24. PALEOCENE RADIOLARIA, DSDP LEG 21

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Sediments cored at Site 208 within the interval 539 to 576 meters below the sea floor (Cores 29 to 32) are of particular interest for Radiolaria. They contain an abundant, well-preserved radiolarian fauna corresponding to the interval between the Mesozoic-Cenozoic boundary and the lower part of the Middle Paleocene inclusive (Zone NP5). The age is based on the calcareous nannoplankton occurring within the same interval. According to data offered by the nannoplankton, the Cretaceous-Tertiary boundary is in the upper part of Core 33, between 33-1, 36 cm, and 33-1, 60 cm. It coincides with a change in sedimentation, from chalk below to silica-rich strata above. This change is also fully reflected in radiolarian faunas.

In the chalky latest Maastrichtian sediments below the boundary, radiolarians are rare and poorly preserved, being represented only by *Myllocercion* sp., *Dictyomitra andersoni*, *Stichomitra* sp., *Amphipyndax stocki*, *Druppatractus* cf. *coronatus*, and two or three additional species, whereas in the overlying Lower Paleocene (Danian) sediments the assemblages are very rich and the radiolarians are much better or very well preserved. Cherts and partly silicified sediments occur also at several levels above the Cretaceous-Tertiary boundary. In such strata the radiolarians are generally less well preserved, sometimes pyritized.

The Lower and Middle Paleocene radiolarians recovered were only preliminarily investigated from the core catcher samples 29, 30, 31, and 32. Their age established by means of the calcareous nannofossils is as follows:

29, CC, early Middle Paleocene

30, CC; 31, CC; 32, CC; Early Paleocene

In the thirteen plates of the present paper almost all nassellarian species and a few spumellarians have been illustrated. A generalization that can be based on these preliminary investigations is that the Lower and Middle Paleocene radiolarians contain many more Upper Cretaceous than Tertiary species. The differences between these faunas and those of Maastrichtian age known from California (Foreman, 1968) or from other parts of the world are minimal as compared with the differences between the former and the Upper Paleocene or Eocene faunas. For example, many Maastrichtian species belonging to *Amphipyndax, Amphipternis, Stichomitra, Dictyomitra, Myllocercion, Theocapsomma, Druppatractus*, pylomatic spongodiscids, neosciadiocapsids, etc., are also found in this Paleocene. A detailed comparison is impossible at present, when both the Maastrichtian and the Paleocene Radiolaria are quite insufficiently known.

New elements in the Paleocene faunas investigated are the acanthodesmiids, represented by a few, little diversified species, and several species of *Buryella*, that by their abundance represent a characteristic element and probably a valuable guide-fossil in a future zonation of this interval.

A few quite informal data about the taxa illustrated are given in the following paragraphs. Most determinations are provisional because of the difficulties for generic assignments of the new taxa. The illustrations on the plates are arranged according to cores, beginning with the oldest, in order to emphasize the most characteristic elements of each core and the possible changes of the faunas.

ORDER SPUMELLARIA

The representatives of this order are among the most frequent members of the Paleocene faunas at Site 208, particularly in 31, CC. They are represented especially by spherical forms with one or more concentric shells. Discoidal and ellipsoidal forms are much less frequent.

?Saturnulus cf. planetes Haeckel
(Plate 1, Figures 7, 8; Plate 5, Figure 7)

Three almost complete specimens and several fragments of the ring have been encountered in Cores 31, CC and 32, CC. These specimens are the oldest Cenozoic forms hitherto recorded. It is interesting that they differ by their smooth ring from the Mesozoic species characterized by spiny rings. Their shell is constituted by a large cortical shell and a double medullary shell.

Genus DRUPPATRACTUS HAECKEL

An interesting evolution was remarked within the interval 32, CC to 29, CC from a spiny species (*Druppatractus* cf. *coronatus*) to a bipolar one (*Druppatractus* sp.). Both species have an ellipsoidal shell consisting of a thick-walled external shell and a thinner internal one.

Druppatractus cf. coronatus (Squinabol)
(Plate 6, Figures 4, 6; Plate 12, Figure 1)

Lithomespilus coronatus Squinabol, 1904, p. 198, pl. 4, fig. 7.

In the oldest specimens (Plate 6, Figures 4, 6) only the longer polar spine differs by its length and axial position from the other spines; the shorter one cannot be distinguished by any particular dimension or position from the spines located at that pole. In the youngest forms (Plate 12, Figure 1) both spines are axial and the by-spines are shorter and fewer. The species is externally quite similar to *Lithomespilus coronatus*. Squinabol did not mention any internal shell but it must be present in his species; rather similar specimens observed by us in the Lower Campanian from Romania have such an internal shell.

The evolution toward a bipolar species is suggested by the similarity in size and shape of the cortical and medullary shells of the two species and by the progressive change of their frequency. In 32, CC, *D.* cf. *coronatus* is rare and the two-horned species, *Druppatractus* sp. is absent. In 31, CC, the former is common and the latter occurs as few specimens, the ratio between them being approximately 15:1. This ratio is inverted in 30, CC, where it reaches 1:3, and decreases to 1:6 in favor of *Druppatractus* sp. in 29, CC.

Druppatractus sp.
(Plate 12, Figure 3)

As said above, the first occurrence of this species was recorded in 31, CC. In 29, CC, the youngest Paleocene core catcher of this interval, it is common, being one of the most frequent species.

Spongodiscus cf. renillaeformis Campbell et Clark
(Plate 9, Figure 7)

Spongodiscus (*Spongodisculus*) *renillaeformis* Campbell and Clark, 1944, p. 18, pl. 6, figs. 5, 6, 8, 10.

Such forms occur in usually small numbers in the samples investigated.

Genus SPONGOPYLE Dreyer

Species with a large pylome have recently been recorded from the Upper Cretaceous by Kozlova and Gorbovetz (1966), Foreman (1968), Riedel and Sanfilippo (1970), Petrushevskaya and Kozlova (1972). In the Lower Paleocene at Site 208 three types provisionally assigned to this genus have been recorded.

?*Spongopyle* sp. A (Plate 2, Figure 1) has a less dense spongy disc with two spines and a simple conical pylome slightly constricted distally.

?*Spongopyle* sp. B (Plate 5, Figure 4) is a large spongy disc also with a simple pylome.

?*Spongopyle* sp. C (Plate 5, Figures 5, 6) with very dense spongy meshwork lacking any trace of circular disposition, and with large conical costate pylome.

Genus SPONGURUS Haeckel

Spongurus spp.
(Plate 5, Figures 1-3)

In the Paleocene samples several species assigned to this genus or to other related genera have been recorded. In almost all a pylome is distinguished.

Astrosphaerids, gen et spp. indet.
(Plate 4, Figure 9; Plate 6, Figure 3)

Trifurcate spines or other kinds of spines occur in almost all samples. The trifurcate spines are morphologically distinctive and seem to be restricted to Cores 31 to 29.

ORDER NASSELLARIA

Acanthodesmiids, gen et spp. indet.
(Plate 2, Figure 4; Plate 9, Figure 5; Plate 11, Figure 4)

Representatives of this family are generally sparse in the Lower Paleocene at Site 208 and belong to a few species differentiated not so much by their cephalic structure as by the descending apophyses. Some of these species appear referable to *Petalospyris* (Plate 11, Figure 4).

Amphipyndax stocki (Campbell et Clark)
(Plate 1, Figure 3; Plate 8, Figures 11, 12; Plate 11, Figure 2; Plate 12, Figure 2)

Amphipyndax stocki (Campbell and Clark), Foreman, 1968, p. 78, pl. 8, figs. 12a-c.

This species, known from Late Cretaceous, extends into the whole Paleocene investigated (Cores 19, CC to 32, CC) where it is rare or few.

Amphipternis clava (Ehrenberg)
(Plate 2, Figures 10, 11; Plate 8, Figures 2, 3; Plate 1, Figure 2)

Amphipternis clava (Ehrenberg), Foreman, 1972, pl. 7, figs. 16, 17; pl. 9, fig. 2.

Probably not all specimens herein ascribed to this species really belong to it. The specimen illustrated in Plate 1, Figure 2, is doubtfully identified.

The other specimens have the cephalic structure described by Foreman. The clearest structure was noticed in the specimen illustrated in Plate 2, Figure 11, disposed with the dorsal bar toward the observer. This bar and the vertical bar descend into the thorax about to the middle of its height from where the lateral bars extend laterally and join the thoracic wall, thus dividing the thoracic cavity into two halves. The distal aperture is armed with several teeth (Plate 2, Figure 11) or is represented by a latticed prolongation (Plate 2, Figure 10).

The species is rare or few in the samples investigated.

Theocampe pirum (Ehrenberg)
(Plate 4, Figure 5)

Eucyrtidium pirum Ehrenberg, 1875, pl. 10, fig. 14.
Theocampe pirum Petrushevskaya and Kozlova, 1972, p. 537, pl. 23, fig. 11.

Very rare in the Paleocene at Site 208.

Lithomitra eruca Haeckel
(Plate 3, Figures 8, 12)

Lithomitra eruca Haeckel, 1887, p. 1485, pl. 79, fig. 3; Petrushevskaya and Kozlova, 1972, p. 539, pl. 24, figs. 32, 33.

Very rare. The specimen illustrated in Figure 12 appears to be an abnormal form of this species.

?Lithomelissa sp.
(Plate 2, Figure 2; Plate 4, Figure 6)

This species has a cephalis armed with four tricostate spines (apical, dorsal, and two lateral). Very rare in Lower Paleocene.

Lophophaena spp.
(Plate 3, Figures 5-7; Plate 9, Figure 6; Plate 11, Figure 8)

Rare or few in the samples investigated.

Ceratocyrtis sp.
(Plate 3, Figures 2-4)

This species with its very distinctive cockscomb-like cephalis and campanulate thorax was recorded in 32, CC. A single specimen was found in 29, CC but its cockscomb structure covers not only the cephalis but also the upper part of the thorax.

?Tripodiscium sp.
(Plate 13, Figures 5, 10)

These Clathromitrinae provisionally ascribed to *Tripodiscium* sensu Petrushevskaya are few in the Lower Paleocene at Site 208.

?Dictyophimus spp.
(Plate 7, Figures 3-9; Plate 8, Figure 4; Plate 9, Figure 8; Plate 12, Figures 6, 7; Plate 13, Figure 4)

Several species referable either to *Dictyophimus* or to *Rhopalocanium* or *Pterocyrtidium* are frequent in the Lower Paleocene. In some of them the thorax is clearly separated from the abdomen by an internal septum, in other species there is only a slight constriction so that there is not a true abdomen.

?Clathrocyclas spp.
(Plate 2, Figure 3; Plate 9, Figure 3; Plate 10, Figure 5)

Species more or less related to *Clathrocyclas* are frequent in Lower Paleocene. No vertical tube was seen in them.

Clathrocycloma sp.
(Plate 11, Figure 6)

The forms with vertical tube, ascribed to this genus, are rather rare in the material investigated.

?Artostrobus spp.
(Plate 6, Figure 5; Plate 13, Figure 9)

Very likely no specimen herein ascribed to this genus really belongs to it. *Artostrobus* is however fairly frequent in the small fractions of each sample.

Cornutella californica Campbell et Clark
(Plate 10, Figure 1)

Cornutella californica Campbell and Clark, 1944, p. 22, pl. 7, figs. 33, 34, 42, 43; Foreman, 1968, p. 22, pl. 3, figs. 1a, b.

Rare in Lower Paleocene at Site 208.

Cornutella sp.
(Plate 9, Figure 2; Plate 13, Figure 1)

Cornutella californica Foreman, 1968, p. 21, pl. 3, fig. 1c.

Rare in Lower Paleocene.

Bathropyramis sp.
(Plate 4, Figure 8; Plate 10, Figure 2)

Fairly frequent, particularly in 29, CC.

?Microsciadiocapsa spp.
(Plate 13, Figures 6-8)

A small number of species referable to *Microsciadiocapsa* or to related genera are present in the Lower Paleocene. In some specimens the thoracic velum is very distinct, as in that illustrated; in others it seems to be missing.

Myllocercion spp.
(Plate 2, Figure 5; Plate 5, Figures 8, 9; Plate 8, Figure 1)

Several specimens have been recorded in Samples 31, CC and 32, CC. The difficulty of their specific determination is due to the wide variability of the ornamentation of the thorax, from smooth (Plate 2, Figure 5) to covered with polygonally framed depressions (Plate 8, Figure 1).

Theocapsomma sp.
(Plate 2, Figures 6, 7)

The specimens illustrated are probably related to *T. amphora.* They are the only specimens of this species encountered in the samples investigated.

?Diacanthocapsa sp.
(Plate 12, Figures 4, 5)

A single specimen of this probably undescribed species was found in the Paleocene samples. Its abdomen is open distally as a pylome with protruding rim. No sutural pore was noticed on the surface exposed.

Cryptoprora cf. ornata Ehrenberg
(Plate 9, Figure 1)

Cryptoprora ornata Ehrenberg, 1875, pl. 5, fig. 8;
This species is fairly similar to some species of *Diacanthocapsa* described by us in a recent paper. In the Lower Paleocene only three specimens have been recorded.

Dictyomitra andersoni (Campbell and Clark)
(Plate 1, Figure 6; Plate 3, Figure 11; Plate 8, Figure 10)

Dictyomitra andersoni (Campbell and Clark), Foreman, 1968, p. 68, pl. 7, figs. 6a-d.
This species is the most frequent *Dictyomitra* in the Lower Paleocene.

Dictyomitra ascelis Foreman
(Plate 3, Figure 1)

?*Dictyomitra ascelis* Foreman, 1968, p. 69, pl. 8, fig. 7.
Very rare in Lower Paleocene.

Dictyomitra cf. regina (Campbell and Clark)
(Plate 8, Figure 9)

Dictyomitra regina (Campbell and Clark), Foreman, 1968, p. 68, pl. 8, figs. 5a-c.
The illustrated specimen is distinguished from *D. regina* by a shorter shell and wider diameter. Very rare.

?Stichomitra livermorensis (Campbell and Clark)
(Plate 2, Figure 9)

?*Stichomitra livermorensis* (Campbell and Clark), Foreman, 1968, p. 76, pl. 8, figs. 2a-b.
Very rare in the Lower Paleocene.

Stichomitra asymbatos Foreman
(Plate 13, Figure 2)

Stichomitra asymbatos Foreman, 1968, p. 73, pl. 8, figs. 10a-c.
Only the broken specimen was found in the samples investigated.

Stichomitra sp. A
(Plate 3, Figures 9, 10; Plate 8, Figure 5)

Rather rare. It seems to be closely related to *S. asymbatos,* from which it is distinguished by lack of external thickenings of the wall.

Stichomitra sp. B
(Plate 13, Figure 3)

Only the illustrated specimen was recorded.

Stichomitra compsa Foreman
(Plate 1, Figure 4; Plate 8, Figure 6)

Stichomitra compsa Foreman, 1968, p. 72, pl. 8, figs. 8a-b.
Forms conformable to this species are rare or few in the Lower Paleocene samples investigated.

Lithocampe aff. marinae Gorbovetz
(Plate 6, Figure 2; Plate 8, Figure 7)

?*Lithocampe marinae* Gorbovetz in Kozlova and Gorbovetz, 1966, p. 118, pl. 5, fig. 10, non fig. 11.
This species is constituted of at least five segments. Diameter of the first four segments increases from cephalis to the fourth, and the last segment is smaller and thinner walled. It differs from *L. marinae* in having a much larger thorax.

Lithocampe sp. A
(Plate 4, Figure 7; Plate 10, Figure 3; Plate 11, Figure 3)

Eucyrtidium ? sp. Kozlova and Gorbovetz, 1966, pl. 6, fig. 11.
Very rare in 29, CC; abundant in 30, CC; few in 31, CC; and common in 32, CC. The variability is very great, expressed in number of segments, size, etc., but almost all have a spindle-shaped outline.

Lithocampe sp. B
(Plate 8, Figure 8)

Specimens such as that illustrated are less frequent and appear to be connected by intermediate forms with the previous species, from which it is distinguished by the cylindrical outline.

Genus BURYELLA Foreman

This is one of the most frequent nassellarians in the Lower Paleocene sediments at Site 208 and shows a rapid evolution from 32, CC to 29, CC, appearing to be the most promising for a biostratigraphic zonation of this interval. The following taxa could be recognized.

Buryella sp. A
(Plate 1, Figure 1; Plate 4, Figures 1-4)

Skeleton constituted of four segments, the third being the largest and with 3 to 5 transverse rows of pores quincuncially or irregularly arranged. The fourth segment is inverted conical, long, with pores disposed in transverse rows. An additional segment may be sometimes separated in the upper part of the fourth.
This species is distinguished from *B. clinata* by its third segment which is shorter, with smaller number of transverse rows of pores, and by the general aspect. Recorded only in 32, CC, where it is abundant, and in 31, CC.

Buryella sp. B
(Plate 6, Figure 1; Plate 10, Figures 4, 6; Plate 11, Figure 1)

Skeleton with commonly five segments, the third or the fourth being the largest, with sutures marked externally, and pores quincuncially arranged.
Frequent in 31, CC and 30, CC, and absent in the other cores.

Buryella sp. C
(Plate 11, Figures 5, 6)

Skeleton with four segments, the third being the largest and with 5 to 7 transverse rows of pores quincuncially or irregularly arranged.
Common in 29, CC and few in 30, CC. It is similar to *Lithocampium* sp. A of Benson (1972, pl. 2, figs. 8, 9) and is probably referable to *B. clinata.* It is also fairly similar to *Buryella* sp. A, from which it differs by the greater number of transverse rows of pores on the third segment.

Buryella cf. tetradica Foreman

Buryella tetradica Foreman, 1973, pl. 8, figs. 4, 5; pl. 9, figs. 13, 14.

This species is fairly frequent in 29, CC. The longitudinal disposition of the pores on the third segment is frequently disturbed in the specimens occurring in this sample

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PLATE 1

All figures 208-32, CC
Figures 1-6, ×440; Figures 7-8, ×155

Figure 1	*Buryella* sp. A
Figure 2	Nassellarian gen et sp. indet.
Figure 3	*Amphipyndax stocki* (Campbell and Clark)
Figure 4	*Stichomitra compsa* Foreman
Figure 5	Nassellaria gen et sp. indet.
Figure 6	*Dictyomitra andersoni* (Campbell and Clark).
Figures 7, 8	?*Saturnulus* cf. *planetes* Haeckel

PLATE 1

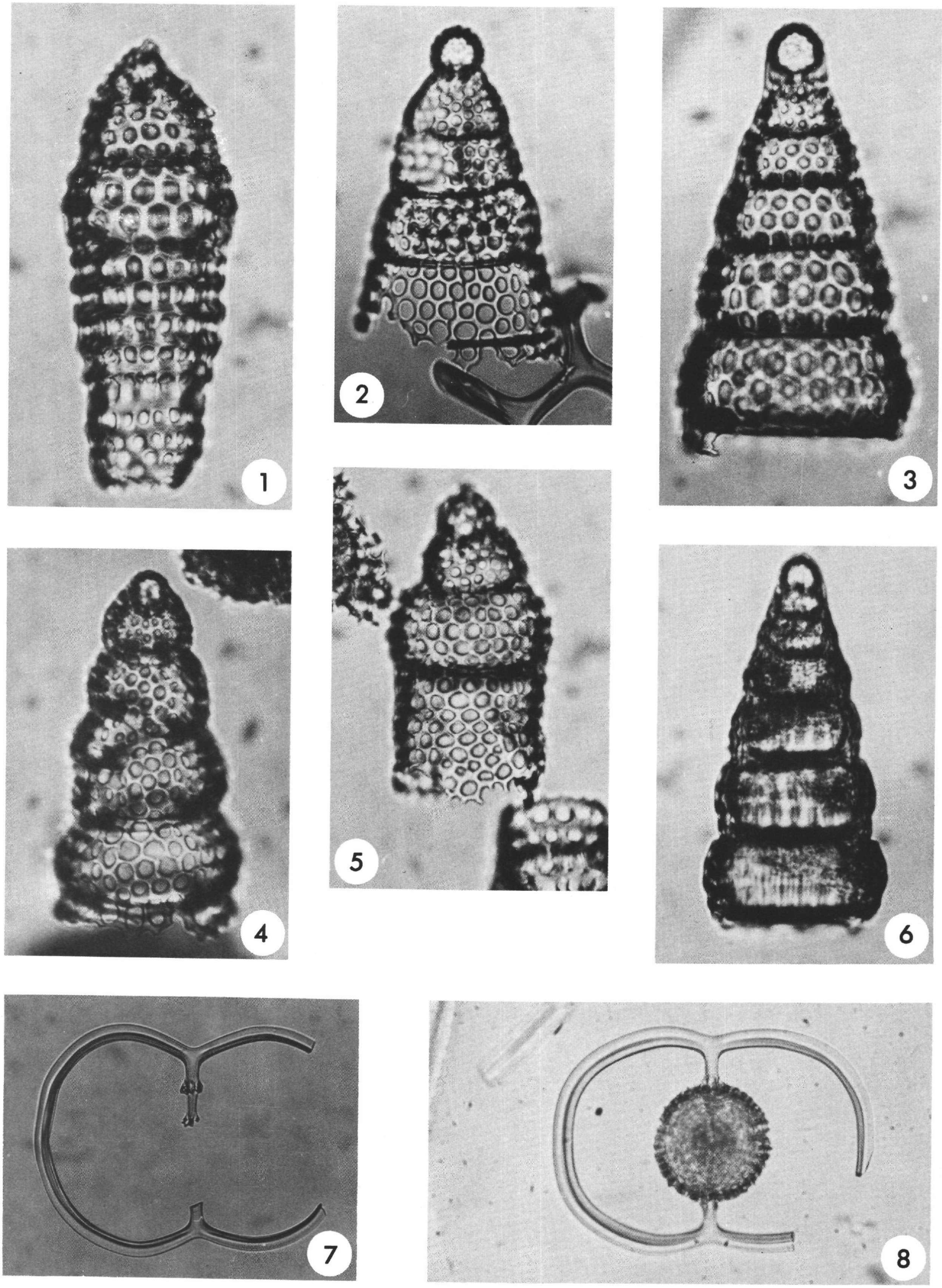

PLATE 2

All figures 208-32, CC
Figures 1, 5, 7, 9, 10, ×310; Figures 2-4, 6, 8, 11, ×440

Figure 1	?*Spongopyle* sp. A
Figure 2	?*Lithomelissa* sp.
Figure 3	?*Clathrocyclas* sp.
Figure 4	Acanthodesmiid, gen et sp. indet.
Figure 5	*Myllocercion* sp.
Figures 6, 7	*Theocapsomma* sp.
Figure 8	Nassellaria, gen et sp. indet.
Figure 9	?*Stichomitra livermorensis* (Campbell and Clark).
Figures 10, 11	*Amphipternis clava* (Ehrenberg).

PLATE 2

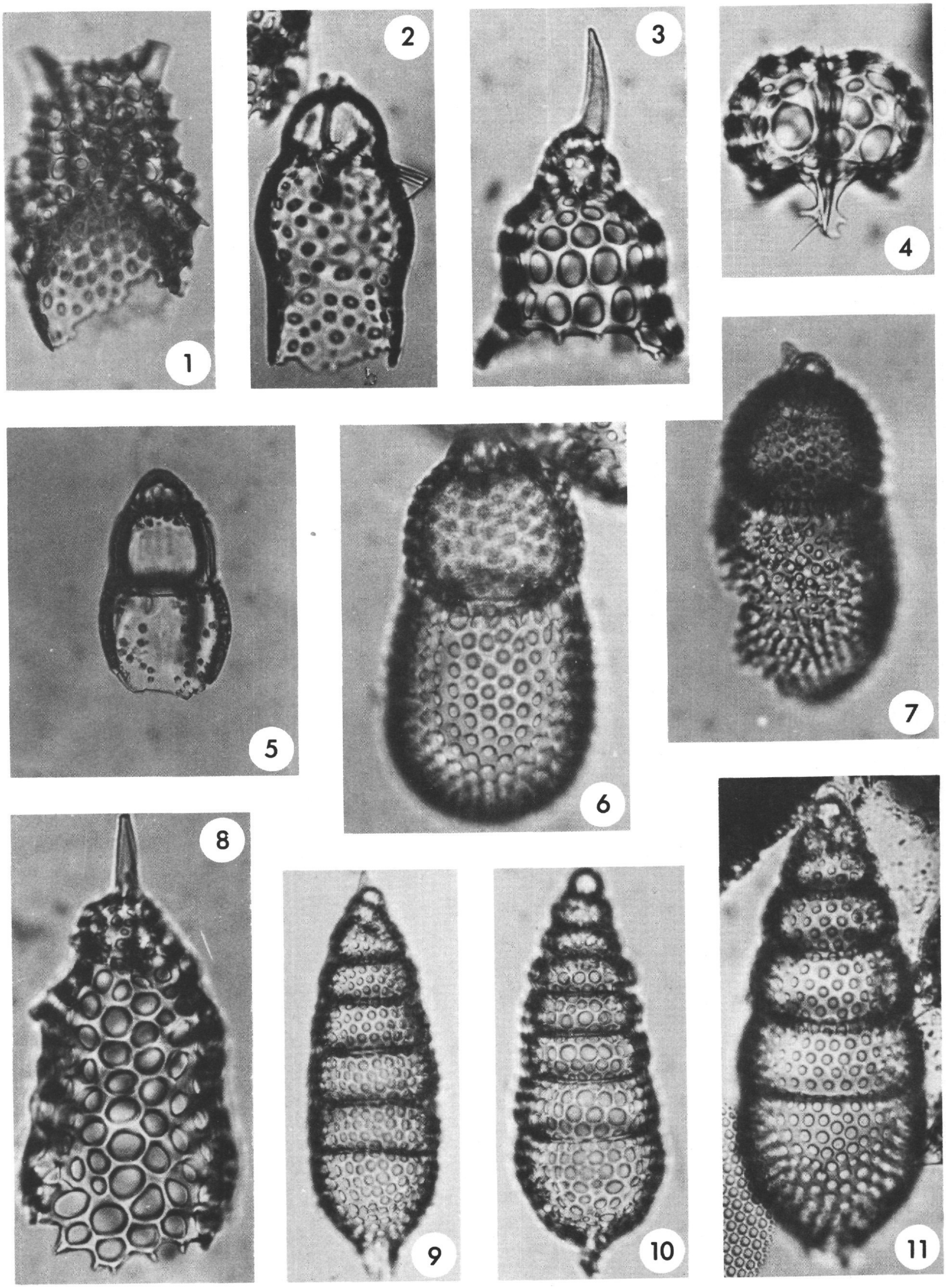

PLATE 3

All figures 208-32, CC
All figures ×310

Figure 1	*Dictyomitra ascelis* Foreman.
Figures 2-4	*Ceratocyrtis* sp. with cockscomb cephalis.
Figures 5-7	*Lophophaena* sp.
Figures 8, 12	*Lithomitra eruca* Haeckel
Figures 9, 10	*Stichomitra* sp., the same specimen focused on diameter and on surface.
Figure 11	*Dictyomitra andersoni* (Campbell and Clark).

PLATE 3

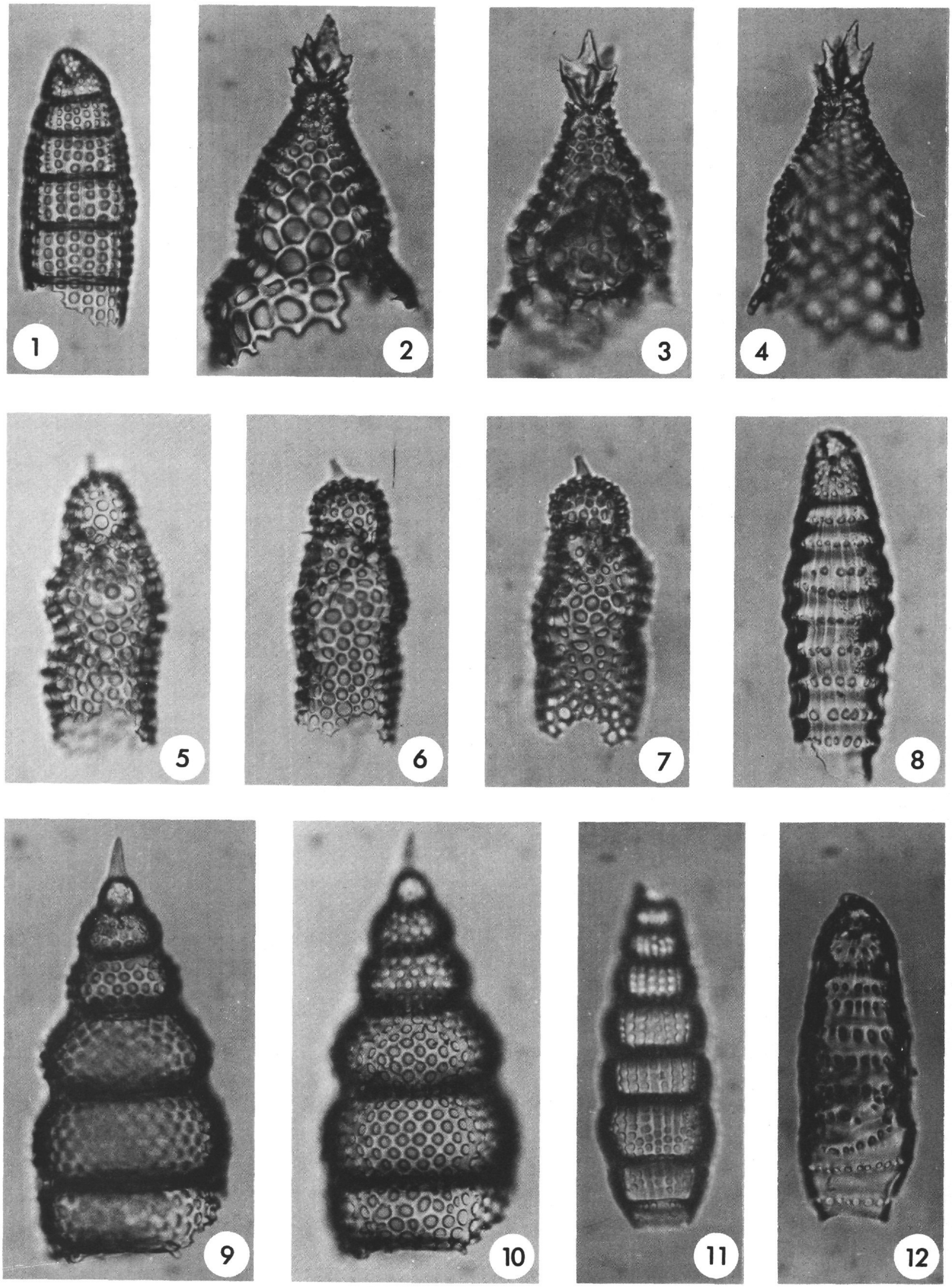

PLATE 4

208-32, CC (Figures 1-7); 208-31, CC (Figures 8, 9)
Figures 1-4, 7, 8, X440; Figures 5, 6, X310;
Figure 9, X220

Figures 1-4	*Buryella* sp. A
Figure 5	*Theocampe pirum* (Ehrenberg).
Figure 6	?*Lithomelissa* sp.
Figure 7	?*Lithocampe* sp. A.
Figure 8	*Bathropyramis* sp.
Figure 9	Radial spine of astrosphaerid, gen et sp. indet.

PLATE 4

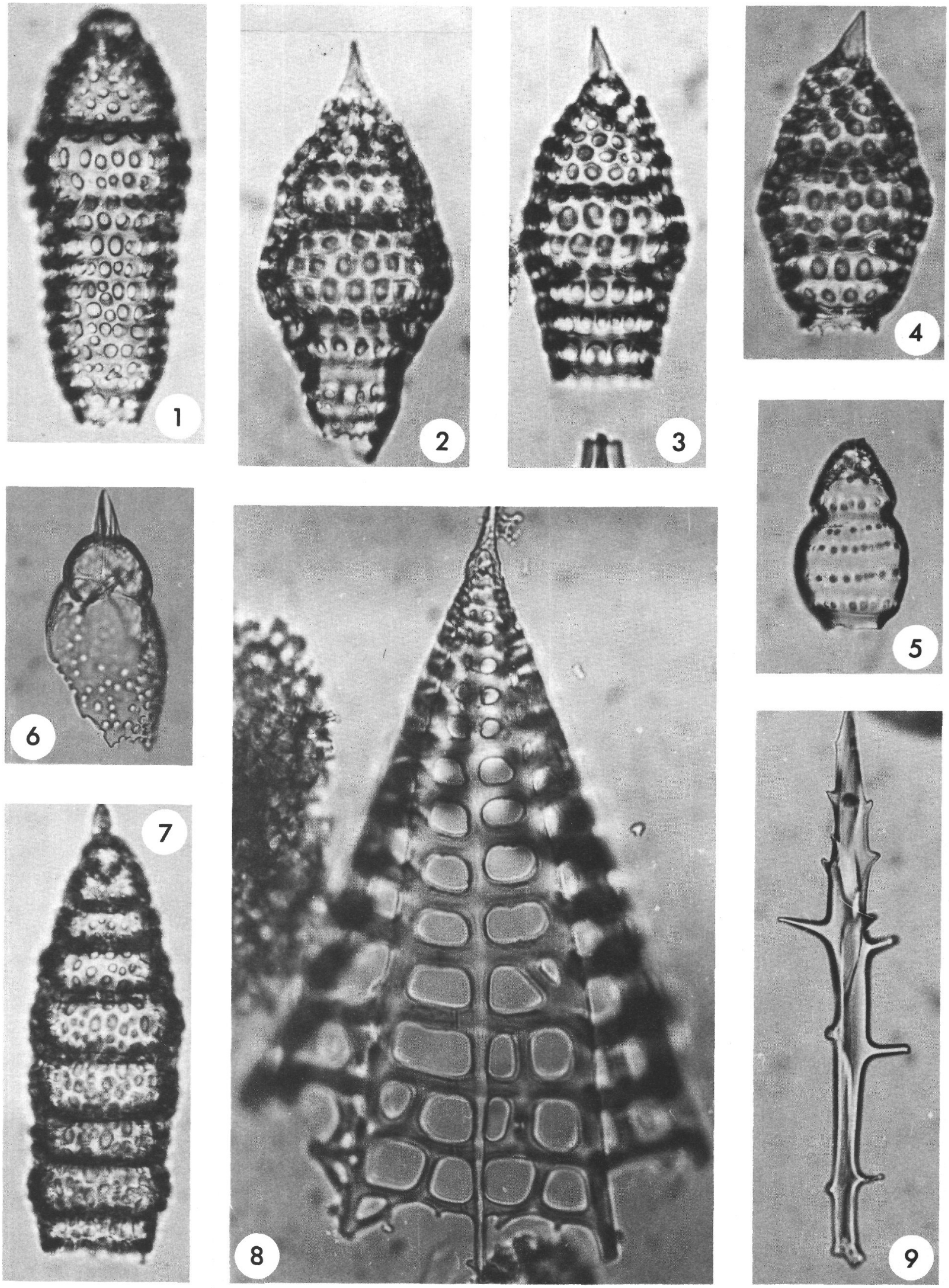

PLATE 5

All figures 208-31, CC
Figures 1-6, 8, 9, ×310; Figure 7, ×155

Figures 1-3	*Spongurus* spp.; Figures 1, 2, the same species, one specimen without patagium, the other with patagium.
Figure 4	?*Spongopyle* sp. B.
Figures 5, 6	?*Spongopyle* sp. C with costate pylome.
Figure 7	?*Saturnulus* cf. *planetes* Haeckel with cortical shell broken off.
Figures 8, 9	*Myllocercion* sp.

PLATE 5

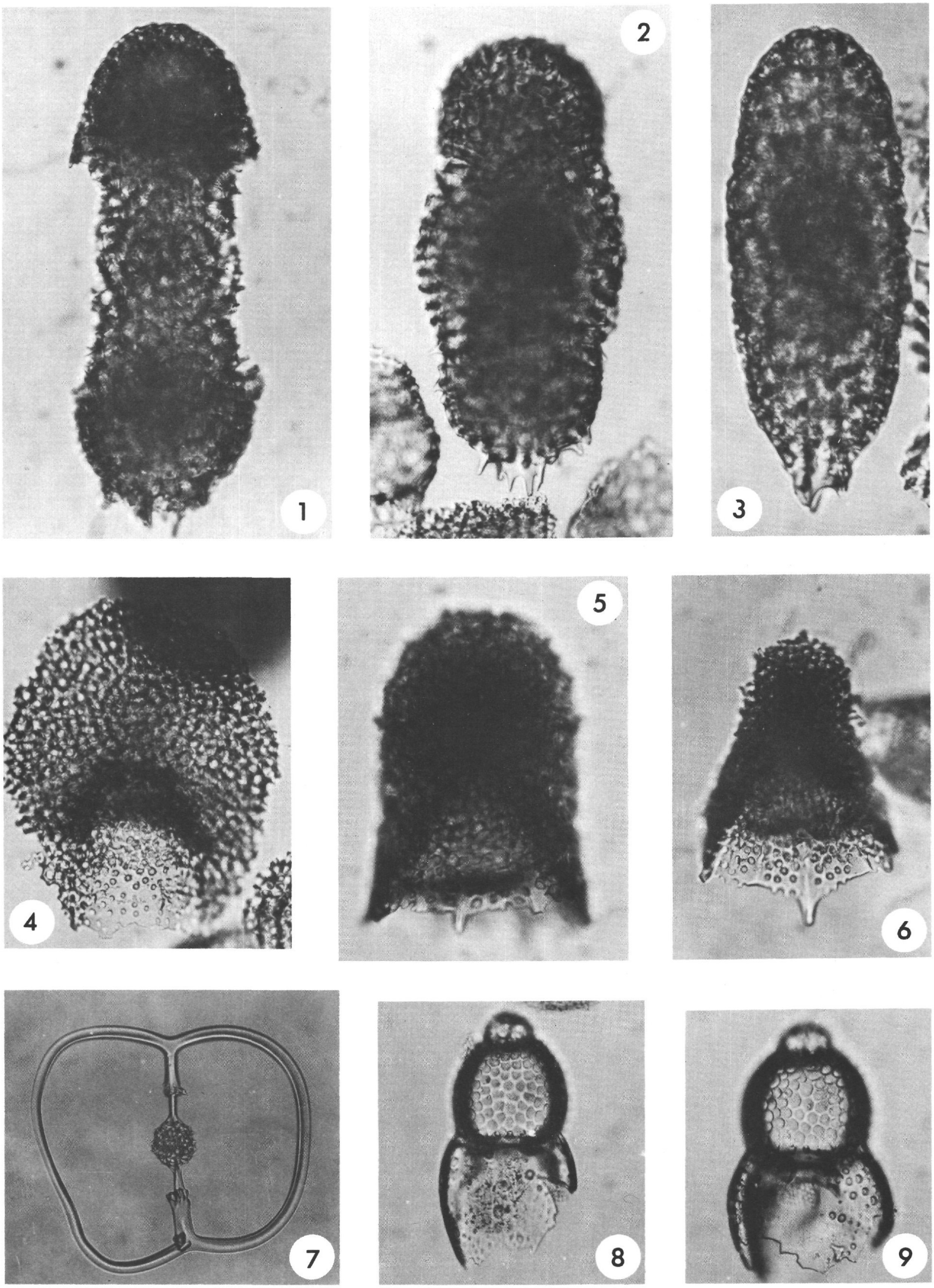

PLATE 6

All figures 208-31, CC
Figures 1-4, 6, ×440; Figure 5, ×310

Figure 1	*Buryella* sp. B
Figure 2	*Lithocampe* aff. *marinae* Gorbovetz
Figure 3	Trifurcate spine of astrosphaerid, gen et sp. indet.
Figures 4, 6	*Druppatractus* cf. *coronata* (Squinabol)
Figure 5	?*Artostrobus* sp.

PLATE 6

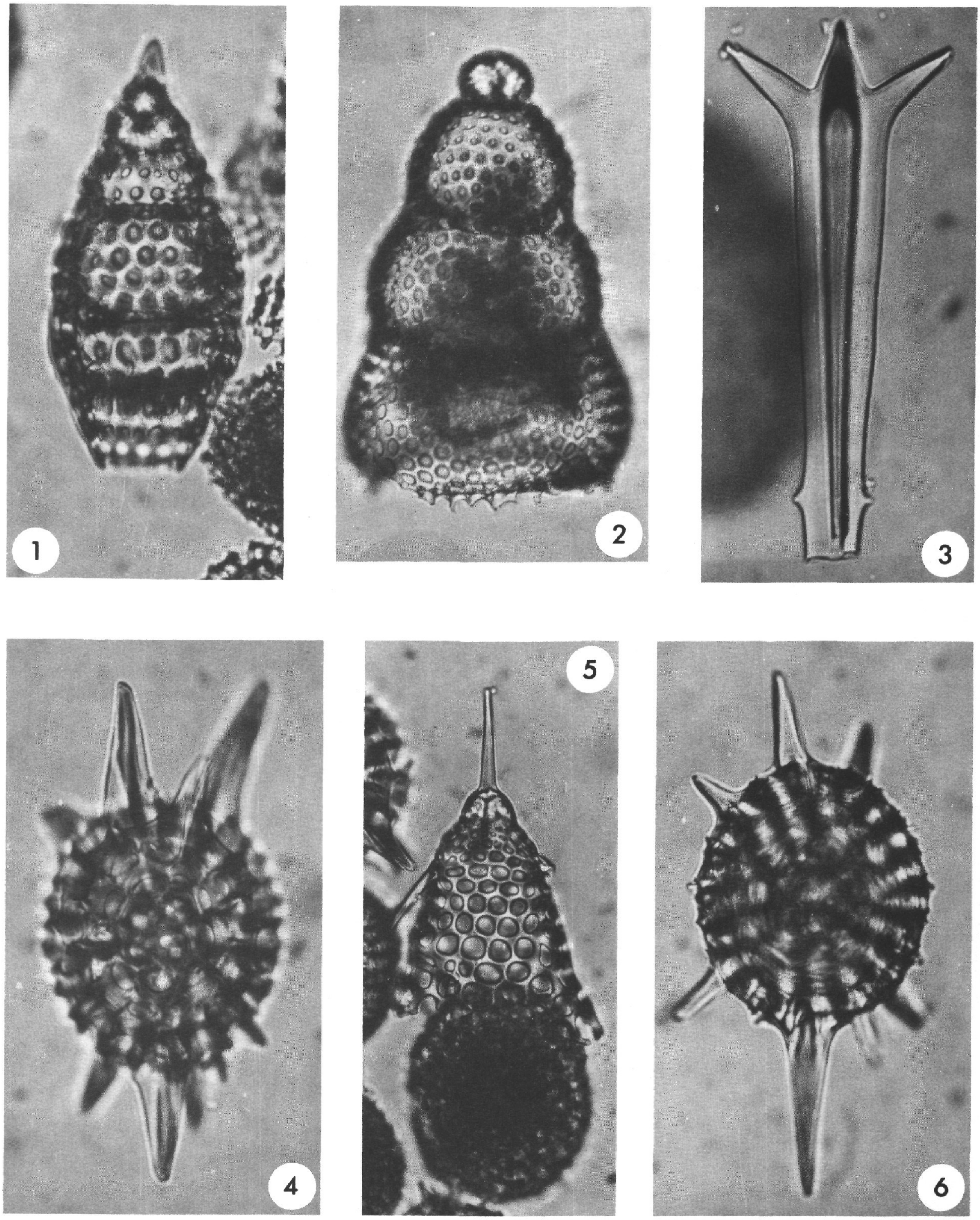

PLATE 7

All figures 208-31, CC
All figures ×310

Figures 1-2	Nassellarians, gen et sp. indet.
Figures 3-9	?*Dictyophimus* spp.

PLATE 7

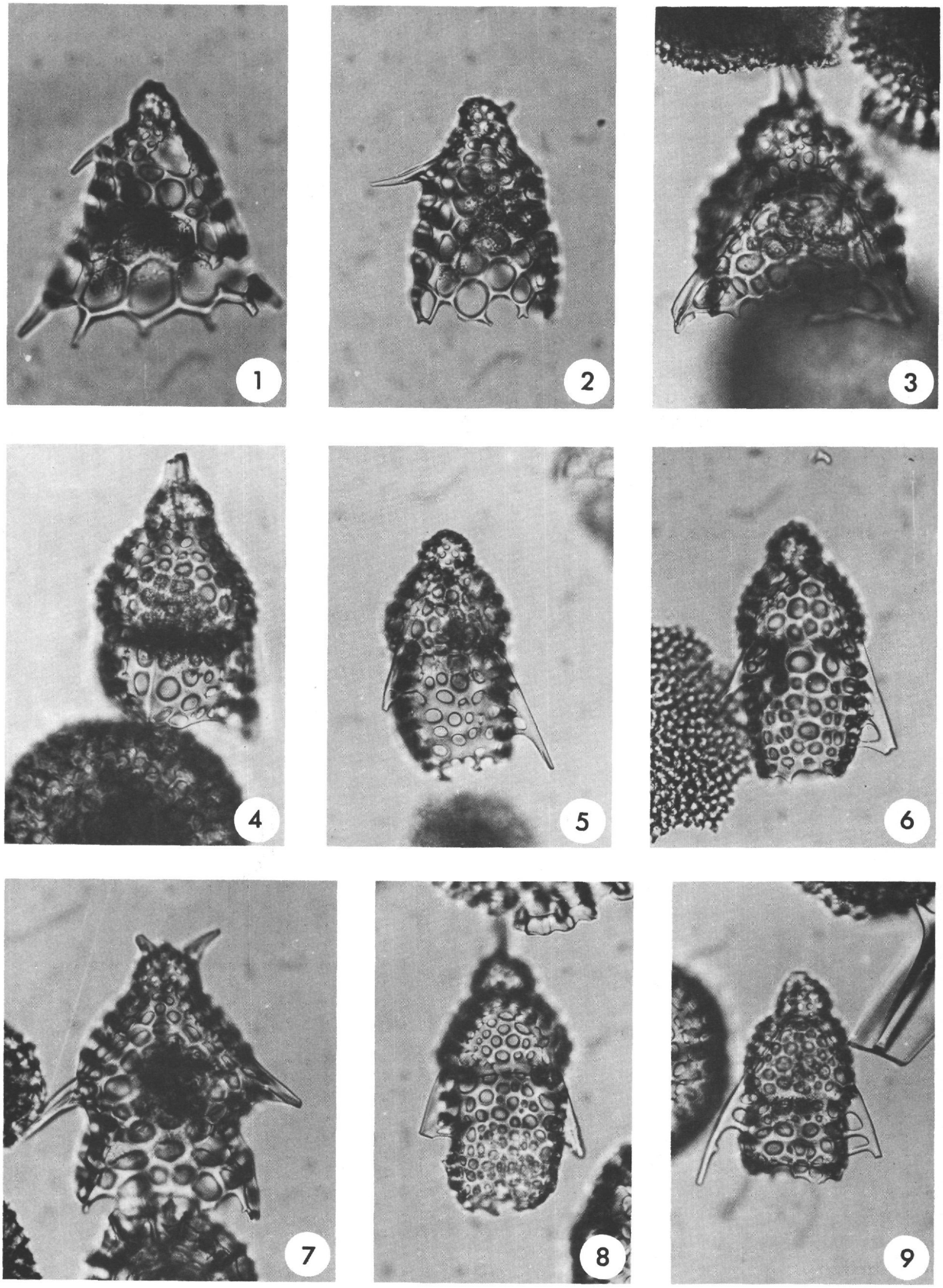

PLATE 8

All figures 208-31, CC
All figures ×310

Figure 1	*Myllocercion* sp.
Figures 2, 3	*Amphipternis clava* (Ehrenberg).
Figure 4	?*Dictyophimus* sp.
Figure 5	*Stichomitra* sp. A.
Figure 6	*Stichomitra compsa* Foreman.
Figure 7	*Lithocampe* aff. *marinae* Gorbovetz
Figure 8	?*Lithocampe* sp. B.
Figure 9	*Dictyomitra* cf. *regina* (Campbell and Clark)
Figure 10	*Dictyomitra andersoni* (Campbell and Clark)
Figures 11, 12	*Amphipyndax stocki* (Campbell and Clark)

PLATE 8

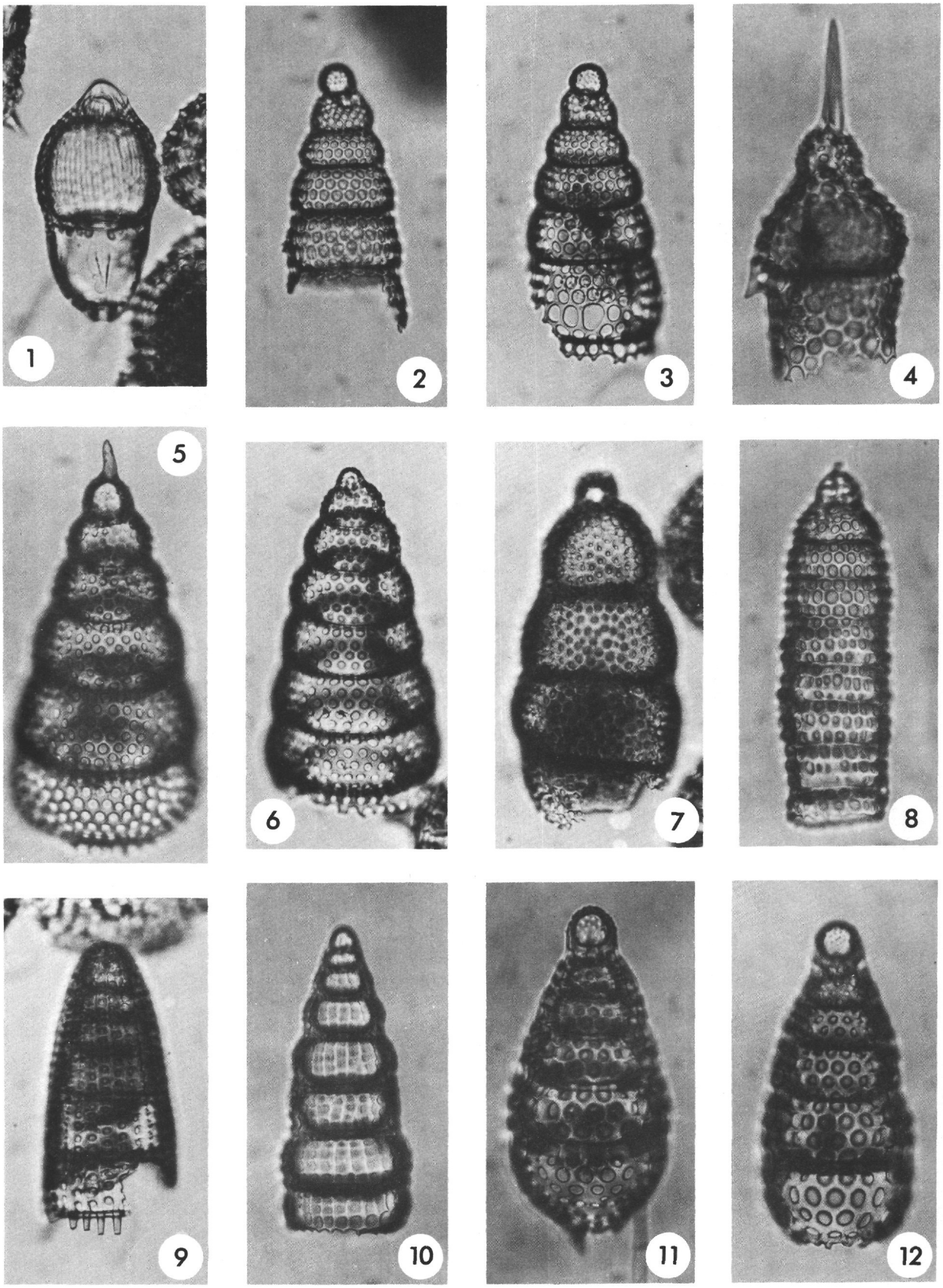

PLATE 9

208-31, CC (Figures 1, 3) and 208-30, CC (Figures 2, 4-8)
Figures 1, 3-6, 8, ×440; Figure 2, ×310; Figure 7, ×220

Figure 1	*Cryptoprora* cf. *ornata* Ehrenberg.
Figure 2	*Cornutella* sp.
Figure 3	?*Clathrocyclas* sp.
Figure 4	Nassellarian, gen et sp. indet.
Figure 5	Acanthodesmiid, gen et sp. indet.
Figure 6	*Lophophaena* sp.
Figure 7	*Spongodiscus* cf. *renilaeformis* Campbell and Clark.
Figure 8	?*Dictyophimus* sp.

PLATE 9

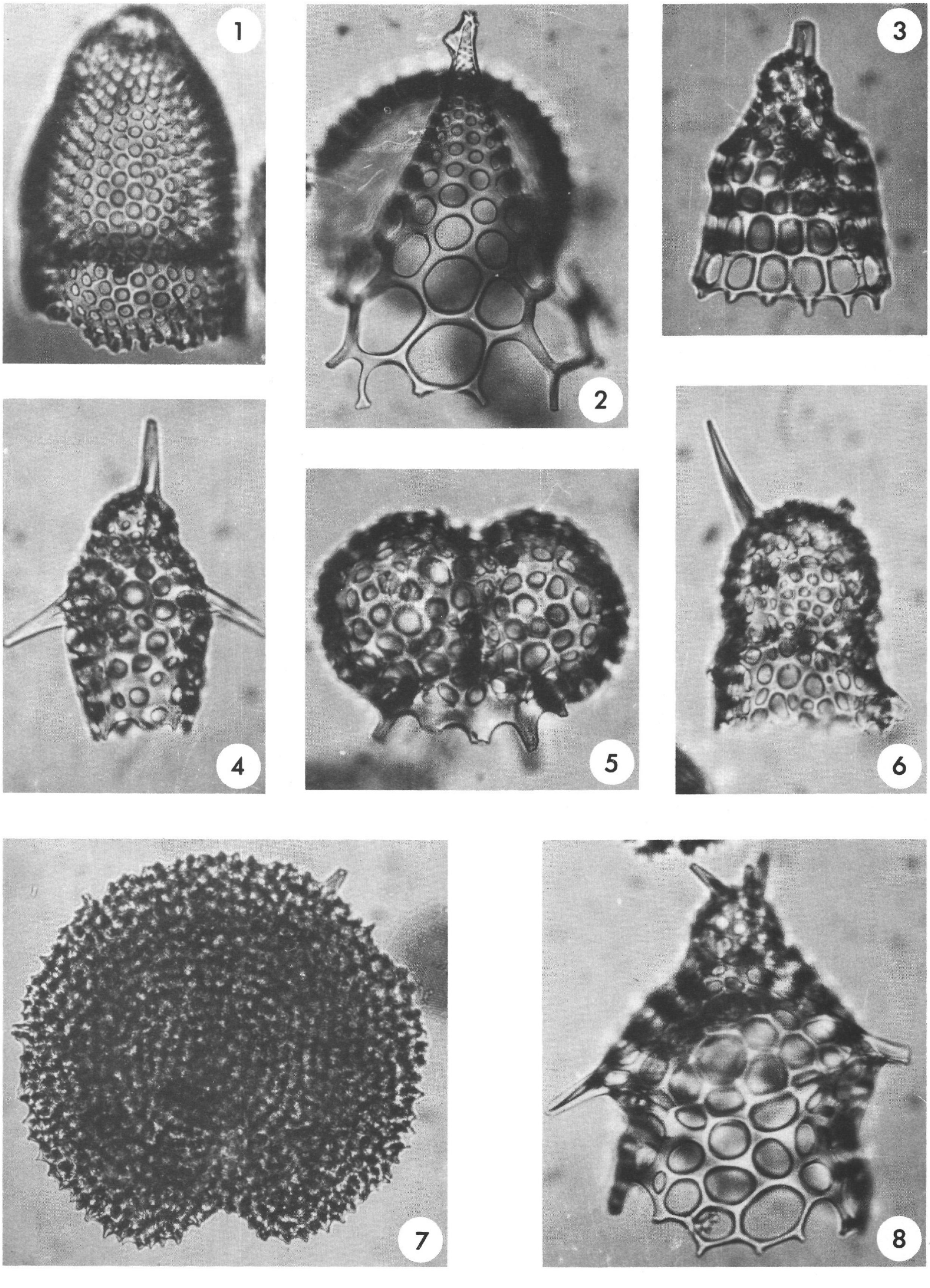

PLATE 10

All figures 208-30, CC
All figures X440

Figure 1	*Cornutella californica* Campbell and Clark.
Figure 2	*Bathropyramis* sp.
Figure 3	?*Lithocampe* sp. A.
Figures 4, 6	*Buryella* sp. B.
Figure 5	?*Clathrocyclas* sp.

PLATE 10

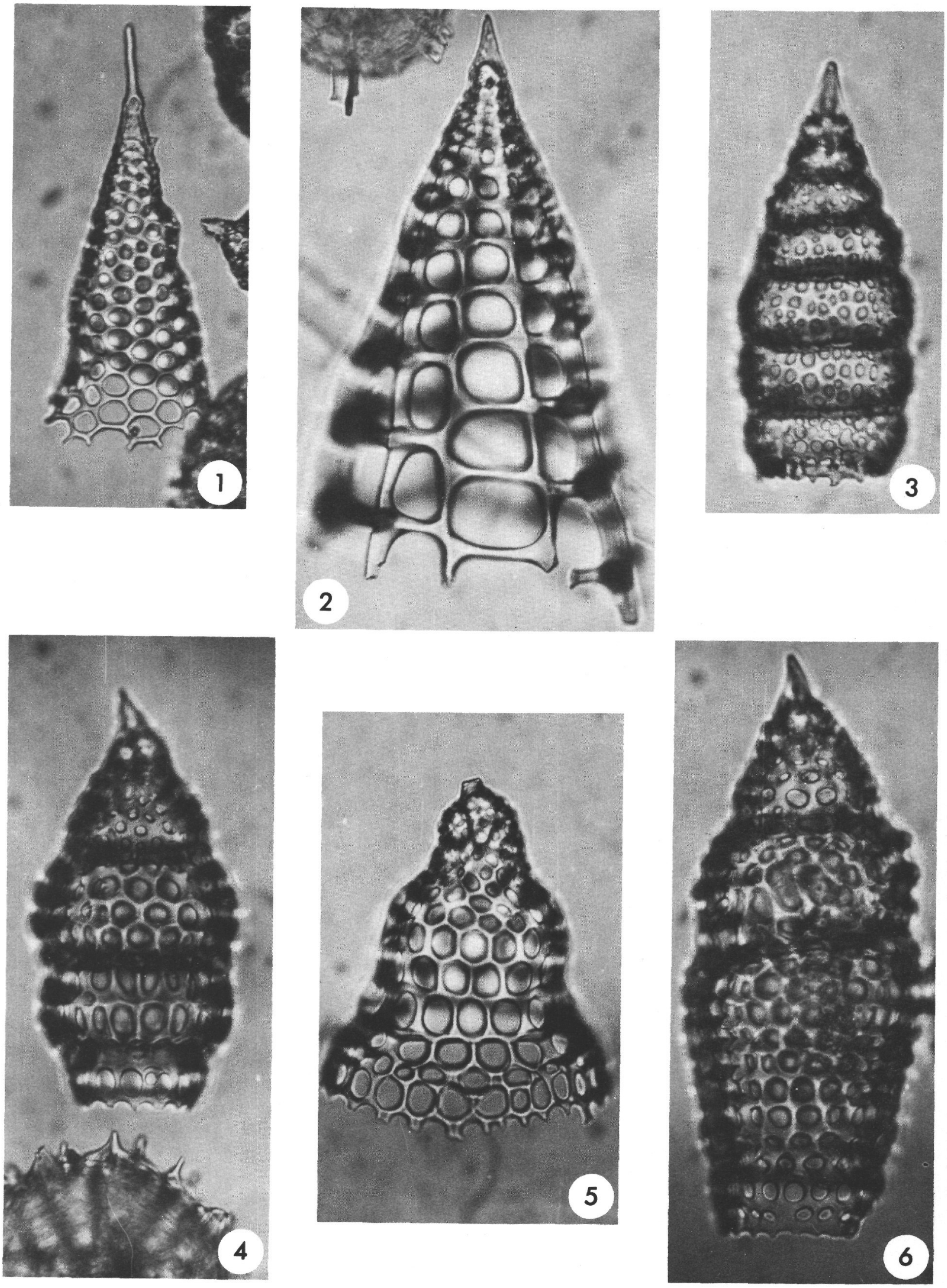

PLATE 11

208-30, CC (Figures 1-3) and 208-29, CC (Figures 4-8)
All figures ×440

Figure 1	*Buryella* sp. B.
Figure 2	*Amphipyndax stocki* (Campbell and Clark)
Figure 3	?*Lithocampe* sp. A.
Figure 4	?*Petalospyris* sp.
Figures 5, 7	*Buryella* sp. C.
Figure 6	*Clathrocycloma* sp.
Figure 8	*Lophophaena* sp.

PLATE 11

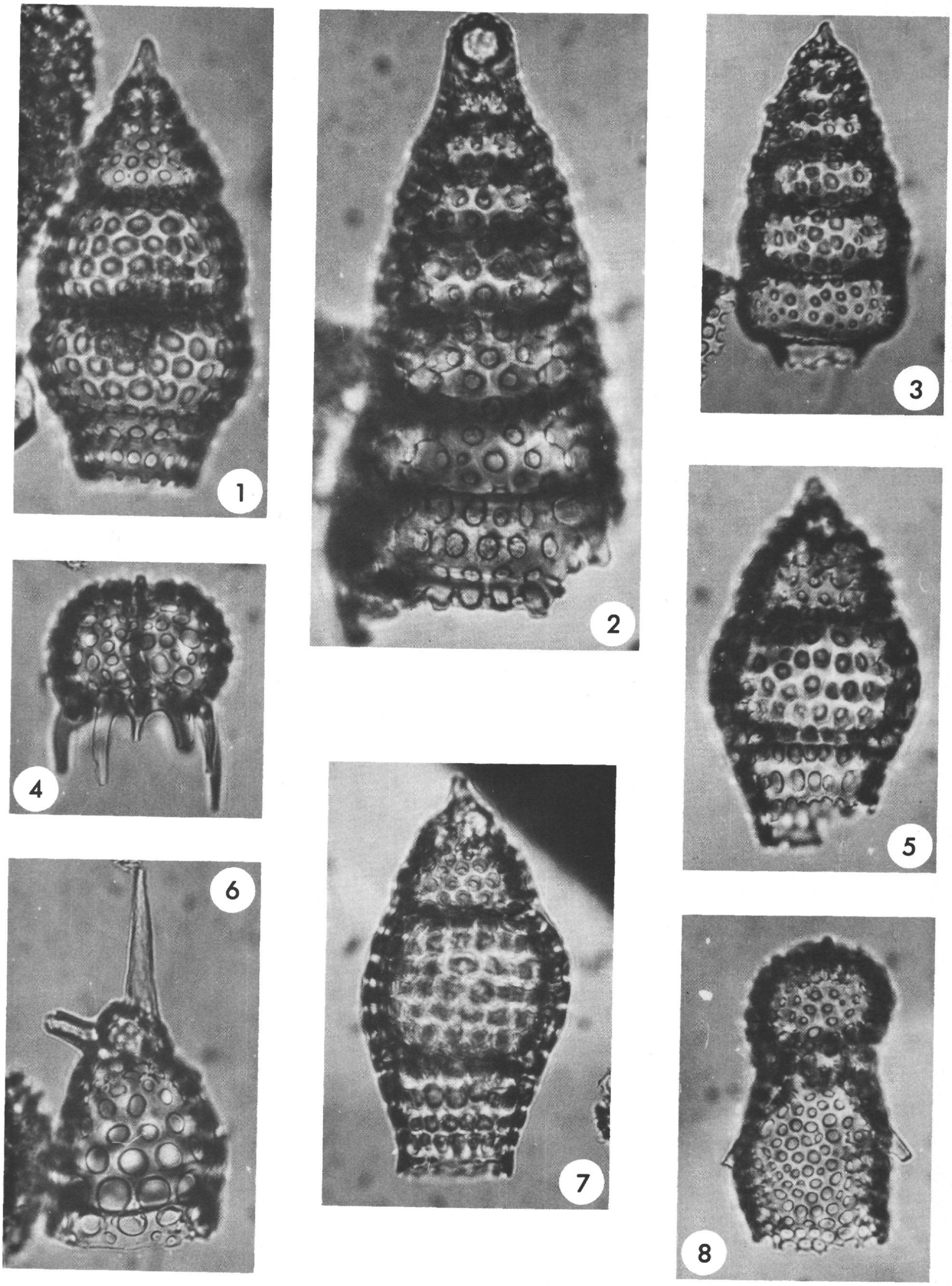

PLATE 12

All figures 208-29, CC
Figures 1-3, 6-8, ×440; Figures 4, 5, ×310

Figure 1	*Druppatractus* cf. *coronatus* (Squinabol)
Figure 2	*Amphipyndax stocki* (Campbell and Clark)
Figure 3	*Druppatractus* sp.
Figures 4, 5	?*Diacanthocapsa* sp., the same specimen focused on surface and on diameter.
Figures 6, 7	?*Dictyophimus* sp.
Figure 8	Nassellarian, gen et sp. indet.

PLATE 12

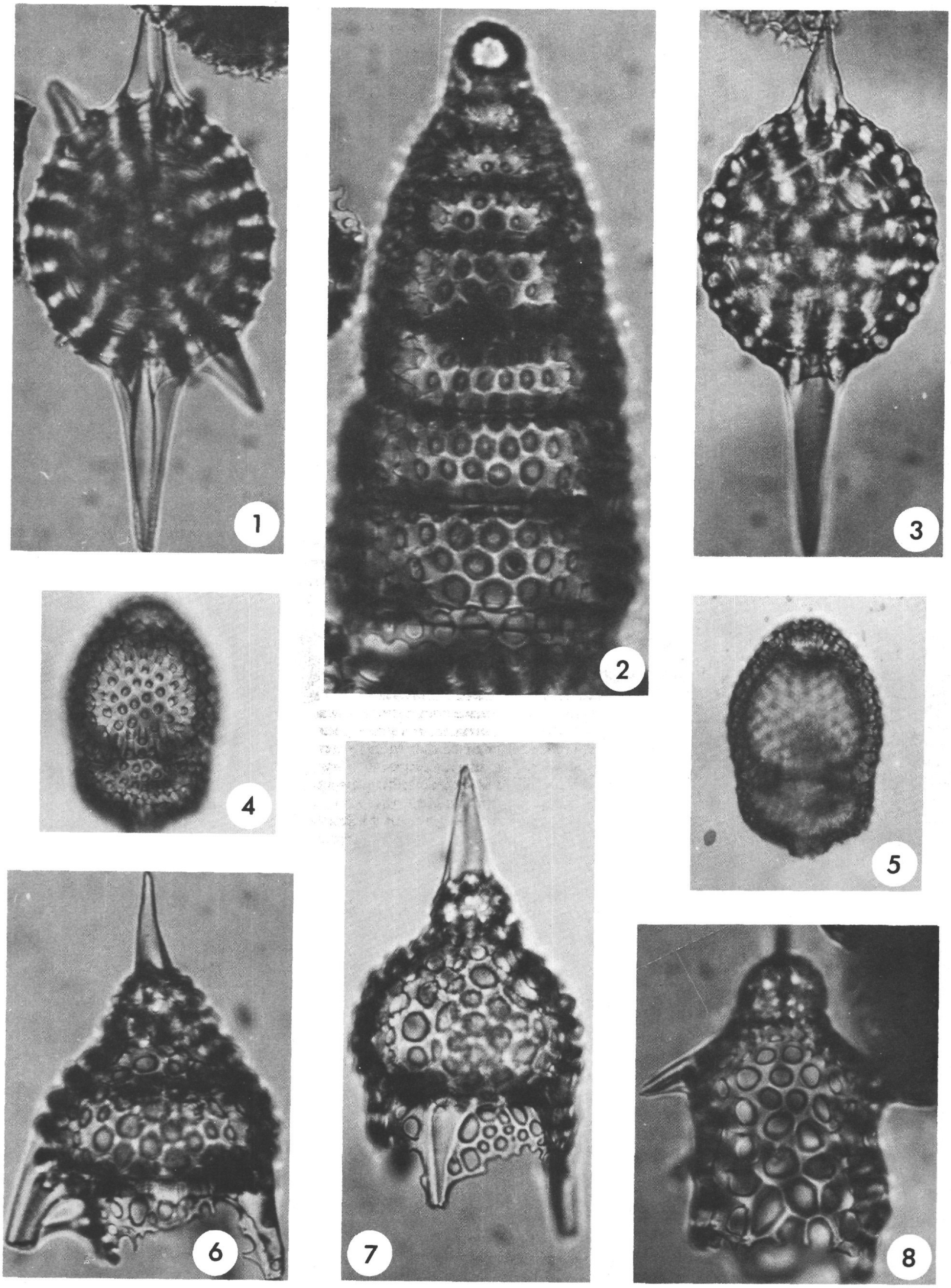

PLATE 13

All figures 208-29, CC
All figures X310

Figure 1	*Cornutella* sp.
Figure 2	*Stichomitra asymbatos* Foreman
Figure 3	*Stichomitra* sp. B.
Figure 4	?*Dictyophimus* sp.
Figures 5, 10	?*Tripodiscium* sp.
Figures 6-8	?*Microsciadiocapsa* sp., the same specimen in basal, lateral, and apical view.
Figure 9	?*Artostrobus* sp.

PLATE 13