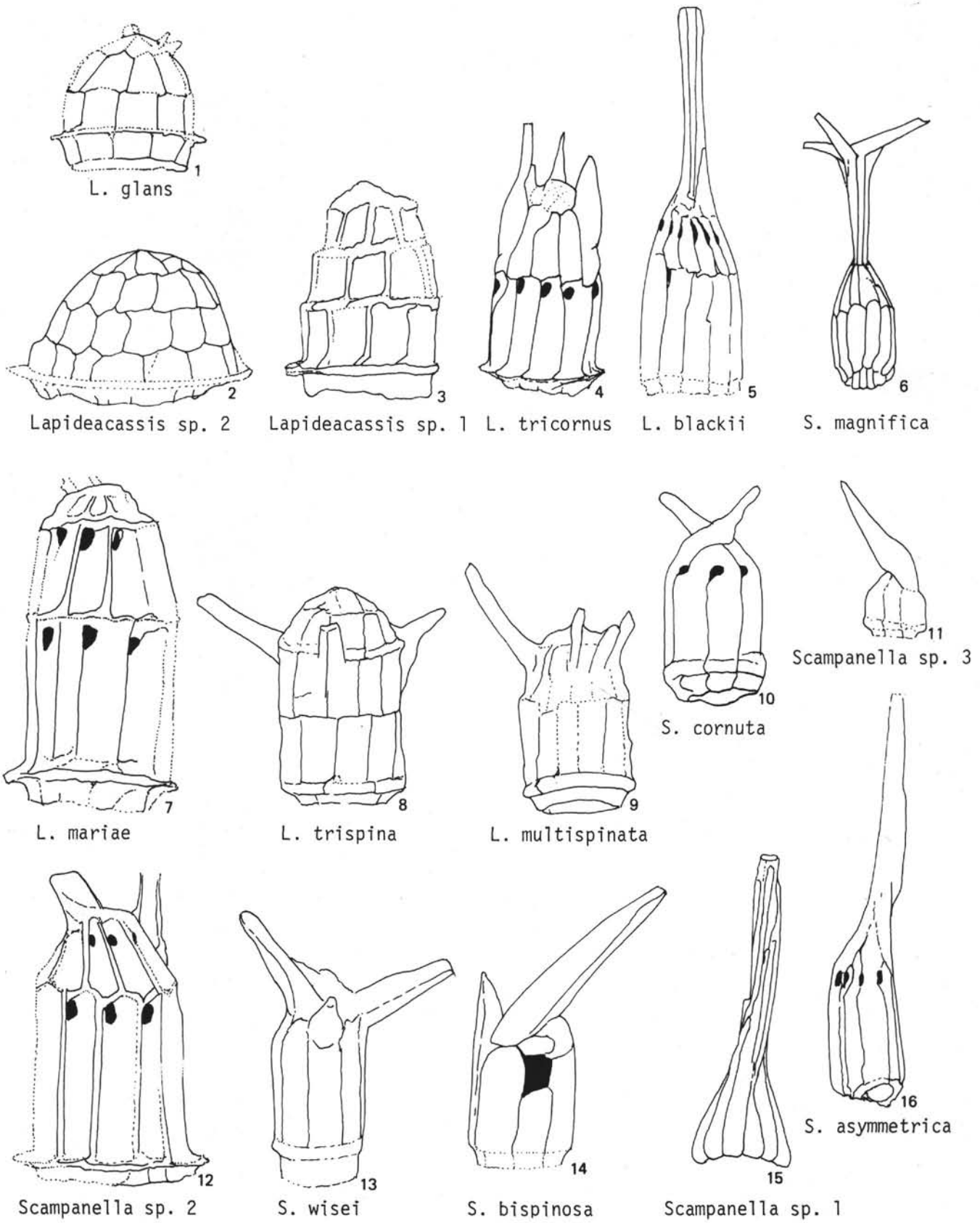


Figure 3. *Sketches of species and specimens of Scampanella and Lapideacassis, described to date.*

**Lapideacassis mariae Black, 1971**
(Text figure 3:7)

1971 *Lapideacassis mariae* Black, p. 326, pl. 1b, not 1a.
NOT 1977 *Lapideacassis mariae* Black *in* Wind and Wise, p. 301, pl. 46, fig. 1-3; pl. 47, fig. 1, 2; pl. 49, fig. 1, 2.

**Description:** Nannolith with a short proximal tier and a well-developed proximal collar. The first distal tier is somewhat higher than the slightly tapering second one and the apical cone is reduced and rounded. It is not clear, whether the holotype has apical spines, an apical process, or additional apical elements at all. Perforations occur at the top of both distal tiers.

**Remarks:** Black (1971) described *L. mariae* as "a species of *Lapideacassis* with smooth-surfaced calcite plates and a small perforation near the aboral end of each plate." The species was emended by Wind and Wise (1977) on the basis of specimens here considered to belong to *Scampanella magnifica* and not to *L. mariae* as represented by the holotype. The two specimens figured by Black are not the same species according to the present authors, thus only the holotype is left in *L. mariae* and the other form is assigned to *Scampanella* sp. While *L. mariae* adequately characterizes the genus which it defines, because the presence or absence of apical spines or an apical process cannot be defintely established, it does not adequately define the species.

**Occurrence:** The holotype of *L. mariae* was described from the Gault of Suffolk, England.

**Lapideacassis cf. L. mariae Black, 1971**
(Plate 6, Figures 31-35)

**Remarks:** Only a light microscope picture is available of *L.* cf. *L. mariae* from the middle Eocene at Site 356. The specimen is higher than most other *Lapideacassis* and bears an unknown number of apical spines. *L. mariae* probably has fewer spines.

**Lapideacassis multispinata Perch-Nielsen, n. sp.**
(Plate 4, Figures 4-6, 7, 9; Plate 6, Figures, 24 25, 28-30; Text figure 3:9)

**Holotype:** Plate 4, Figures 4-6, 9.

**Type level:** Early Paleocene (NP4 *Ellipsolithus macellus* Zone). (Possibly reworked from the Cretaceous).

**Type locality:** DSDP Site 356, São Paulo Plateau.

**Diagnosis:** Nannolith with a proximal tier, a proximal collar, two distal tiers, an apical cone and more than three apical spines.

**Description:** The proximal tier is short and consists of overlapping elements. The proximal collar is well developed. The first distal tier is slightly higher than the second one and both consist of 8 to 10 plates. The apical cone is low and rounded. The apical spines, at least six in the holotype, are oriented radially to slightly tangentially at an angle of about 45°.

**Remarks:** No other species of *Lapideacassis* or *Scampanella* has more than three apical spines.

**Occurrence:** *L. multispinata* was found in Samples 356-28-3, 70 cm, 356-25-5, 70 cm, and 356-23-2, 70 cm, of early and late Paleocene age.

**Lapideacassis tricornus Wind and Wise, 1977**
(Text figure: 3:4)

1977 *Lapideacassis tricornus* Wind and Wise, p. 301, pl. 46, fig. 4; pl. 48, fig. 1-8.

**Description:** Nannolith with a short proximal tier, a well-developed proximal collar, two distal tiers of about equal length, a reduced, rounded apical cone and three almost vertically oriented apical spines. Perforations occur between the two distal tiers.

**Remarks:** *L. tricornus* is the only species of *Lapideacassis* with three almost vertical apical spines. Wind and Wise (1977) have also included one of the two specimens of *L. mariae* shown by Black (1971) into *L. tricornus*. We did not do this here, because in the specimen described by Black (1971, pl. 1a), the first distal tier is much higher than the second one which is, in fact, an apical cone rather than a distal tier. Also the number and orientation of the apical spines is not clear from Black's illustration.

**Occurrence:** *L. tricornus* was described from the Maestrichtian at DSDP Site 327 on the Falkland Plateau. It was not observed in the Leg 39 material.

**Lapideacassis trispina Perch-Nielsen, n. sp.**
(Plate 4, Figures 1-3, 8; Plate 5, Figures 1, 3, 4, 6, 7, 9; Plate 6, Figures 21-23, 26, 27; Text figure 3:8)

**Holotype:** Plate 4, Figures 1-3.

**Type level:** Early Paleocene (NP3, *Chiasmolithus danicus* Zone) (possibly reworked from the Cretaceous).

**Type locality:** DSDP Site 356, São Paulo Plateau.

**Diagnosis:** Nannolith with a proximal tier and collar, two distal tiers, an apical cone and three apical spines. The spines are nearly horizontal and at an angle of 120° to each other in apical projection.

**Description:** The proximal tier is short and consists of overlapping elements. The proximal collar is well developed in some specimens. The distal tiers are of nearly equal height and consist of about 10 to 12 elongated elements. The apical cone is rounded. The apical spines develop from the upper part of elements of the second distal tier and are oriented slightly upwards, about 20° above horizontal.

**Remarks:** *L. trispina* differs from *L. tricornus* by the orientation of the apical spines which is very steep, almost vertical, in *L. tricornus*. *S. wisei*, which also has three apical spines has a higher proximal tier and asymmetrically arranged spines. It also has only one distal tier.

**Occurrence:** *L. trispina* was found in Samples 356-28-3, 70 cm, and 356-29-1, 90 cm, of early Paleocene age.

**Lapideacassis sp. 1**
(Text figure 3:3)

1971 *Lapideacassis glans* Black, p. 326, 327; pl. 1d, not 1c.
1977 *Lapideacassis glans* Black *in* Wind and Wise, p. 301; pl. 47, fig. 6, not 5 and not pl. 46, fig. 5, 6.

**Description:** Cylindrical nannolith with a proximal tier, a well developed proximal collar and three distal tiers. The first distal tier is higher than the second one which likewise is higher than the third tier. The first distal tier consists of about 10, the second of 6 to 10, and the third of 6 to 8 elements. The apical cone is reduced and rounded. No remains of apical spines or of an apical process are visible on the two specimens illustrated thus far.

**Remarks:** *Lapideacassis* sp. 1 and *Lapideacassis* sp. 2 are the only forms of the genus that have three distal tiers: sp. 1 is cylindrical and sp. 2 is hemispherical. Text figure 3:3 was taken from the TEM by Black (1971). The specimen figured by Wind and Wise (1977) is less well preserved and neither proximal collar nor tier were preserved.

**Occurrence:** Black's specimen was found in the Upper Gault of Kent, England. The specimen illustrated by Wind and Wise (1977) is from the Albian at DSDP Site 330.

**Lapideacassis sp. 2**
(Text figure 3:2)

1977 *Lapideacassis glans* Black *in* Wind and Wise, p. 301, pl. 46, fig. 5, 6, not pl. 47, fig. 5, 6.

**Description:** Hemispherical nannolith with a short proximal tier, a well-developed proximal collar and three distal tiers of about equal height but with decreasing number of elements. The first distal tier consists of about 16 elements, the second of about 12, and the third of about 10, nearly quadrangular plates. The apical cone is rounded. No remains of an apical process or of apical spines can be seen on the specimen figured by Wind and Wise (1977) and shown on Text figure 3:2.

**Remarks:** *Lapideacassis* sp. 2 and *Lapideacassis* sp. 1 are the only forms of the genus with three distal tiers, and *Lapideacassis* sp. 2 is the only hemispherical form besides *L. glans*, to which the specimen was assigned by Wind and Wise (1977). We consider *L. glans* to be restricted to forms with only two distal tiers.

**Occurrence:** *Lapideacassis* sp. 2 was found in the Maestrichtian of DSDP Site 327 on the Falkland Plateau.

**Scampanella Forchheimer and Stradner, 1973 emend.**

**Type Species:** *S. cornuta.*

The original definition of *Scampanella* included coccoliths with one distal tier and two apical spines. It is here emended to include also forms with an apical process or one or more apical spines. An apical cone may or may not be present. *Scampanella* was included by Wind and Wise (1977) in *Lapideacassis* but we consider *Lapideacassis* here to be a separate genus with two or more distal tiers.

**Scampanella asymmetrica Perch-Nielsen, n. sp.**
(Plate 2, Figures 3-6, 9, 10; Plate 6, Figures 7-9; Text figure 3:16)

**Holotype:** Plate 2, Figures 9, 10.

**Type level:** Early Paleocene (NP3, *Chiasmolithus danicus* Zone) (possibly reworked from the Cretaceous).

**Type locality:** DSDP Site 356, São Paulo Plateau.

**Diagnosis:** Nannolith consisting of a proximal tier, a proximal collar, a high distal tier, and an asymmetrical apical cone extending to a high apical process.

**Description:** The proximal tier, (missing on the holotype) is short and the proximal collar is reduced. The distal tier is very high and separated from the apical cone by a row of perforations. A long apical process sits asymmetrically on the apical cone.

**Remarks:** *S. asymmetrica* is the only *Scampanella* with an asymmetrical apical process.

**Occurrence:** *S. asymmetrica* was found in Sample 356-28-3, 70 cm, of early Paleocene age.

**Scampanella bispinosa Perch-Nielsen, n. sp.**
(Plate 3, Figures 1-7; Plate 6, Figures 12-14, 15-17; Text figure 3:14)

**Holotype:** Plate 3, Figures 4-7.

**Type level:** Early Paleocene (NP4, *Ellipsolithus macellus* Zone) (possibly reworked from the Cretaceous).

**Type locality:** DSDP Site 356, São Paulo Plateau.

**Diagnosis:** Nannolith with a proximal tier, a proximal collar, a distal tier, and two apical spines, one vertical and one pointing at an angle of about 45°.

**Description:** The proximal tier is relatively high in the holotype, but missing in the other specimen illustrated on Plate 3. The distal tier consists of 6 to 8 plates and perforations can be seen at its top in the holotype. The vertically oriented apical spine extends directly from an element of the distal tier.

**Remarks:** *S. bispinosa* differs from *S. cornuta*, the type species of *Scampanella*, by the orientation of the apical spines.

**Occurrence:** *S. bispinosa* was found in Sample 356-25-5, 70 cm, of early Paleocene age; in Sample 354-16-6, 70 cm, of late Paleocene age; and in Sample 356-7-3, 70 cm, of middle Eocene age.

**Scampanella cornuta Forchheimer and Stradner, 1973**
(Text figure 3:10)

1973 *Scampanella cornuta* Forchheimer and Stradner, p. 285-289, fig. 1-9.

1977 *Lapideacassis cornuta* (Forchheimer and Stradner) Wind and Wise, p. 300, pl. 48, fig. 11, 12; pl. 49, fig. 3-8.

**Description:** Nannolith with a short proximal tier, a high distal tier, a row of perforations between the distal tier and the apical cone, and two apical spines crossing at an angle of about 45°.

**Remarks:** *S. cornuta* is the only species of *Scampanella* or *Lapideacassis* with apical spines which cross each other.

**Occurrence:** *S. cornuta* was found in the Hauterivian (?) of southern Sweden (described with the SEM) and in the Coniacian of Austria (described with TEM). The specimens assigned to this species by Wind and Wise from the Albian, Cenomanian, and reworked Eocene of the Falkland Plateau are illustrated by light microscope. *S. cornuta* was not found (or not recognized ?) in the Leg 39 material.

**Scampanella magnifica Perch-Nielsen, n. sp.**
(Plate 1, Figures 1-5; Plate 6, Figures 4-6; Text figure 3:6)

1977 *Lapideacassis mariae* Black *in* Wind and Wise, pl. 49, fig. 1, 2; pl. 47, fig. 1, 2.

**Holotype:** Plate 1, Figures 1-4.

**Type level:** Early Paleocene (NP3, *Chiasmolithus danicus* Zone), (possibly reworked from the Cretaceous).

**Type locality:** DSDP Site 356, São Paulo Plateau.

**Diagnosis:** Nannolith with a short proximal tier, one distal tier and an apical cone bearing an apical process topped by a cross with tapering arms.

**Description:** The proximal tier is short and consists of about 12 elements extending into the distal tier. The relatively high apical cone consists of about 12 elements of which four extend upwards to form the apical process and the horizontally oriented cross on top of it. The arms of the cross taper.

**Remarks:** *S. magnifica* differs from *S. asymmetrica* by the nearly equal height of the distal tier and the apical cone in *S. magnifica*, as compared to a distal tier considerably higher than the apical cone in *S. asymmetrica*. Also, in *S. asymmetrica* the apical process does not extend from the middle of the nannolith. Perforations were not observed at the upper end of the distal tier in *S. magnifica* but occur in *S. asymmetrica*. The apical process of *S. campanella* sp. 1 consists of the extensions of all elements of the apical cone, while the apical process of *S. magnifica* is built only by four of the twelve elements forming the apical cone.

**Occurrence:** *S. magnifica* was found in Sample 356-28-3, 70 cm of Paleocene age. It was also found in the Maestrichtian of Tunisia (personal observation) and in DSDP Sample 327A-12, CC, of Maestrichtian age (Wind and Wise, 1977).

**Scampanella wisei Perch-Nielsen, n. sp.**
(Plate 5, Figures 2, 5, 8; Plate 6, Figures 1-3, 10, 11, 18-20; Text figure 3:13)

**Holotype:** Plate 5, Figures 2, 5, 8.

**Type level:** Early Paleocene (NP3 *Chiasmolithus danicus* Zone) (possibly reworked from the Cretaceous).

**Type locality:** DSDP Site 356, São Paulo Plateau.

**Diagnosis:** Nannolith with a proximal tier, a distal tier, and an apical cone from which three asymmetrically arranged apical spines extend.

**Description:** The proximal tier is narrow and high. The distal tier is high and topped by an apical cone. The three apical spines radiate at different angles from the apical cone or its base.

**Remarks:** *S. wisei* is the only *Scampanella* with three apical spines and the only known form in *Scampanella* or *Lapideacassis* with three asymmetrically arranged spines.

**Occurrence:** *S. wisei* was found in Sample 356-28-3, 70 cm, of early Paleocene age and in Sample 356-23-2, 70 cm, of late Paleocene age.

**Scampanella? sp. 1**
(Plate 2, Figures 1, 2; Text figure 3:15)

**Description:** *Scampanella*? sp. 1 seems to consist only of an apical cone built of about 12 elements, each of which extends upwards to form a long apical process. We are unsure whether this form is complete or represents only the apical part of a *Scampanella* or *Lapideacassis*.

**Remarks:** *Scampanella*? sp. 1 differs from *S. magnifica*, *S. asymmetrica*, and *L. blackii* by the construction of the apical process and from the *S. asymmetrica* also by the asymmetrical position of the apical process in the latter.

**Occurrence:** Only a single specimen was found in Sample 356-28-3, 70 cm, of Paleocene age. The specimen was possibly reworked from the Cretaceous, inasmuch as other Cretaceous calcareous nannofossils occur in this sample.

**Scampanella sp. 2**
(Text figure 3:12)

1971 *Lapideacassis mariae* Black, p. 326, pl. 1a, not 1b.

**Description:** Cylindrical nannolith with a short proximal tier, a proximal collar and a high distal tier. The apical cone is relatively high and remains of two apical spines seem to be present on the specimen illustrated by Black (1971) and in Text figure 3:12. A row of perforations occurs between the distal tier and the apical cone.

**Remarks:** The only other *Scampanella* with an equally well developed apical cone is *S. asymmetrica*, which is distinguished by an asymmetrical apical process. We have removed *Scampanella* sp. 2 from *L. mariae* because of its different body construction.

**Occurrence:** The specimen figured was found in the Upper Gault of Kent, England.

**Scampanella sp. 3**
(Text figure 3:11)

1977 *Scampanella* sp. Perch-Nielsen, this volume, pl. 50, fig. 39.

**Remarks:** Only a light microscope picture is available of *Scampanella* sp. 3. The specimen was found in the middle Eocene at Site 356. It has a body with a proximal tier, a proximal collar, and a short distal tier. The body is about as high as it is wide. A prominent apical spine is oriented at about 45°.

## CONCLUSIONS

### Systematics

We do not suggest to which existing family *Scampanella* and *Lapideacassis* could belong.

### Stratigraphy

Table 1 shows the stratigraphic distribution of species of *Lapideacassis* and *Scampanella* illustrated in Black (1971), Forchheimer and Stradner (1973), Wind and Wise (1977), and in this report. Very rare specimens of *Scampanella* sp. were also found in the Maestrichtian at Site 357.

The oldest known form is probably not *S. cornuta* from the Hauterivian of Southern Sweden, because the "foraminiferal Hauterivian age" of the sample from 986.35 meters, where the holotype of *S. cornuta* was found, is questionable (Forchheimer, 1972). While the presence in this sample of *Gartnerago obliquum Eiffellithus turriseiffeli* and *Kamptnerius* indicate an age not older than Turonian, the presence of *Marthasterites* suggests a Coniacian/Santonia age. This would be more consistent with the Coniacian age of the paratype designated by Forchheimer and Stradner (1973) from Klafterbruun, Austria.

The specimens described by Black (1971) and Wind and Wise (1977) from the Albian thus must be regarded as the oldest *Lapideacassis* and *Scampanella* thus far found. None has yet been reported from the Turonian and Campanian and their presence in the Paleocene and Eocene is established in this report. Because the Tertiary specimens were found in Danian samples containing reworked Cretaceous coccoliths, we first assumed that the presence of *Lapideacassis* and *Scampanella* in Tertiary sediments was the result of reworking. The presence of specimens in upper Paleocene samples, where reworked Cretaceous forms are very rare, indicated that they more probably were in place. Moreover, their presence in middle Eocene samples that contain no Cretaceous coccoliths at all, supports the conclusion that *Lapideacassis* and *Scampanella* did live during the Paleocene and Eocene and that the Danian specimens are in place. *Lapideacassis* and *Scampanella* then are two of the rare genera that survived the widespread Late Cretaceous disappearance of calcareous planktonic micro- and nannofossils. Others are *Markalius*, *Biscutum*, *Braarudosphaera*, and the calcareous dinoflagellate *Thoracosphaera*.

### Paleobiogeography

*Scampanella* and *Lapideacassis* lived in high northern and high southern latitudes of the Atlantic realm during the Albian to at least Coniacian/Santonian time. In the Maestrichtian they lived in high and mid-southern and mid-northern latitudes. The Paleocene specimens were found in sediments of mid-southern and low-northern latitudes and in mid-southern latitudes in the middle Eocene. We hope that this report will draw the attention of other specialists to these rare calcareous nannofossils. Only then will we learn whether they were restricted to the Atlantic realm or also lived in the Indian and Pacific oceans and whether they were restricted to high latitudes in the late Early Cretaceous and subsequently moved to lower latitudes.

## ACKNOWLEDGMENTS

We thank U. Gerber, ETH, Zürich for the photographic work. All SEM work was done in the SEM lab of the Federal Institute of Technology (ETH), Hönggerberg, where the SEM negatives are also stored. We thank F. Wind and W. Wise Jr. for providing the relevant parts of their Leg 36 manuscript and for comments on an early version of our manuscript.

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## PLATE 1

Figures 1-5 *Scampanella magnifica* Perch-Nielsen, n. sp.
1. Distal view of holotype. ×5400.
2. General view of holotype. ×3250.
3, 4. Proximal views of holotype. ×7200; ×9000.
5. Specimen with broken distal process; Sample 356-28-3, 70 cm, early Paleocene. ×6300.

(see page 856)

## PLATE 2

Figures 1, 2 *Scampanella*? sp. 1.
1. General view. ×4000.
2. Proximal view; Sample 356-28-3, 70 cm, early Paleocene. ×8000.

Figures 3-6, 9, 10 *Scampanella asymmetrica* Perch-Nielsen, n. sp.
×4800, ×5600, ×12,800, ×6400, ×8000, ×3200)
9, 10. Holotype. Sample 356-28-3, 70 cm, early Paleocene.

Figures 7, 8 *Lapideacassis blackii* n. sp.
7. Holotype. Sample 356-28-3, 70 cm, early Paleocene. ×4000.

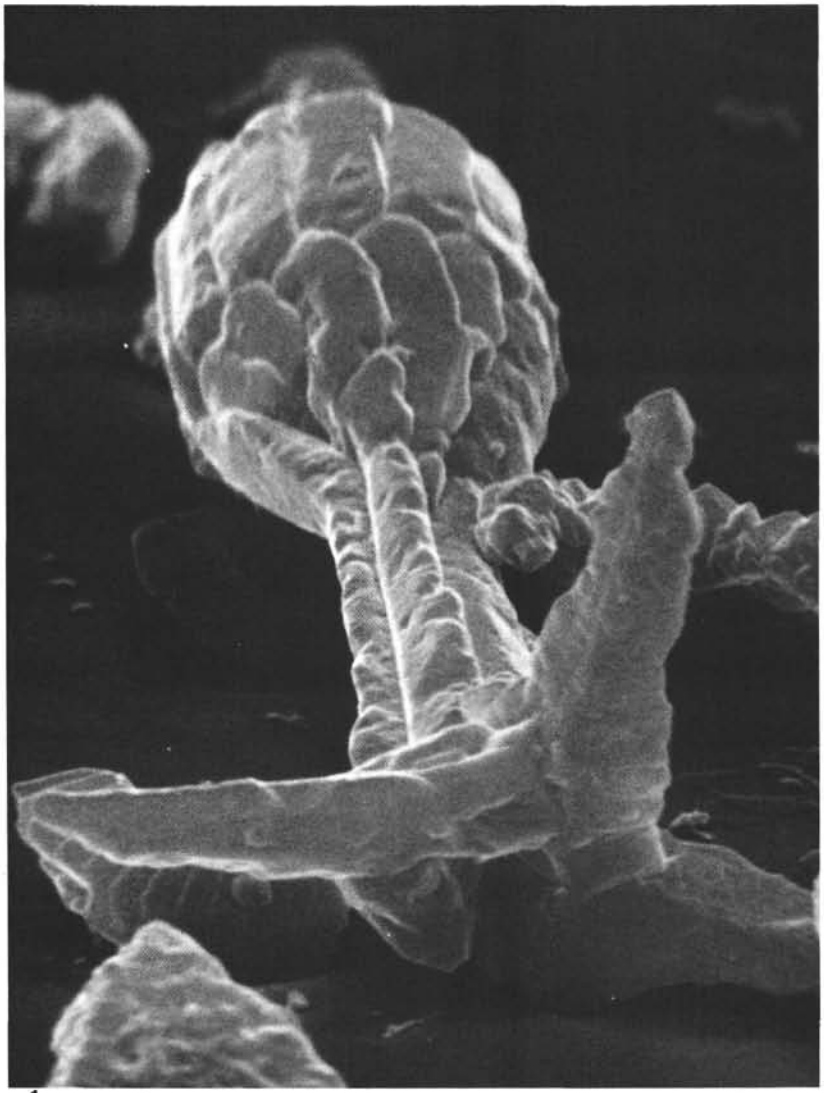
(see page 857)

## PLATE 3

Figures 1-7 *Scampanella bispinosa* Perch-Nielsen, n. sp.
1-3. Sample 354-16-6, 70, late Paleocene. ×6300, ×6300, ×7200.
4-7. Holotype. Sample 356-25-5, 70 cm, early Paleocene. ×5850, ×5850, ×5850, ×6300.

(see page 858)

PLATE 1



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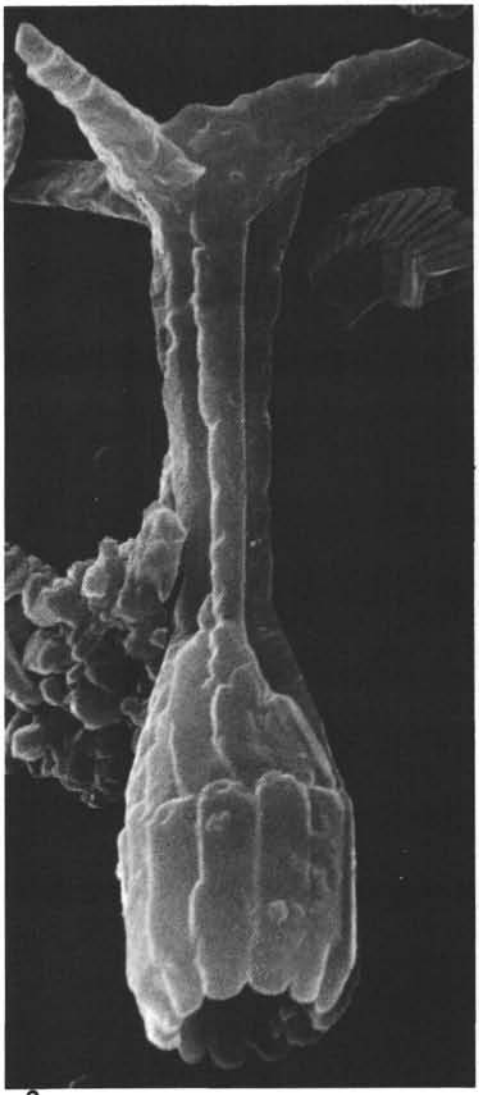

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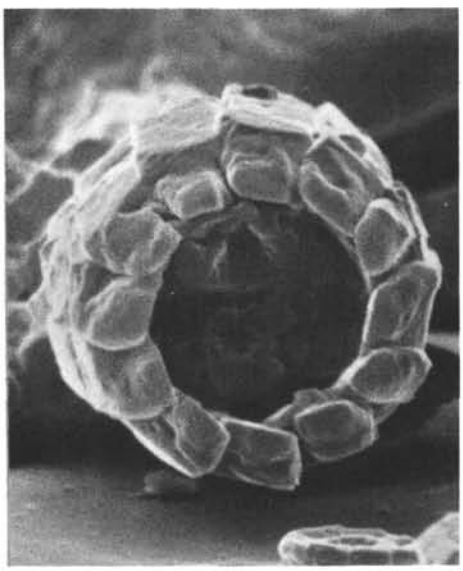

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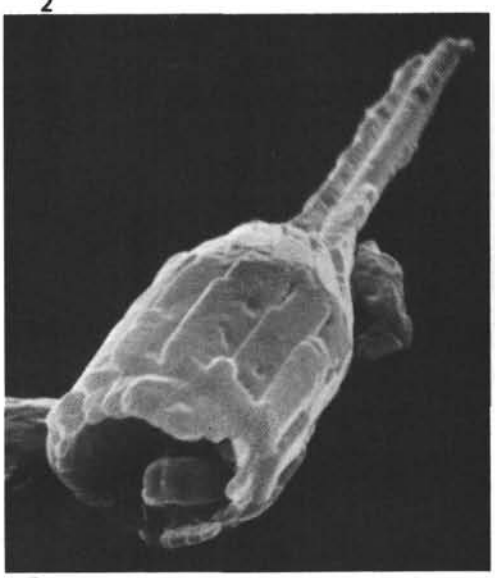

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## PLATE 2

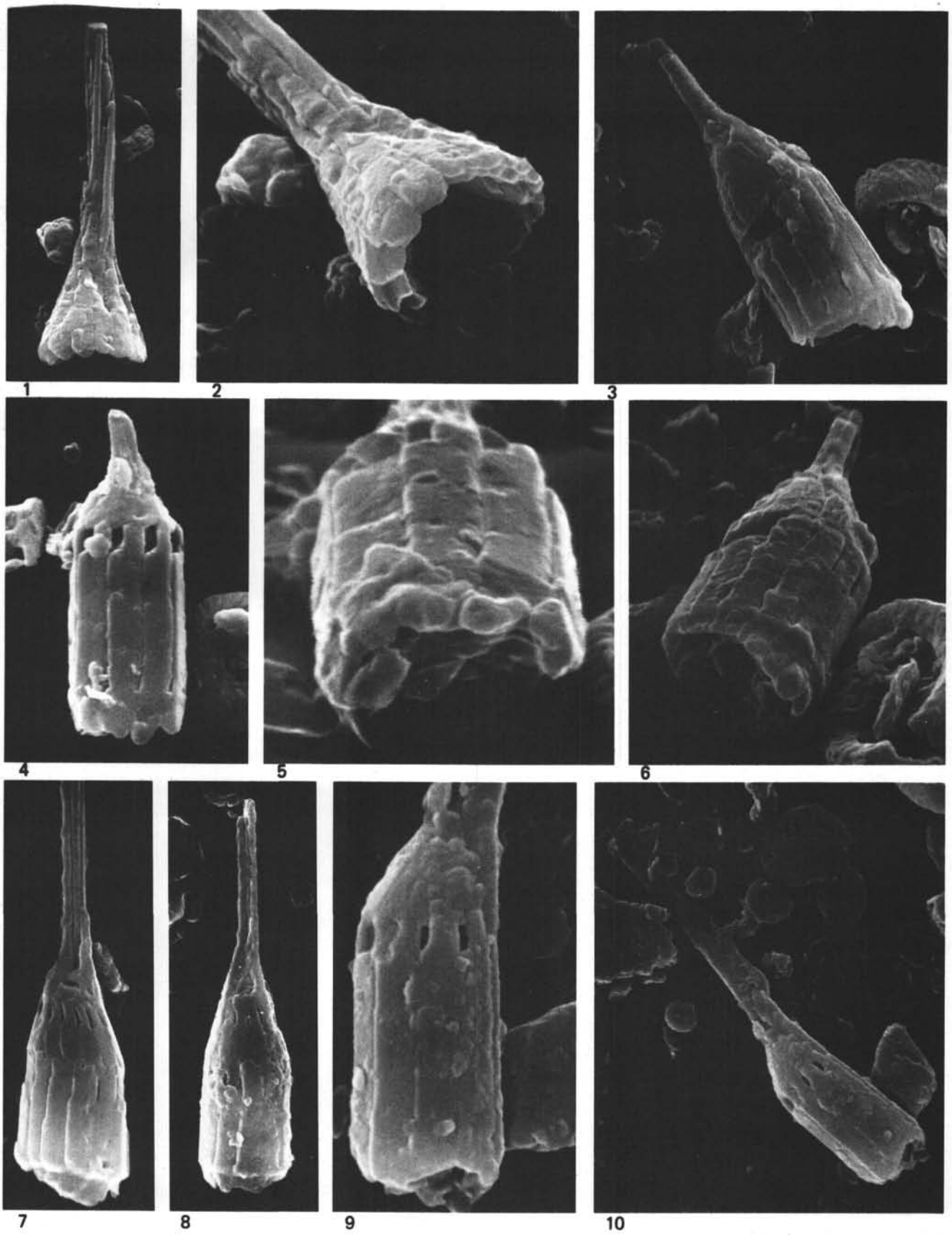
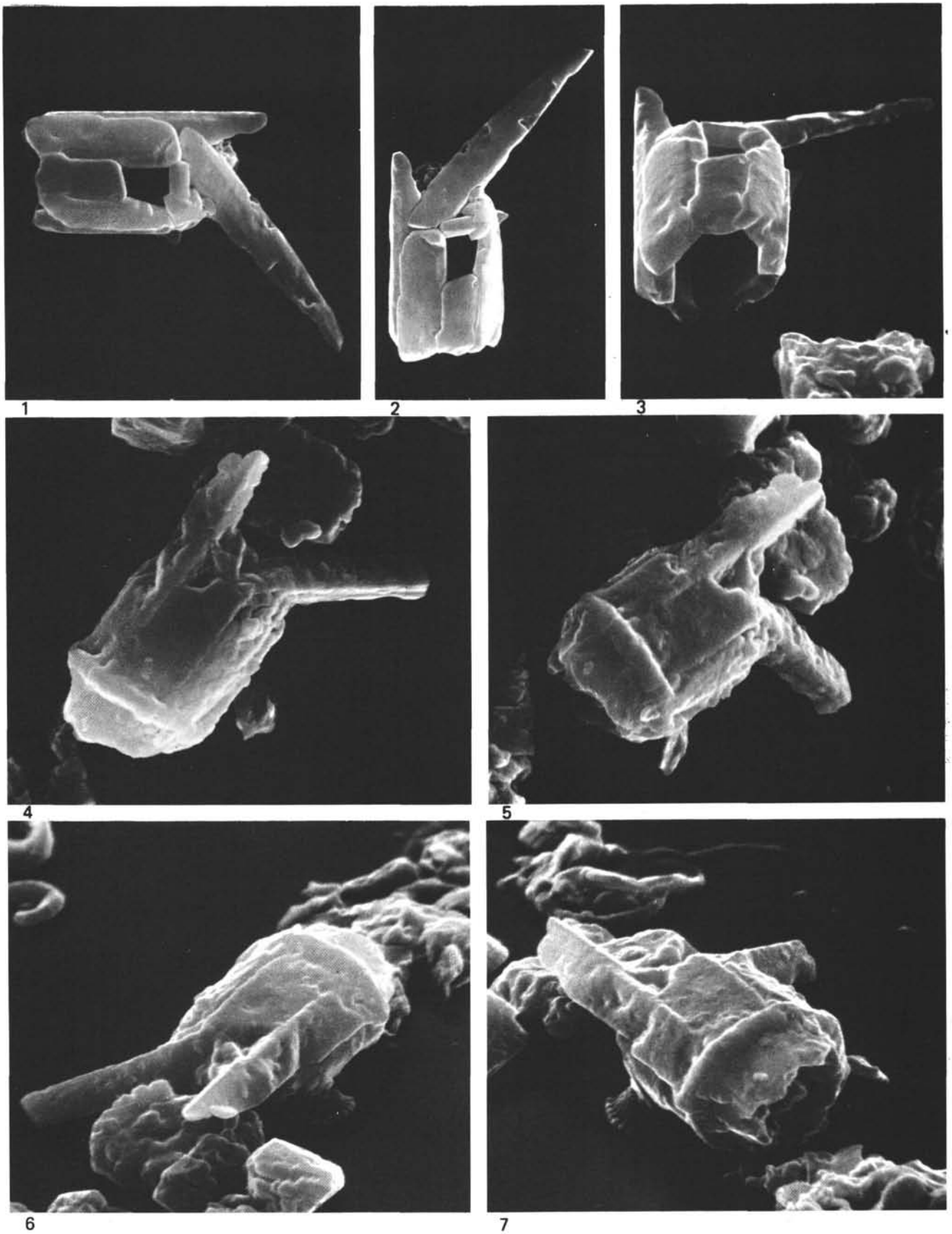


PLATE 3



## PLATE 4

Figures 1-3, 8 *Lapideacassis trispina* Perch-Nielsen, n. sp.
1-3. Holotype. Sample 356-28-3, 70 cm, early Paleocene. ×3500.

Figures 4-6, 7, 9 *Lapideacassis multispinata* Perch-Nielsen, n. sp. ×4900, ×3500, ×4900, ×4900, ×7000.
4-6, 9. Holotype. Sample 356-25-5, 70 cm, early Paleocene.

(see page 860)

## PLATE 5

Figures 1, 3, 4, 6, 7, 9 *Lapideacassis trispina* Perch-Nielsen, n. sp. ×4200, ×4550, ×4900, ×4900, ×3500, ×4550.
1, 4, 7. Sample 356-28-3, 70 cm, early Paleocene.
3, 6, 9. Sample 356-25-5, 70 cm, early Paleocene.

Figures 2, 5, 8 *Scampanella wisei* Perch-Nielsen, n. sp.
Holotype. Sample 356-28-3, 70 cm, early Paleocene. ×5600, ×4550, ×4550.

(see page 861)

## PLATE 6

Figures 1-3 *Scampanella wisei* Perch-Nielsen, n. sp.
Sample 356-23-2, 70 cm, late Paleocene. ×9000, ×7000, ×7000.

Figures 4-6 *Scampanella magnifica* Perch-Nielsen, n. sp., Maestrichtian, El Kef, Tunisia. ~×2000.

Figures 7-9 *Scampanella asymmetrica* Perch-Nielsen, n. sp. Sample 356-28-3, 70 cm, early Paleocene. ~×2000.

Figures 10, 11 18-20 *Scampanella wisei* Perch-Nielsen, n. sp., Sample 354-16-6, 70 cm, late Paleocene, Sample 356-28-3, 70 cm, early Paleocene. ~×2000.

Figures 12-14, 15-17 *Scampanella bispinosa* Perch-Neislen, n. sp., Sample 356-7-3, 70 cm, middle Eocene, Sample 354-16-6, 70 cm, late Paleocene. ~×2000.

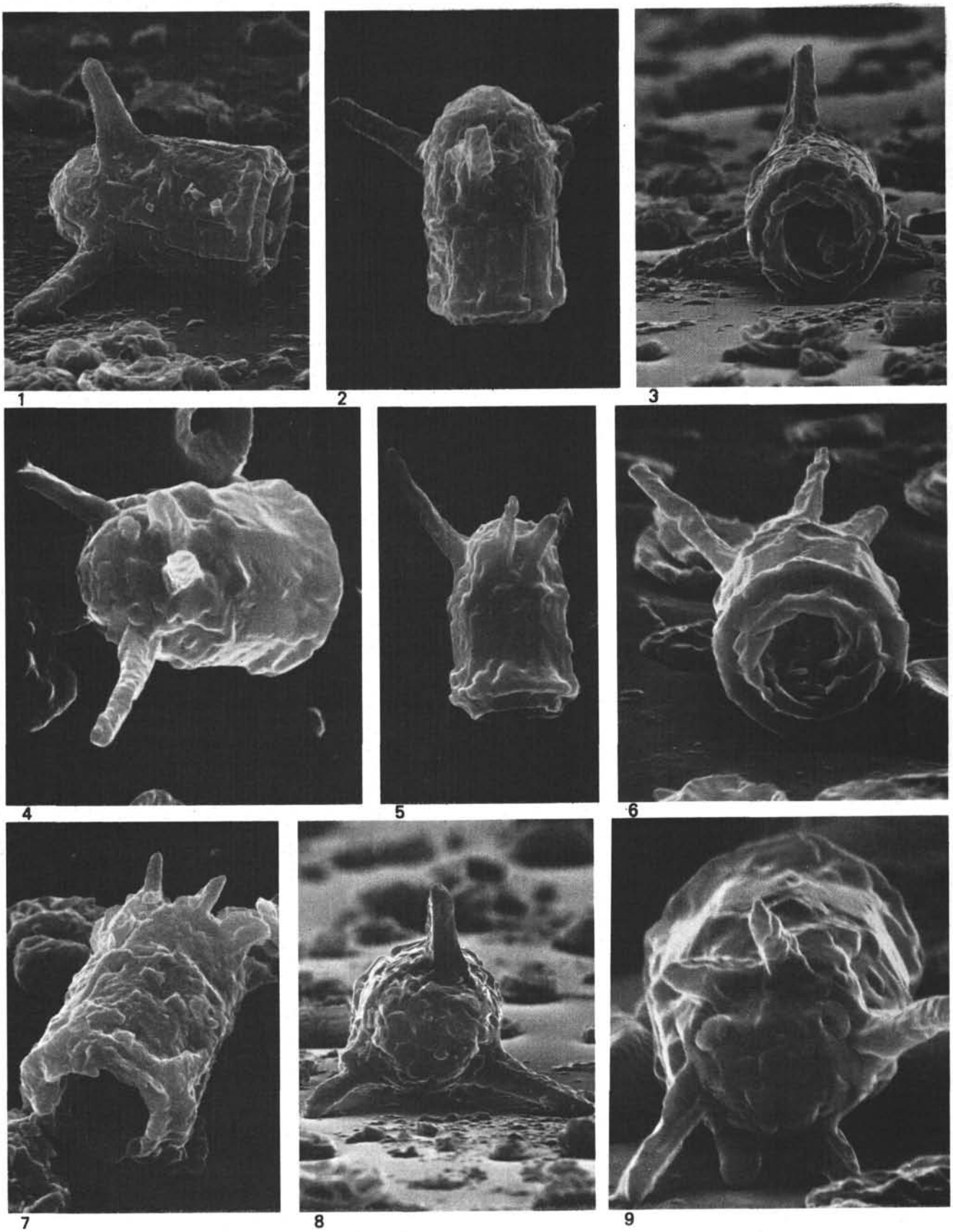
Figures 21-23, 26, 27 *Lapideacassis trispina* Perch-Nielsen, n. sp., Sample 356-29-1, 90 cm, early Paleocene, Sample 356-28-3, 70 cm, early Paleocene. ~×2000.

Figures 24, 25, 28-30 *Lapideacassis multispinata* Perch-Nielsen, n. sp., Sample 356-28-3, 70 cm, early Paleocene, Sample 356-23-2, 70 cm, late Paleocene. ~×2000.

Figures 31-33 *Lapideacassis* cf. *L. mariae* Black, Sample 356-7-3, 70 cm, middle Eocene. ~×200.

(see page 862)

PLATE 4



## PLATE 5

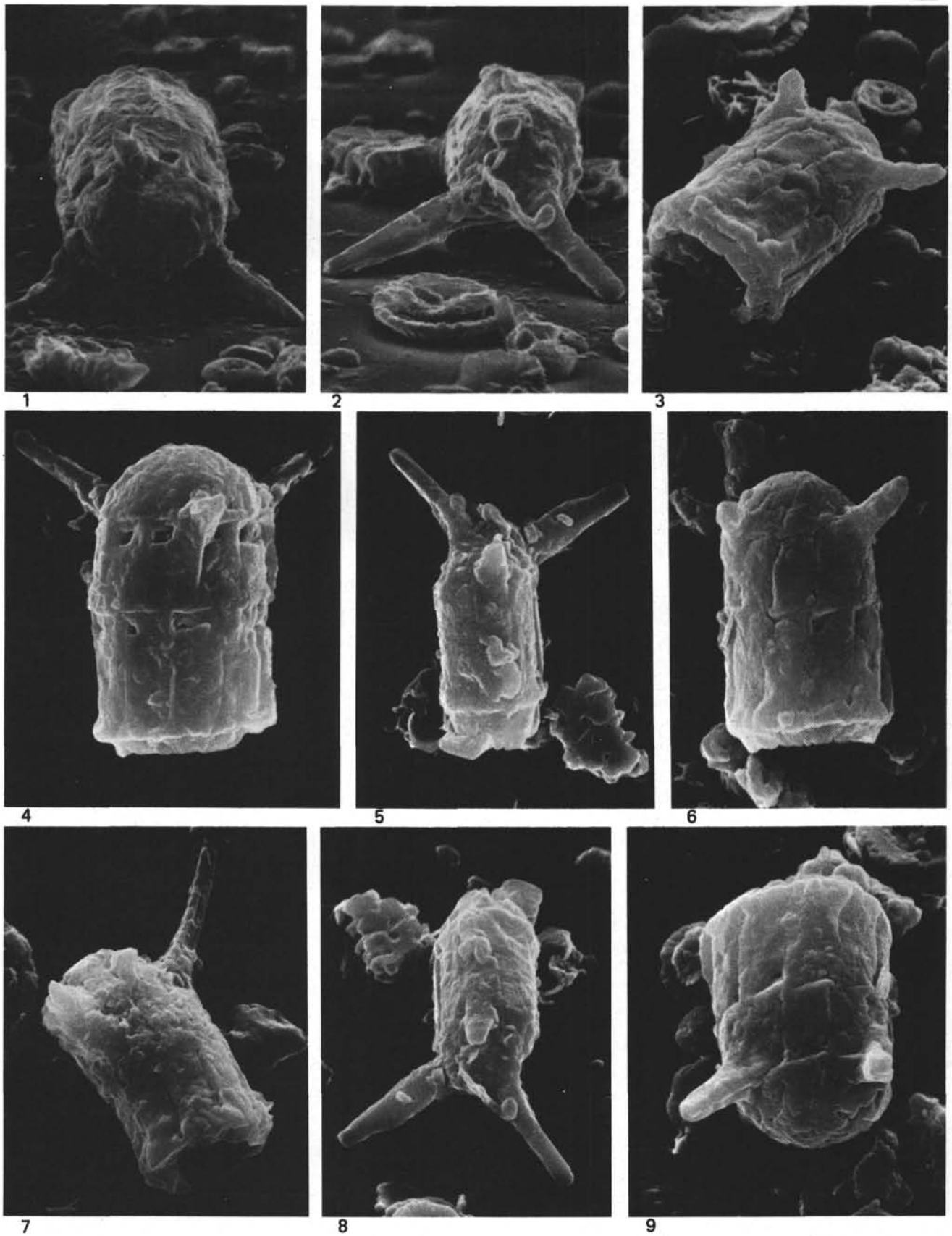


PLATE 6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