# 33. CRETACEOUS RADIOLARIA, LEG 7, DSDP

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CONTENTS



## INTRODUCTION

Sediments containing Upper Cretaceous Radiolaria were cored at Sites 61 and 66. At Site 61, Hole 0, well-preserved Radiolaria were found in the core catcher sample of Core 1, approximately 80 meters below the sediment surface; and moderately well-preserved Radiolaria were found in Hole 1, Core 1, Section 2 at 7 to 10 centimeters, 71 to 74 centimeters, and in the core catcher sample, approximately 83 to 89 meters below the sediment surface. At Site 66, Hole 0, Core 9, at about 187 to 192 meters below the sediment surface, poorly preserved Radiolaria were found in a sample at the top and in Section 3 between 40 and 147 centimeters.

Sample localities are indicated as follows: Hole number (beginning with zero), which includes the site number separated by a decimal point from the number of the hole; core number; and section number (six sections to a complete core). Level within a section is given in centimeters measured from the top of the section; CC indicates a sample from the core catcher.

Locality and age assignments of the comparative material mentioned in the descriptions are as follows:

Fresno County, California, Cima Hill Hole III, upper Maestrichtian to Danian (Foreman, 1966).

Alameda County, California, CAS loc. 39545, low Maestrichtian-?upper Campanian (Foreman, 1968).

Tesla quadrangle, California, Sample NSF 451, upper Campanian (Pessagno, 1969), received from E. A. Pessagno, Jr.

East of Rousseau, South Dakota, Sample RCC-1, Pierre shale, Campanian (Foreman, 1966).

Bavaria, Germany, Sample WRE 67-42, 4 meters above Herm's sample 2030(223) Zone B, upper Campanian (Herm, 1962) or low Campanian (Douglas, 1969), received from W. R. Riedel.

South Atlantic, lat. 6° 16.58′S, long. 30° 53.46′W; water depth 5148 meters, Sample 24A-1-1 from DSDP Leg 4, Upper Cretaceous, probable Campanian (Riedel and Sanfilippo, 1970), loaned by W. R. Riedel.

West Pacific, lat. 11° 46.8′N, long. 147° 34.9′E; water depth 5554 and 5547 meters, Sample 59.2-5-CC from DSDP Leg 5, probable Campanian (Kling, 1970).

Habana Province, Cuba, Sample B191, Santonian-Campanian (Foreman, 1966).

Trinidad, Marac well 1, low Santonian *Globotruncana concavata* Zone (Foreman, 1966).

Island of Roti near Timor, sample ser. VIII, no. 154 of Tan Sin Hok 1927, Turonian-early Senonian (Foreman, 1966).

Yolo County, California, Sample NSF 327-C, Coniacian (Pessagno, 1969), received from E. A. Pessagno, Jr.

Val Dorbia, Italy, Sample RM 312 of AGIP Mineraria 1959, Cenomanian (Foreman, 1966).

Yolo County, California, Sample NSF 350, early Cenomanian (Pessagno, 1969), received from E. A. Pessagno, Jr.

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## SITE 61
## (lat. 12° 05.8'N, long. 147° 03.9'E; water depth 5562 meters)

### Sample 61.0-1-CC

The assemblage is very diverse, preservation is excellent and Radiolaria are numerous. The fauna is characterized by abundant specimens of a relatively few species of artostrobiids, many species of neosciadiocapsids, and common saturnalin rings. All the species mentioned below come from this sample, most are briefly described and illustrated; a few belonging to the genus *Dictyomitra* and the family Artostrobiidae are described in greater detail.

### Systematics

Suborder SPUMELLARIA Ehrenberg, 1875

Family ACTINOMMIDAE Haeckel, 1862, emend. Riedel, 1967b

*Gen. and sp. indet.*

Remarks: A number of species characterized by relatively small spherical shells and long, sturdy, three-bladed, branched or thorny spines are present. The broken spines of these forms are common elements of the assemblage.

Plate 1, Figure 1. A small sturdy spherical shell with large pores, irregular in size and shape, has seven long three-bladed main spines; these spines, each with three branches distally, have never been observed complete. Known occurrence: Low Santonian of Trinidad.

Genus **Spongoprunum** Haeckel, 1887

Type species: (Subsequent designation by Campbell 1954, p. D74) *Spongoprunum amphilonche* Haeckel, 1887, p. 347; not pl. 48, figure 7 which is of *Spongolonche conostyla.*

*Spongoprunum* sp.

Plate 1, Figure 2. An ellipsoidal, finely spongy form, with some circular structure centrally, has two three-bladed twisted polar spines of unequal length. A single row of nodes or short ridges encircles the spongy shell near each polar spine.

Known occurrence: Santonian-Campanian of Cuba and in the upper Campanian (Herm, 1962) or low Campanian (Douglas, 1969) of Germany.

*Gen. et sp. indet.*

Plate 1, Figure 3. A bell-shaped, finely spongy form has a single sturdy three-bladed, twisted polar spine arising from the narrow end. A single row of nodes or short ridges encircles the spongy shell near this narrow end. This form is not known elsewhere.

Subfamily SATURNALINAE Deflandre, 1953

Remarks: Saturnalin rings are common. Although the shells on which the generic classification is based are generally lacking, some species can be tentatively assigned to the genus Spongosaturnalis on the basis of fragmentary thorns on the polar spines or rings which indicate that the shell was probably spongy.

Genus **Spongosaturnalis** Campbell and Clark, 1944

*Spongosaturnalis?* sp.

Plate 1, Figure 4. Saturnalin rings with a ridge on the outer edge have not been reported. The species illustrated is the same as an undescribed form in the low Santonian of Trinidad, the only other locality where this species and this feature have been observed.

*Spongosaturnalis?* sp. cf. *Saturnalis euganeus* Squinabol

*Saturnalis euganeus* Squinabol, 1914, p. 300-301, pl. 24, figs. 8-11.

Plate 1, Figure 5. Fragments of flat, unridged saturnalin rings with slender spines are common throughout the Upper Cretaceous. Complete rings, however, generally have more numerous and shorter spines than does the species illustrated here, and are probably not related to this species which appears to be very similar to *S. euganeus* described by Squinabol from the Upper Cretaceous of Baone (Euganei), Italy. More information concerning the nature of the missing shell of both *S. euganeus* and the species illustrated here is, however, necessary before certain identification can be made.

*Spongosaturnalis?* spp. indet.

Plate 1, Figures 6 and 7. The two unusual species illustrated here are distinguished from all other described saturnalins by the spiny protrusions on the inner margin of the saturnalin ring. They probably indicate that a spongy shell almost completely filled the space enclosed by the ring. These forms have not been observed elsewhere.

*Gen. et sp. indet.*

Plate 1, Figure 8. This form differs from a very similar undescribed form in the low Santonian of Trinidad only in that the former has longer spines.

Family PHACODISCIDAE Haeckel, 1881

*Gen. et sp. indet.*

Plate 2, Figure 1. A discoidal form with three complete lattice-shells and two partial shells developed between but not touching the three equidistant three-bladed spines on the equatorial margin. The inner (medullary) shell appears to be spherical, but because the specimens could not be turned it is not certain if the intermediate complete shell is also spherical or discoidal as are the three outer shells. The illustrated specimen lacks the two outer incomplete shells.
Known occurrence: Low Santonian of Trinidad.

Family SPONGODISCIDAE Haeckel, 1862
emend. Riedel, 1967b

Genus **Amphibrachium** Haeckel, 1881

*Amphibrachium* sp. cf. *A. ornatum* Lipman, 1960

*Amphibrachium ornatum* Lipman, 1960, p. 126, pl. 28, figs. 10-13.

Plate 2, Figure 2. The species illustrated here is similar to *A. ornatum* from the Santonian-Campanian and Turonian of Western Siberia in that they both have circular concentric rings centrally and two expanded spongy arms. They differ, however, in the former having arms with rounded ends and at least one bladed spine at the end of each arm.
Known occurrence: Probable Campanian of DSDP Leg 4, 24A-1-1 and doubtful in the Santonian-Campanian and Turonian of Western Siberia.

*Amphibrachium* sp.

Plate 2, Figure 3. The second species of *Amphibrachium* illustrated here differs from *Amphibrachium* sp. cf. *A. ornatum* in its smaller size and generally elongated rectangular shape with little or no indentation at the junction of the central circular structure with the spongy arms. It is not known elsewhere.

*Gen. et sp. indet.*

Plate 2, Figure 4. A three-armed form with arms of approximately equal length and equidistant. Two of the arms have three spines at their slightly broadened free end, the central spine ridged and markedly longer and broader than the other two which sometimes appear only as large thorns. At its free end, the third arm has only the two outer spines; between them, instead of a spine, there is a tube-like structure with walls of fragile meshwork. The surface structure of the central area is irregularly spongy. In contrast, the arms have a meshwork of regular, circular to subangular pores arranged in regular longitudinal rows. Small slender rod-like spines along the margin of the central area indicate the probable presence of a patagium.

Remarks: This species appears closely related by its shape and terminal arm structures to a three-armed unnamed form (Plate 2, Figure 8) assigned doubtfully to the family Pseudoaulophacidae, but is here included in the family Spongodiscidae because of its shape and the character of its spongy structure.

Family PSEUDOAULOPHACIDAE Riedel, 1967a

Genus **Pseudoaulophacus** Pessagno, 1963

*Pseudoaulophacus superbus* (Squinabol)

Plate 2, Figure 5.
Known occurrence: Cenomanian of Italy, middle Turonian-upper Campanian of California (E. A. Pessagno, Jr., personal communication), Santonian-Campanian of Caribbean region, probable Campanian of DSDP Leg 4, 24A-1-1, and DSDP Leg 6, 59.2-5-CC.

*Pseudoaulophacus floresensis* Pessagno, 1963

Plate 2, Figure 6.
Known occurrence: Middle Turonian of California, Santonian-Campanian of Cuba, and low Campanian of Puerto Rico.

*Pseudoaulophacus pargueraensis* Pessagno, 1963

Plate 2, Figure 7.
Known occurrence: Santonian-Campanian of Cuba and low Campanian of Puerto Rico.

*Gen. et sp. indet.*

Plate 2, Figure 8. A three-armed form with arms of approximately equal length and equidistant. Two of the arms have three long, slender, smooth spines at their slightly broadened free end, the third arm has only two outer spines; between them, instead of a spine, is a tube-like structure with walls of fragile meshwork. Well-developed specimens have the surface with pseudoaulophacid structure over all; on some specimens this gives way to a more regular rectangular structure medianly on the arms. Small, slender, rod-like spines along the margin of the arms indicate the probable presence of a patagium.

Remarks: This form differs from *Dictyastrum amissum* Squinabol, 1914, in having pseudoaulophacid spongy structure, rather than circular pores. It is apparently related to the spongodiscid (Plate 2, Figure 4), but differs in having pseudoaulophacid spongy structure.

Known occurrence: Upper Campanian of California and doubtful in the low Santonian of Trinidad.

Suborder NASSELLARIA Ehrenberg, 1875

Family THEOPERIDAE Haeckel, 1881, emend. Riedel, 1967b

*Gen. et sp. indet.*

Plate 3, Figure 1. This distinctive two-segmented form has a small cephalis, partly hidden in a large elongated to globose thorax which has a small circular aperture. The cephalis is poreless and occasionally has a tiny vertical horn. The thorax has small circular pores arranged in irregularly spaced, approximately vertical rows, and surface with numerous longitudinal undulations. This two-segmented form somewhat resembles *Sethamphora microstoma* Haeckel (1887, p. 1252, pl. 57, fig. 5), but differs in having a poreless cephalis and thoracic pores in less regular rows.

Known occurrence: Low Santonian of Trinidad, Santonian-Campanian of Cuba, and probable Campanian of DSDP Leg 4, 24A-1-1 and DSDP Leg 6, 59.2-5-CC.

*Gen. et sp. indet.*

Plate 3, Figure 2. A three-segmented form with a small cephalis bearing a short sturdy ridged horn which may have more than one point. Thorax globose with small, circular, uniform pores. Abdomen, very variable in size, ovate with a short, narrow cylindrical aperture, and pores small, circular, uniform, sometimes set in weak angular frames. There may be three smooth ribs in the abdominal wall, which protrude not at all, or only very slightly, and extend from the lumbar stricture for from one-third to about two-thirds the length of the abdomen.

Remarks: This three-segmented form appears related to the type species of the genus *Rhopalatractus* Haeckel, 1881 (*R. pentacanthus* Haeckel, 1887). It differs, however, in that the abdominal ribs, when present, do not extend as wings distally, and basally there is a cylindrical aperture, rather than a spine.

Known occurrence: Upper Campanian (Herm, 1962) or low Campanian (Douglas, 1969) of Germany.

*Gen. et sp. indet.*

Gen. and sp. indet. Kling (1970) pl. 8, figs. 7 and 8.

Plate 3, Figure 3. This common, but unusual, four-segmented form has a small poreless cephalis with a roughened surface and may or may not have a long, irregularly shaped, roughened horn. The thorax is generally poreless with angular depressions over all. The first abdominal segment is globose, very variable in size, with small, circular, uniform pores; these pores may have angular frames, sometimes with nodes at the angles. Proximally there are three gates which in well-preserved specimens are covered by three uniform, conical, hollow arms with short ridged spines at their free ends. Pores on the arms are uniform, small, circular, and closely spaced. The second abdominal segment closely resembles the above described hollow arms.

Known occurrence: Santonian-Campanian of Cuba, and probable Campanian of DSDP Leg 6, 59.2-5-CC.

Another species belonging to this genus is known from the low Maestrichtian-?Campanian of California where it is extremely rare.

*Gen. et sp. indet.*

Plate 3, Figure 11. This distinctive rare four-segmented form is distinguished by its relatively small almost cylindrical proximal segments and the large ellipsoidal terminal segment. Cephalis small, spherical with a few small pores immediately above the collar stricture. Thorax and first abdominal segment cylindrical with a few small pores; the latter partly depressed in the large terminal segment which has very large pores, irregular in size and shape, and a smooth surface except for a few short widely spaced thorns. Aperture slightly constricted with short variably developed teeth. This form is not known elsewhere.

Genus **Dictyomitra** Zittel, 1876, sensu Foreman, 1968

Remarks: It has recently become apparent [Foreman (1968) and this study] that incomplete specimens of *Dictyomitra* with longitudinal ribs (e.g. those in which the distalmost segments are missing) cannot confidently be identified until a number of complete or almost complete specimens have been observed and the range of variations established. A number of complete excellently preserved specimens of *Dictyomitra* are present in this assemblage. Three species are illustrated and the most common one described as *D. torquata.*

*Dictyomitra torquata* new species

Plate 3, Figure 4. Shell sturdy, of from seven to ten segments, conical except for the terminal segment which may be slightly narrower. Segments increase gradually in length distally. The cephalis, without a horn but thickened apically, is small, poreless, with a smooth surface, and the thorax is equal to or slightly longer than the cephalis. The proximal two to four post-cephalic segments are smooth and increase gradually in width with only a single row of downward directed pores and no indentation at the strictures. The remaining segments have longitudinal ribs; the area between ribs smooth or with a single vertical row of transverse irregularly elliptical depressions. A single row of circular pores, one between adjacent ribs, is present at or immediately below each stricture and generally another similar row is above. These median and distal segments are each markedly expanded

distally. The first expanded segment may be broader than the one immediately following, and the last segment may be slightly narrower than the one immediately preceding. Occasionally a distalmost segment may be cylindrical with a thin wall similar to the lamellar ribbed (sometimes only weakly ribbed) teeth at the apertural margin. These teeth are generally connected with lamellar shell material proximally and there may be one or two transverse rows of elongate elliptical pores, one pore between adjacent ribs. The teeth are parallel or very slightly constricted.

This species is distinguished by a combination of the following characteristics: sturdy shell, widely spaced ribs, individual segments expanded distally, and ribbed lamellar teeth.

Length of complete specimens of seven to ten segments–212 to 350$\mu$, of seven segments–175 to 212$\mu$; width of broadest segment–105 to 178$\mu$, width between ribs of broadest segment–15 to 32$\mu$. Dimensions based on ten specimens.

Known occurrence: Santonian-Campanian of Cuba, low Campanian of Puerto Rico, upper Campanian (Herm, 1962) or low Campanian (Douglas, 1969) of Germany, and probable Campanian of DSDP Leg 4, 24A-1-1 and DSDP Leg 6, 59.2-5-CC.

*Dictyomitra* sp.

Plate 3, Figure 5. This form is characterized by a fourth or fifth (generally fourth) expanded segment, the remaining segments are not at all, or only very slightly, expanded.

Known occurrence: Santonian-Campanian of Cuba, upper Campanian (Herm, 1962) or low Campanian (Douglas, 1969) of Germany, and probable Campanian of DSDP Leg 6, 59.2-5-CC.

*Dictyomitra* sp.

Plate 3, Figure 6. This form is characterized by its relatively smooth outline, circular pores in single vertical rows between adjacent ribs on the distal segments, and long, lamellar, sometimes ribbed, slender teeth.

Similar broken specimens without the distinctive teeth have been observed in samples from other localities. However, until this form is better known, the broken forms cannot be identified confidently.

*Dictyomitra* sp.

Plate 3, Figure 7. This form is characterized by its relatively smooth outline, and the numerous small circular pores between ribs on the median and/or distal segments; these pores are in from one to five irregular vertical rows between adjacent ribs. It is not known elsewhere.

*Dictyomitra andersoni* (Campbell and Clark) emend. Foreman, 1968

Plate 3, Figure 8. Specimens observed here agree well with those described from the upper Maestrichtian of California.

Known occurrence: Low Santonian of Trinidad, and from many other localities through the upper Maestrichtian of California.

Family AMPHIPYNDACIDAE Riedel, 1967a

Genus **Amphipyndax** Foreman, 1966

*Amphipyndax stocki* (Campbell and Clark) emend. Foreman, 1968

This species is common throughout much of the Upper Cretaceous and has previously been reported from the low Santonian of Trinidad into the early Danian of California.

Family ARTOSTROBIIDAE Riedel, 1967b

Genus **Artostrobium** Haeckel, 1887, emend. Foreman, 1966

*Artostrobium urna* new species

Artostrobiid, gen. et sp. indet., Riedel and Sanfilippo (1970, in press) pl. 3, fig. 13.

Artostrobiid, gen. et sp. indet. Kling (1970) pl. 7, fig. 8.

Plate 4, Figures 1 and 2. Shell of four segments, slightly narrowed laterally and expanded in the sagittal plane. The cephalis and thorax together are conical, the first abdominal segment medianly inflated, and the second abdominal segment apparently cylindrical. The cephalis bears a sturdy ridged horn and a large horizontally directed tube; sparse circular pores are irregularly distributed. The thorax has downwardly directed circular pores quincunicially arranged in up to four transverse rows; the distal rows frequently have distinctive elongated pear-shaped frames below their lower margin, the distalmost extending on to the lumbar stricture. An irregular, variably developed transverse ridge is sometimes present medianly or distally. Externally the lumbar stricture is marked by a change of contour and internally by only a slight thickening of the shell wall. The expanded abdomen has four to eight, rarely more, transverse rows of small circular pores; its surface is roughened by prominent irregular longitudinal ridges dividing one to three rows of pores; frequently transverse ridges cross the longitudinal ridges and form rectangles which enclose groups of pores. The postlumbar stricture is smooth, markedly indented and then expanded to form a thick ringlike collar. Only fragments of the fragile, smooth, thin-walled, second abdominal segment have been observed; it has at least

one row of transverse, closely spaced, circular pores immediately below the thick ringlike collar of the post-lumbar stricture.

*Artostrobium urna* differs from the following *Artostrobium tina* in the presence of a thick ringlike collar at the post-lumbar stricture. In general it has a rougher, more massive shell, with larger, fewer pores on the abdomen, which is more expanded.

Length of horn–15 to 35$\mu$, of cephalis and thorax–35 to 45$\mu$, of abdomen–75 to 90$\mu$; width in sagittal plane of thorax–45 to 55$\mu$, of abdomen–75 to 95$\mu$. Dimensions based on ten specimens.

Known occurrence: Low Santonian of Trinidad, Santonian-Campanian of Cuba, upper Campanian (Herm, 1962) or low Campanian (Douglas, 1969) of Germany, and probable Campanian of DSDP Leg 4, 24A-1-1 and DSDP Leg 6, 59.2-5-CC.

*Artostrobium tina* new species

Plate 4, Figure 3. Shell of four segments, slightly narrowed laterally and expanded in the sagittal plane. The cephalis and thorax together are subconical, the first abdominal segment medianly expanded, and the second abdominal segment cylindrical. The cephalis bears a sturdy ridged horn, and a large horizontally directed tube; sparse small, circular pores are irregularly distributed on the cephalis and proximal part of the thorax. Distally the thorax has a distinct sharp ridge with one or two rows of circular, downwardly directed pores below. The lumbar stricture is smooth, marked externally by a change of contour and internally by a slight thickening of the shell wall. The expanded abdomen has five to nine transverse, approximately equidistant rows of small circular pores. The surface generally has irregular, frequently incomplete, longitudinal ridges dividing one to four rows of pores, sometimes also with transverse ridges forming rectangles which enclose groups of pores. Occasionally there are no ridges and the surface is smooth. The post-lumbar stricture is similar to the lumbar stricture. The fragile second abdominal segment, never observed complete, is cylindrical, smooth, with up to four irregularly spaced, transverse rows of small circular pores, some rows with only a few irregularly spaced pores.

This form is distinguished from *A. urna* as described under that species, and is not known elsewhere.

Length of horn–15 to 35$\mu$, of cephalis and thorax–35 to 45$\mu$, of expanded abdomen–65 to 80$\mu$, of cylindrical abdomen (3 incomplete)–40$\mu$, 45$\mu$ and 60$\mu$; width in sagittal plane of thorax–45 to 50$\mu$, of widest part of expanded abdomen–70 to 85$\mu$, of cylindrical abdomen–60 to 70$\mu$. Dimensions based on ten specimens.

Genus **Theocampe** Haeckel, 1887, emend. Burma, 1959

*Theocampe ascalia* new species

*Theocampe* sp. Riedel and Sanfilippo (1970) pl. 3, fig. 12.

*Theocampe* sp. Kling (1970) pl. 7, figs. 2, 3 and 4.

Plate 4, Figure 4. Shell of three segments, ovate, narrowed laterally and expanded in the sagittal plane. The cephalis, without a horn and with a horizontally to upward directed tube which does not protrude, has small circular pores set in circular to angular frames. Thoracic pores are circular and arranged in transverse quincuncial rows; proximally in circular to angular frames, distally in downward directed elliptical frames or arches. The lumbar stricture has no (or only slight) indentation externally, and a distinct shelf internally. Abdominal pores are circular, arranged in three to four widely-spaced transverse rows; the median rows sometimes lacking pores on the lateral surface. Longitudinal weak ridges, approximately nine or ten per half a circumference, extend from the lumbar stricture to the last row of pores. The surface may or may not be finely granular. Distally, the abdomen constricts to form an aperture about one-third the diameter of the abdomen at its widest part. Apertural margin even.

*T. ascalia* differs from the following *T. salillum* in its shorter length, smoother more delicate shell with only weak longitudinal ridges on the abdomen, and ovate form. It is one of the most abundant forms in the assemblage.

Length overall–103 to 110$\mu$, of cephalis and thorax–35 to 40$\mu$, of abdomen–65 to 70$\mu$; width in sagittal plane of thorax–45 to 60$\mu$, of abdomen–65 to 80$\mu$.

Known occurrence: Low Santonian of Trinidad, Santonian-Campanian of Cuba, and probable Campanian of DSDP Leg 4, 24A-1-1 and DSDP Leg 6, 59.2-5-CC.

*Theocampe salillum* new species

*Theocampe* sp. Kling (1970) pl. 7, figs. 1 and 5.

Plate 4, Figure 5. Shell of three segments, slightly narrowed laterally and expanded in the sagittal plane. Cephalis and thorax together are conical to subhemispherical, abdomen subcylindrical, slightly inflated. The cephalis, without a horn, has a horizontally directed tube which does not protrude. Cephalic and proximal thoracic pores are small, circular, irregularly arranged. On the median part of the thorax they become downwardly directed and are sometimes set in variably developed irregular angular or curved frames; the distalmost pores are arranged in a vague transverse row. The

lumbar stricture is defined externally by only a slight change in contour and internally by a sturdy shelf. Abdominal pores are arranged in one transverse row immediately below the lumbar stricture and generally three to five additional (rarely as many as eight) approximally equally spaced rows beyond; there is some tendency to form longitudinal rows. Pores are circular and tend to be smaller proximally, larger distally. They are frequently set in curved or angular arches which join to form wavy irregular longitudinal ridges and less prominent irregular transverse ridges. Distally the abdomen constricts to an aperture approximately one-half the diameter of the abdomen at its widest part. Apertural margin even.

*T. salillum* differs from *T. ascalia* as described under that species and from *T. mongolfieri* in having abdominal pores in less regular longitudinal rows. This is one of the most abundant forms in the assemblage.

Length overall–120 to 138$\mu$, of cephalis and thorax–50$\mu$, of abdomen–70 to 95$\mu$; width in sagittal plane of thorax–56 to 70$\mu$, of the widest part of the abdomen–70 to 85$\mu$, of aperture–30 to 35$\mu$.

Known occurrence: Low Santonian of Trinidad, Santonian-Campanian of Cuba, upper Campanian (Herm, 1962) or low Campanian (Douglas, 1969) of Germany, and probable Campanian of DSDP Leg 4, 24A-1-1 and DSDP Leg 6, 59.2-5-CC.

*Theocampe apicata* new species

*Theocampe* sp. Kling (1970) pl. 7, fig. 9.

Plate 4, Figure 6. Shell triangular, of three segments, the abdomen markedly narrowed in the sagittal plane and expanded in the lateral plane. The cephalis, without a horn, has a small tube. Pores of the cephalis and proximal thorax are small, circular, irregularly arranged. Distally the thorax has a single row of downward directed pores. The lumbar stricture is defined by no or only slight change of contour externally and a sturdy shelf internally. The abdomen, expanded distally, has a single row of small circular pores immediately below the lumbar stricture and five to six incomplete rows of similar pores below. These pores, on the lateral surfaces only, are absent dorsally and ventrally. The surface of the thorax and abdomen may be finely granular. Weak longitudinal ridges sometimes extend from arched or angular frames around the pores. Distally the abdomen constricts sharply to form an aperture approximately one-third the diameter of the abdomen at its widest part. Apertural margin smooth.

This distinctive form differs from all other known artostrobiids in its triangular shape and in being markedly expanded in the lateral plane.

Length overall–110 to 125$\mu$, of cephalis and thorax–40 to 45$\mu$, of abdomen–70 to 80$\mu$; width in lateral plane of thorax–45$\mu$, of widest part of abdomen–80 to 100$\mu$, of aperture–30 to 35$\mu$. Dimensions based on ten specimens.

Known occurrence: Probable Campanian of DSDP Leg 6, 59.2-5-CC and upper Campanian (Herm, 1962) or low Campanian (Douglas, 1969).

*Theocampe* sp.

A form closely related to *Theocampe altamontensis* (Campbell and Clark) is rare in this assemblage. It differs in that the abdomen has wavy longitudinal ridges and its pores are without prongs on their margin.

Family ARTOSTROBIIDAE ? Riedel, 1967b

Genus **Rhopalosyringium** Campbell and Clark, 1944, emend. Foreman, 1968

The relationship of the genus *Rhopalosyringium* to the members of the family Artostrobiidae (e.g., the genus *Theocampe* in Foreman, 1968) and early members of the family Cannobotryidae Haeckel, Haeckel, 1881, emend. Riedel, 1967 (described under the genus *Eribotrys* in Foreman, 1968) is uncertain. It appears to stand between the two, because although it has a dorsal branch close to the apical wall of the cephalis as do the artostrobiids, the posterior part of the cephalis above the jugular pores is large as in the early cannobotryids.

*Rhopalosyringium* sp.

Plate 3, Figure 9. This fairly common form has a hemispherical cephalis, bearing a sturdy three-bladed horn and an upwardly directed tube which does not protrude. The globose thick-walled thorax has uniform circular pores in angular frames, and the fragile cylindrical abdomen with thin lamellar wall has small irregularly shaped and spaced pores, sometimes tending to be transversely aligned. A similar form is present in the Santonian-Campanian of Cuba.

*Rhopalosyringium* sp.

Plate 3, Figure 10. A number of species, all rare, are characterized by having an abdomen elongated on the ventral side and shortened on the dorsal side. One species is illustrated.

Species with this unusual abdominal structure have not been observed in any other Cretaceous locality.

Family NEOSCIADIOCAPSIDAE Pessagno, 1969

Genus **Microsciadiocapsa** Pessagno, 1969

*Microsciadiocapsa* sp.

Plate 4, Figure 8. This distinctive species is characterized by pleat-like ribs on the abdomen with the distal margin between the ribs straight or slightly concave. The

poreless cephalis bears a small horn and a tube is present. Thorax and abdomen have few pores; when present they are most abundant near the lumbar stricture, arranged in transverse and vertical rows. A flat lamellar almost poreless velum completely covers the basal opening and is joined to the shell on all sides at the lumbar stricture. This species is not known elsewhere.

*Microsciadiocapsa* sp.

Plate 4, Figure 7. This species differs from that described above in its larger size, circular margin, and more numerous very regularly arranged pores. Only fragments of an apparently lamellar, poreless velum have been seen at the lumbar stricture.
Known occurrence: Low Santonian of Trinidad.

Family NEOSCIADIOCAPSIDAE ?

*Gen. et sp. indet.*

Plate 4, Figures 9 and 10. Several species with a large abdomen and large pores are common. One species not known elsewhere is illustrated. It is only doubtfully assigned to the Neosciadiocapsidae because in the type species of the type genus of the family there is a well-developed velum which is absent here. Instead, a few widely spaced very tiny thorns are sometimes present on the underside of the proximal abdomen.

*Gen. et sp. indet.*

Plate 4, Figures 11 and 12. This common form is distinguished by the dorsally raised, flared, abdominal segment, and is similar to a rare undescribed form in the Santonian-Campanian of Cuba. It is probably related to the unnamed neosciadiocapsid on Plate 8, Figure 1 of Pessagno (1970, in press) but differs in bearing an apical horn and in having pores of the thorax, abdomen and velum all very similar in character. Pores of the abdomen are in less distinct transverse rows.

In the type species of the type genus of the Neosciadiocapsidae, the velum appears to be a separate structure attached to the flaring shell wall, but in the form illustrated here the velum may well be a direct continuation of the thoracic wall. For this reason, the family assignment is tentative.
Known occurrence: Low Santonian of Trinidad.

*Gen. et sp. indet.*

Plate 4, Figure 13. This form, known here only by the distinctive fragments of its terminal segment, is believed to belong either to the Neosciadiocapsidae or a related, as yet undescribed, family. It is here only doubtfully assigned to the Neosciadiocapsidae because the nature and number of the proximal segments are not known. A similar, slightly better preserved specimen of a species from the low Santonian of Trinidad shows fragments of a second segment within the circular central area. This form is not known elsewhere.

**Age**

The assemblage described above includes numerous species which are common in the low Santonian of Trinidad, and/or the Santonian-Campanian of Cuba and the low Campanian of Puerto Rico. The resemblance to the material from the low Santonian of Trinidad is striking. There is not as yet, however, sufficient data to establish the ranges of most of the common species. Two species, *Artostrobium urna* and *Theocampe salillum,* are known to range at least from the low Santonian of Trinidad to the upper Campanian (Herm, 1962) or low Campanian (Douglas, 1969) of Germany. This together with the absence from the low Santonian locality of robust specimens of *Dictyomitra torquata* (common here and in other Campanian localities) may indicate an age somewhat younger than low Santonian, and it is thus suggested that the assemblage may be Santonian-low Campanian in age.

**Samples 61.1-1-2, 7-10 cm and 71-74 cm; 61.1-1-CC**

Radiolarians are numerous and diverse in these samples. However, they are only moderately well-preserved and, therefore, none are illustrated or described.

These three samples contain an essentially similar fauna which include many of the elements found in Sample 61.0-1-CC. Radiolaria mentioned as present in the core-catcher sample of Hole 0 and present in the samples from Hole 1 are:

*Spongoprunum* sp., Plate 1, Figure 2 (only in 61.1-1-2, 71 to 74 centimeters).

Phacodiscid, gen. and sp. indet., Plate 2, Figure 1.

*Pseudoaulophacus superbus* (Squinabol).

Theoperid, gen. and sp. indet., Plate 3, Figure 1.

Theoperid, gen. and sp. indet., Plate 3, Figure 2 (not in 61.1-1-2, 7 to 10 centimeters).

Theoperid, gen. and sp. indet., Plate 3, Figure 3.

*Dictyomitra torquata* new species.

*Dictyomitra* sp., Plate 3, Figure 5.

*Amphipyndax stocki.*

*Artostrobium urna* new species.

*Artostrobium tina* new species (not in 61.1-1-2, 71 to 74 centimeters).

*Theocampe ascalia* new species.

*Theocampe salillum* new species.

*Theocampe apicata* new species.

The assemblage in Hole 1 differs markedly, however, from that described for Hole 0 in being composed primarily of discoidal and ellipsoidal spongodiscids. Saturnalin rings are almost entirely absent, with only one sample (61.1-1-2, 7 to 10 centimeters) containing a few small fragments. Crytoids are relatively few; among them the neosciadiocapsids are entirely lacking. Sample 61.1-1-2, 71 to 74 centimeters, contained a species of *Solenotryma* referred to in Foreman (1968) as cf. *Solenotryma dacryodes.*

These samples are from a few meters below 61.0-1-CC, and the difference in the assemblages may be due to a slight difference in age.

**SITE 66**
**(lat. 2° 23.6′N, long. 166° 07.3′W; water depth 5293 meters)**

**Samples 66.0-9-top, and 66.0-9-3 at 145-147 cm**

The assemblage here is diverse, but preservation is poor and the Radiolaria are few. The majority of the specimens described and illustrated come from the best sample at the top and only a few from Section 3. All specimens described are illustrated, and locality information of the illustrated specimen is given with the figure description.

**Systematics**

Suborder SPUMELLARIA Ehrenberg, 1875

Family ACTINOMMIDAE Haeckel, 1862, emend. Riedel, 1967b

**Gen. indet.**

Plate 5, Figure 1. A common spherical form has a smooth surface except for ridges which form an irregular pattern of large angular frames, about five per half-circumference. There are two or three small circular pores, or occasionally none, within each frame. This form is apparently the same as an undescribed species in the Cenomanian of Italy, and is not known elsewhere.

Family SPONGODISCIDAE Haeckel, 1862, emend. Riedel, 1967b

**Gen. indet.**

Plate 5, Figures 2 and 3. Numerous disc-shaped, circular to elliptical, spongy forms are present; some with margins smooth, others indented, and still others with bases of approximately broken-off spines. Members of this group have been illustrated frequently by authors in the past, but because of the generally poor preservation and the resulting difficulty in distinguishing species it is judged that the majority of this group cannot be used for age determination at this time. Two of the more distinctive forms are illustrated.

Plate 5, Figure 4. One unusual three-armed spongy form with short irregular spiny projections on the distal margin is present. Two of the angles between the arms are about 100°, the other about 160°. The short arms and central area are irregularly spongy on the surface. The distal half of each arm has some slight longitudinal structure, and there is an apparent small circular structure at the center internally. An identical undescribed form has been observed in the Turonian-early Senonian from the island of Roti, and a similar form but without such a broad angle between two of the arms in two samples from the Coniacian and early Cenomanian of California.

Plate 5, Figure 5. Another form with spongy arms is represented by one arm only, so that the number of arms is unknown. The surface spongy structure is coarse with a distinct longitudinal alignment and there are three short, stout, ridged spines at the flared distal end. Similar broken-off single arms are present in the Turonian-early Senonian of the island of Roti.

Plate 5, Figure 6. A four-armed form has a surface finely and irregularly spongy, and the four arms of equal length and equidistant with a single, apparently short, ridged spine at each tip. Internally a single straight line extends from the distal end of each arm to a small, circular, central structure.

Plate 5, Figure 7. Another four-armed form has a moderately fine spongy surface and four broken arms equidistant, with longitudinal structure extending towards the center. The large central area has, internally, a circular structure which extends to the margin.

Suborder NASSELLARIA Ehrenberg, 1875

Family THEOPERIDAE Haeckel, 1881, emend. Riedel, 1967b

Genus **Theocapsomma** Haeckel, 1887, emend. Foreman, 1968

Plate 5, Figures 8, 9, 10 and 11. A number of species referable to *Theocapsomma* are present in all of the samples. Although many similar forms have been described or illustrated by earlier authors, the descriptions are generally not sufficiently detailed and the preservation here is too poor to allow any identification beyond the generic level. Figure 11 may be comparable to *Tricolocapsa pachyderma* Tan Sin Hok, 1927 from the Turonian-early Senonian of Roti.

**Gen. indet.**

Plate 5, Figures 12 and 13. An interesting common form has five, or sometimes four segments. The cephalis

may or may not have a tiny apical spine or a thickened apical cephalic wall and is sometimes almost entirely enclosed within the thick thoracic wall. The thorax and first abdominal segment (in some specimens a second abdominal segment) are very similar in the character of their circular, irregularly arranged pores and thick wall. Because of this, and the presence of only very thin septa dividing these segments, the number of subdivisions of the proximal part of the abdomen is uncertain in some specimens. The last segment is short, inverted-conical, with a thin wall and irregularly arranged, closely spaced pores. A short sharp thorn extends distally on some specimens.

Genus **Dictyomitra** Zittel, 1876, sensu Foreman, 1968

Plate 5, Figures 14, 15 and 16. Two forms with longitudinal ribs may be assigned to the genus *Dictyomitra* in the sense of Foreman, 1968. The first is the most common theoperid in these two samples. It has five to seven segments, a thorax slightly longer than the cephalis, and the terminal thin-walled segment slightly constricted. It may be referable to *Eucyrtidium brouweri* Tan Sin Hok, 1927. The specimens here observed and illustrated, however, resemble specimens in the topotypic material rather more than they do those illustrated by Tan Sin Hok. A very similar form is also present in the early Cenomanian of California. The second form may possibly be referable to the ubiquitous *Dictyomitra multicostata* Zittel variously reported from the Upper Cretaceous; Senonian; and Campanian, Santonian and Coniacian. The specimens observed here differ slightly from those illustrated by Zittel and by Foreman, 1968, in that the cephalis has a very thick apex. As the thickness of the apex is quite variable in many species it is not considered an important distinguishing feature.

Family AMPHIPYNDACIDAE Riedel, 1967a

**Gen. indet.**

Plate 5, Figure 17. A few specimens of a species related to *Cyrtocapsa moelengraaffi* and *C. asseni* Tan Sin Hok, 1927, have been observed. The forms here have four segments, as do the forms illustrated by Tan Sin Hok if one considers that his small thoracic segment is the lower half of an *Amphipyndax* type of cephalis. The *Amphipyndax* type of cephalis here is poreless, with or without a small apical horn; the thorax short with a few tiny pores; and the two abdominal segments with small circular pores in angular frames; the last segment globose or slightly flattened proximally and distally and markedly larger than the others. This form differs from the illustrations of *C. moelengraaffi* and *C. asseni* by the presence of at least two (probably three well-preserved specimens) short feet. The topotypic material available, however, did show feet on specimens comparable to the two species mentioned above.

Family ARTOSTROBIIDAE ? Riedel, 1967a

Genus **Rhopalosyringium ?** Campbell and Clark, 1944, emend. Foreman, 1968

Plate 5, Figure 18. A distinctive three-segmented cyrtoid is possibly referable to *Rhopalosyringium*. Distinguishable features include the large cephalis with horn, globose thorax with irregularly arranged circular pores in angular frames, and narrow, cylindrical, smooth, poreless abdomen with unconstricted aperture.

## Age

The assemblage described above contains a few species which closely resemble forms described by Tan Sin Hok (1927), or are identical with undescribed forms, from his Turonian-early Senonian material of Roti. In addition, the general aspect of the assemblage resembles that of Tan Sin Hok in the many forms with large globose terminal segments and the numerous specimens with longitudinal ribs. One form is similar to a longitudinally ribbed form known from the Cenomanian of California. Also present is a form common in this assemblage and in the Cenomanian of Italy and not known elsewhere. These common characteristics may be due to approximate age equivalence, and it is thus suggested that this assemblage may be of Turonian-Cenomanian age.

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## Explanation of Plates

Information for the figure descriptions is given in the following order: Figure number, name, locality, magnification, USNM number and "England finder" coordinates (Riedel and Foreman, 1961). The England finder coordinates give the location of the specimen on the slide, when the specimen slide is arranged with the large slide label to the left of the microscopist.

PLATE 1

Figure 1 — Actinommid, gen. and sp. indet. 61.0-1-CC. X 126. Slide USNM 167931; P27/2.

Figure 2 — *Spongoprunum* sp. 61.0-1-CC. X 206. Slide USNM 167932; C18/4.

Figure 3 — Actinommid, gen. and sp. indet. 61.0-1-CC. X 206. Slide USNM 167933; 034/0.

Figure 4 — *Spongosaturnalis?* sp. 61.0-1-CC. X 126. Slide USNM 167910; B31/3.

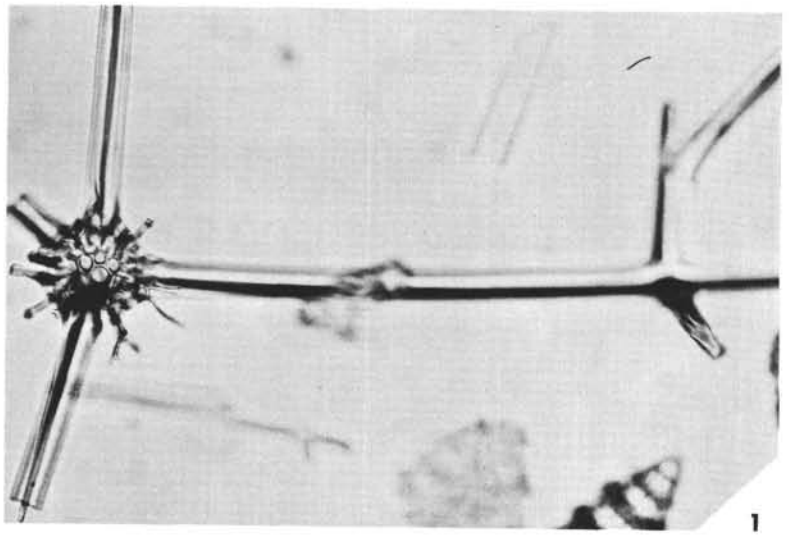
Figure 5 — *Spongosaturnalis?* sp. cf. *Saturnalis euganeus* Squinabol 61.0-1-CC. X 126. Slide USNM 167911; G22/4.

Figure 6 — *Spongosaturnalis?* sp. 61.0-1-CC. X 126. Slide USNM 167912; J23/3.

Figure 7 — *Spongosaturnalis?* sp. 61.0-1-CC. X 126. Slide USNM 167913; V49/3.

Figure 8 — Saturnalin, gen. and sp. indet. 61.0-1-CC. X 126. Slide USNM 167914; F31/0.

## Plate 1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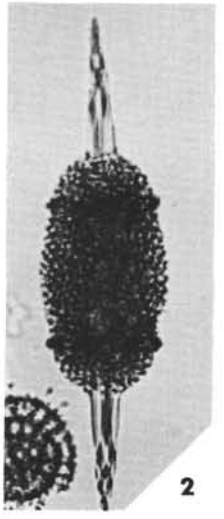
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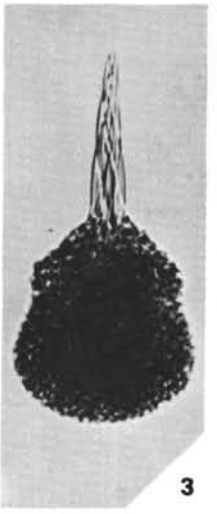
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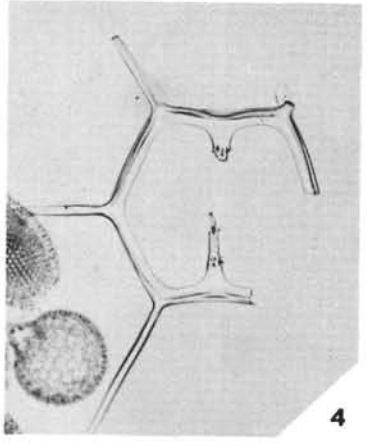
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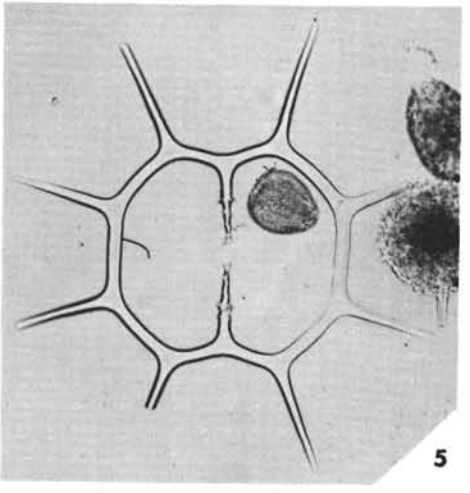
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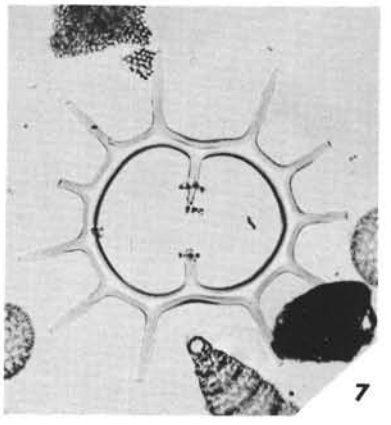
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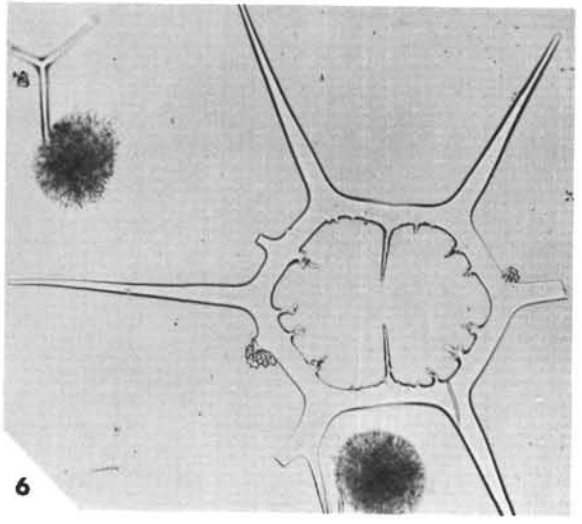
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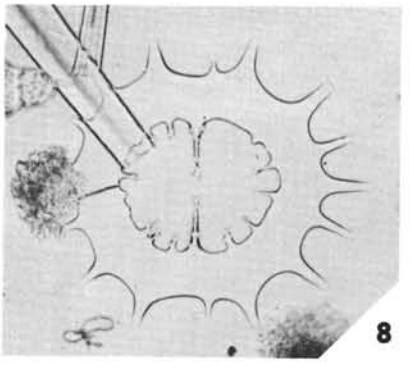
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PLATE 2

Figure 1 Phacodiscid, gen. and sp. indet. 61.0-1-CC. X 126. Slide USNM 167915; L22/0.

Figure 2 *Amphibrachium* sp. cf. *A. ornatum* Lipman 1960. 61.0-1-CC. X 206. Slide USNM 167916; H29/2.

Figure 3 *Amphibrachium* sp. 61.0-1-CC. X 206. Slide USNM 167934; X28/2.

Figure 4 Spongodiscid, gen. and sp. indet. 61.0-1-CC. X 126. Slide USNM 167935; B16/1.

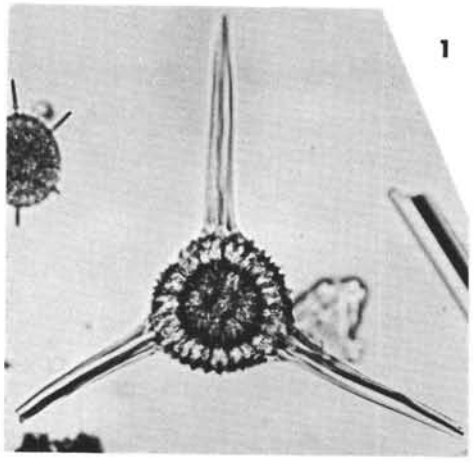
Figure 5 *Pseudoaulophacus superbus* (Squinabol). 61.0-1-CC. X 126. Slide USNM 167936; A15/0.

Figure 6 *Pseudoaulophacus floresensis* Pessagno 1963. 61.0-1-CC. X 126. Slide USNM 167937; L16/1.

Figure 7 *Pseudoaulophacus parguerаensis* Pessagno 1963. 61.0-1-CC. X 126. Slide USNM 167938; H21/4.

Figure 8 Pseudoaulophacid?, gen. and sp. indet. 61.0-1-CC. X 126. Slide USNM 167917; D27/2.

## Plate 2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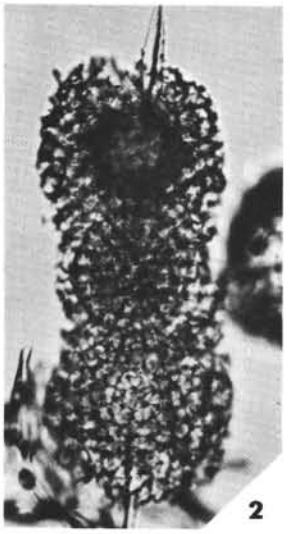
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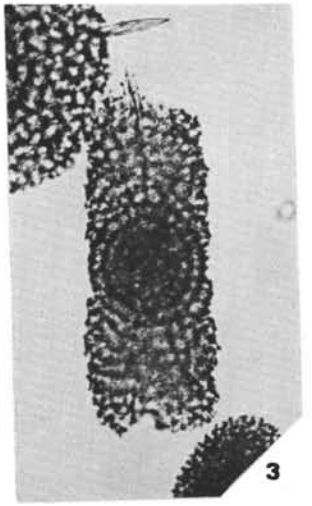
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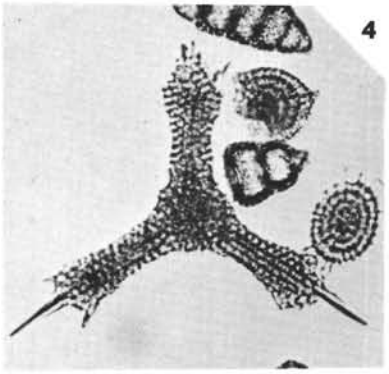
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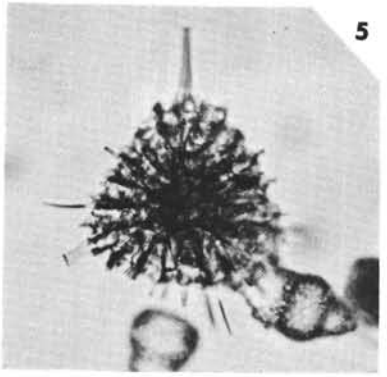
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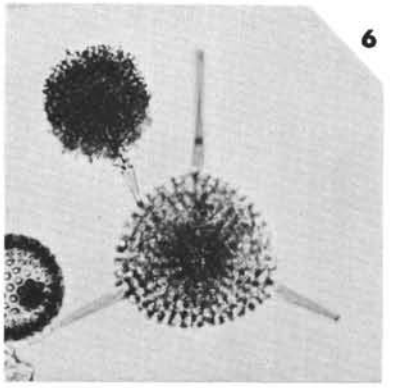
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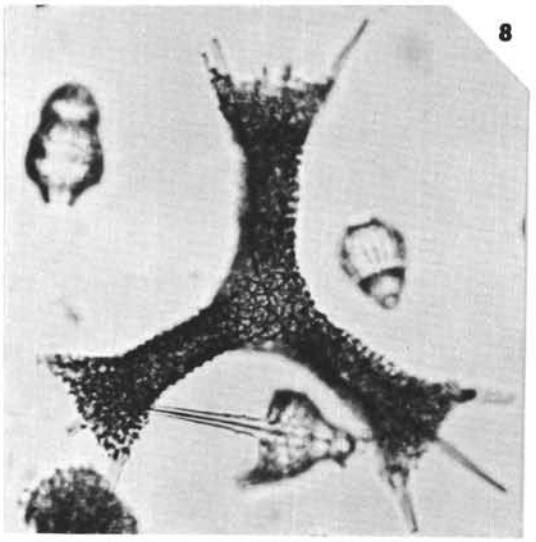
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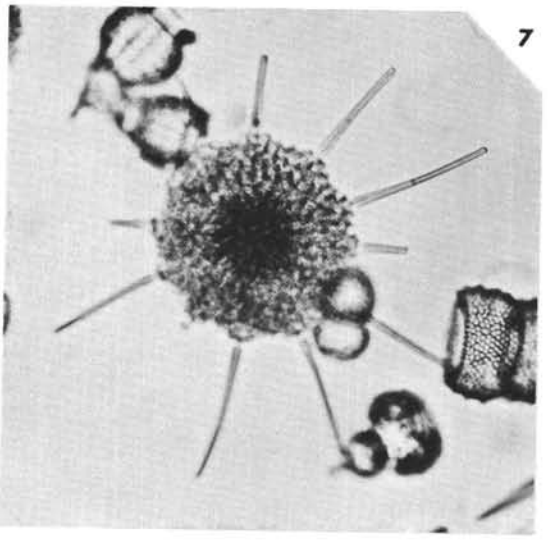
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PLATE 3

Figure 1 — Theoperid, gen. and sp. indet. 61.0-1-CC. × 206. Slide USNM 167939; O25/2.

Figure 2 — Theoperid, gen. and sp. indet. 61.0-1-CC. × 206. Slide USNM 167940; R52/3.

Figure 3 — Theoperid, gen. and sp. indet. 61.0-1-CC. × 206. Slide USNM 167941; R27/2.

Figure 4 — *Dictyomitra torquata* n. sp. 61.0-1-CC. × 206. Slide USNM 167918; N26/4; Holotype.

Figure 5 — *Dictyomitra* sp. 61.0-1-CC. × 206. Slide USNM 167942; V13/4.

Figure 6 — *Dictyomitra* sp. 61.0-1-CC. × 210. Slide USNM 167919; M54/4.

Figure 7 — *Dictyomitra* sp. 61.0-1-CC. × 210. Slide USNM 167920; B27/0.

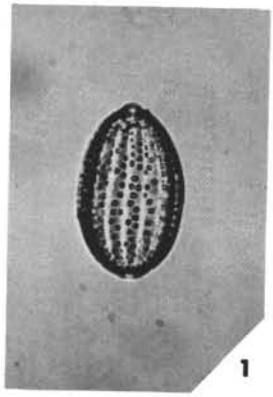
Figure 8 — *Dictyomitra andersoni* (Campbell and Clark) emend. Foreman, 1968. 61.0-1-CC. × 206. Slide USNM 167943; R16/0.

Figure 9 — *Rhopalosyringium* sp. 61.0-1-CC. × 206, left lateral view. Slide USNM 167944; A41/4.

Figure 10 — *Rhopalosyringium* sp. 61.0-1-CC. × 206, dorsal-right lateral view. Slide USNM 167921; T34/4.

Figure 11 — Theoperid, gen. and sp. indet. × 206. Slide USNM 167922; O16/0.

## Plate 3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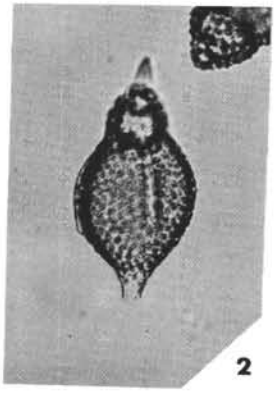
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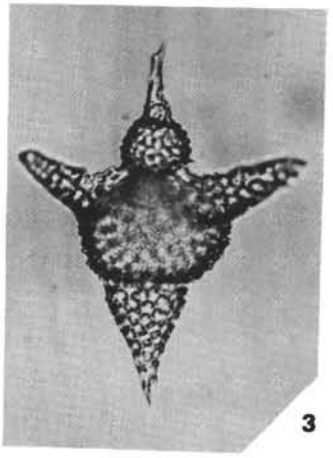
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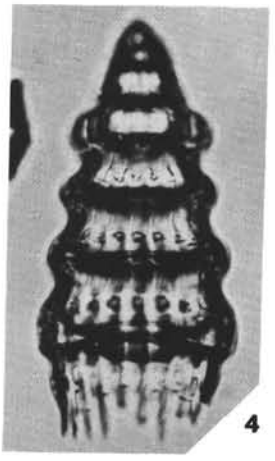
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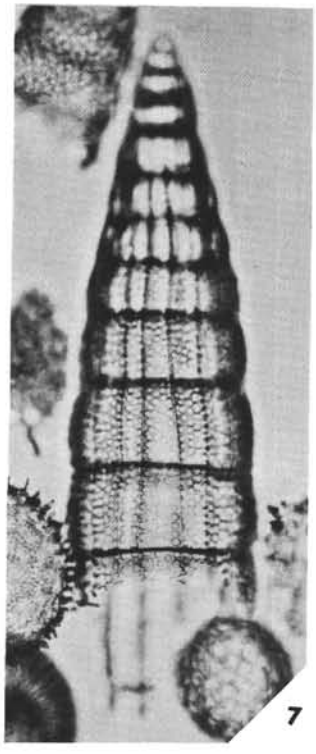
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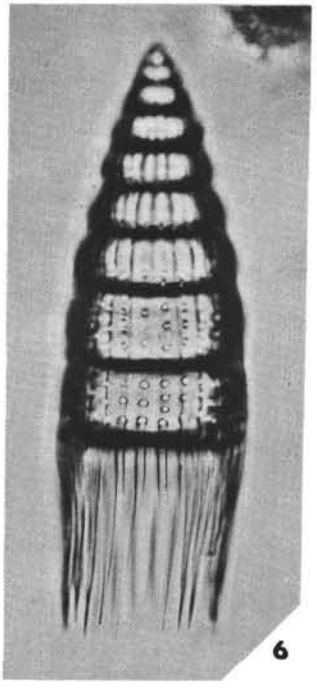
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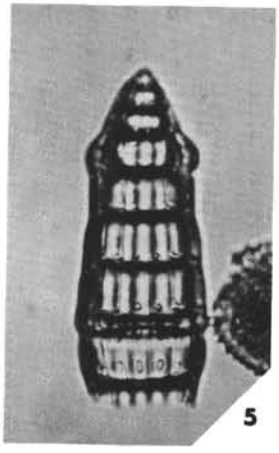
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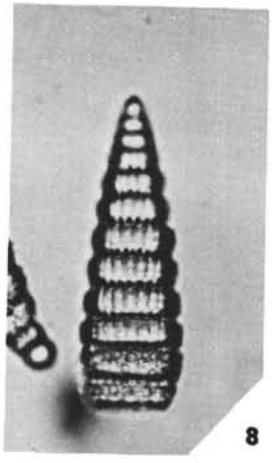
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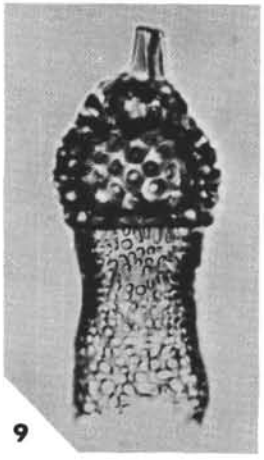
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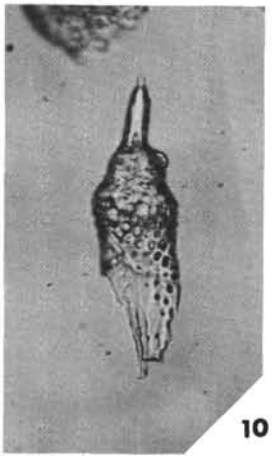
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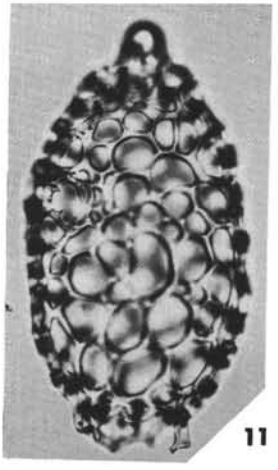
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PLATE 4

Figures 1 & 2 *Artostrobium urna* n. sp. 61.0-1-CC. X 206.

1. Left lateral view, Slide USNM 167923; V16/3; Holotype.
2. Left lateral view. Slide USNM 167945; Q27/4.

Figure 3 *Artostrobium tina* n. sp. 61.0-1-CC. X 206, left lateral view. Slide USNM 167924; L24/2; Holotype.

Figure 4 *Theocampe ascalia* n. sp. 61.0-1-CC. X 206, right lateral view. Slide USNM 167946; Q20/3; Holotype.

Figure 5 *Theocampe salillum* n. sp. 61.0-1-CC. X 206, right lateral view. Slide USNM 167925; M20/2; Holotype.

Figure 6 *Theocampe apicata* n. sp. 61.0-1-CC. X 206, dorsal view. Slide USNM 167926; Q19/0; Holotype.

Figure 7 *Microsciadiocapsa* sp. 61.0-1-CC. X 210, apical view. Slide USNM 167927; M19/0.

Figure 8 *Microsciadiocapsa* sp. 61.0-1-CC. X 206, apical view. Slide USNM 167928; Q22/1.

Figures 9 & 10 Neosciadiocapsid?, gen. and sp. indet. 61.0-1-CC. X 126.

9. Lateral view. Slide USNM 167947; O25/4.
10. Apical view. Slide USNM 167948; D40/0.

Figures 11 & 12 Neosciadiocapsid?, gen. and sp. indet. 61.0-1-CC. X 206.

11. Dorsal view. Slide USNM 167929; P19/3.
12. Right lateral view. Slide USNM 167930; Q51/0.

Figure 13 Neosciadiocapsid?, gen. and sp. indet. 61.0-1-CC. X 126. Slide USNM 167949; F31/0.

## Plate 4


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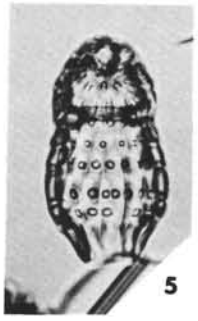
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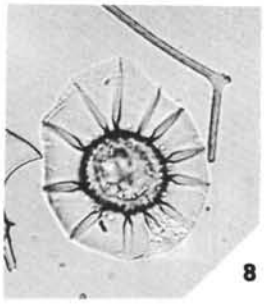
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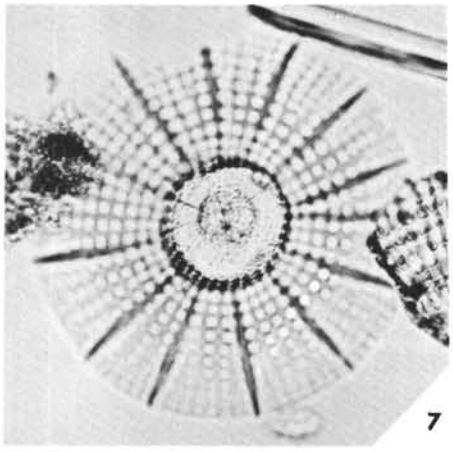
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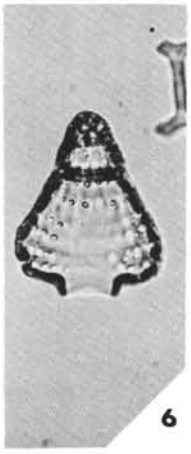
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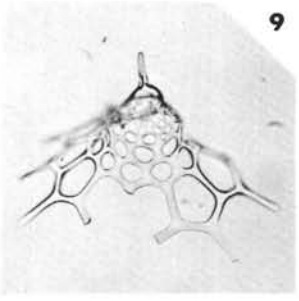
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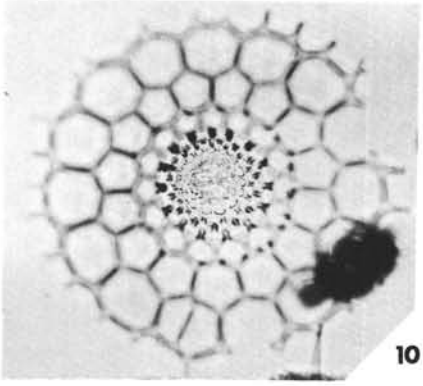
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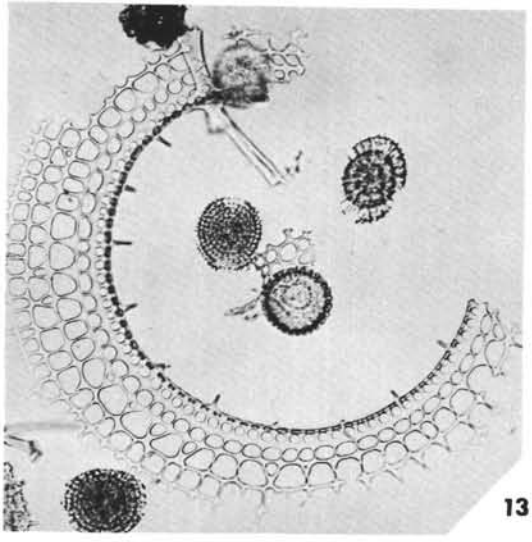
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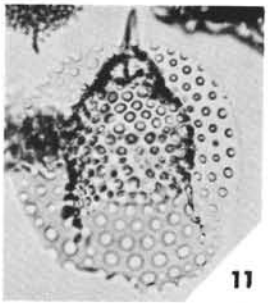
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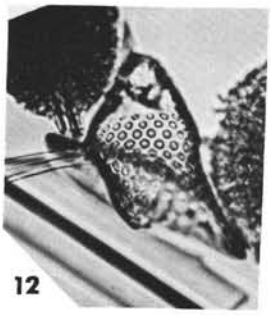
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## PLATE 5

(All figures X 206)

Figure 1 — Actinommid, gen. and sp. indet. 66.0-9-top. Slide USNM 167950; V29/0.

Figure 2 — Spongodiscid, gen. and sp. indet. 66.0-9-top. Slide USNM 167951; W25/2.

Figure 3 — Spongodiscid, gen. and sp. indet. 66.0-9-top. Slide USNM 167960; J15/2.

Figure 4 — Spongodiscid, gen. and sp. indet. 66.0-9-top. Slide USNM 167952; C21/0.

Figure 5 — Spongodiscid, gen. and sp. indet. 66.0-9-top. Slide USNM 167957; N13/2.

Figure 6 — Spongodiscid, gen. and sp. indet. 66.0-9-top. Slide USNM 167954; F47/3.

Figure 7 — Spongodiscid, gen. and sp. indet. 66.0-9-top. Slide USNM 167953; W47/1.

Figure 8 — *Theocapsomma* sp. 66.0-9-top. Slide USNM 167954; M45/1.

Figure 9 — *Theocapsomma* sp. 66.0-9-top. Slide USNM 167955; Z16/0.

Figure 10 — *Theocapsomma* sp. 66.0-9-top. Slide USNM 167961; E24/0.

Figure 11 — *Theocapsomma* sp. cf. *Tricolocapsa pachyderma* Tan Sin Hok. 66.0-9-top. Slide USNM 167962; H11/1.

Figure 12 — Theoperid, gen. and sp. indet. 66.0-9-top. Slide USNM 167963; T23/0.

Figure 13 — Theoperid, gen. and sp. indet. 66.0-9-top. Slide USNM 167964; Q20/2.

Figure 14 — *Dictyomitra* sp. cf. *Eucyrtidium brouweri* Tan Sin Hok. 66.0-9-top. Slide USNM 167956; W39/0.

Figure 15 — *Dictyomitra* sp. cf. *Eucyrtidium brouweri* Tan Sin Hok. 66.0-9-top. Slide USNM 167958; J42/2.

Figure 16 — *Dictyomitra* sp. cf. *D. multicostata* Zittel. 66.0-9-top. Slide USNM 167959; T26/2.

Figure 17 — Amphipyndacid, gen. and sp. indet. 66.0-9-3, 145-147 cm. Slide USNM 167966; C16/2.

Figure 18 — *Rhopalosyringium?* sp. 66.0-9-3, 145-147 cm. Slide USNM 167967; K34/0.

## Plate 5


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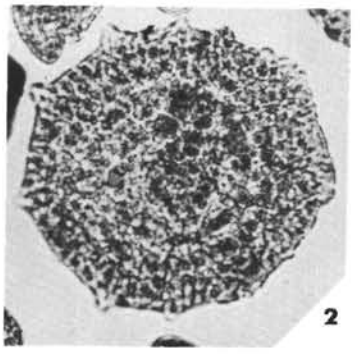
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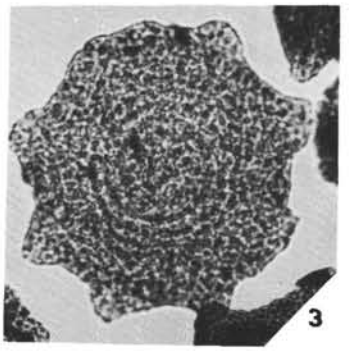
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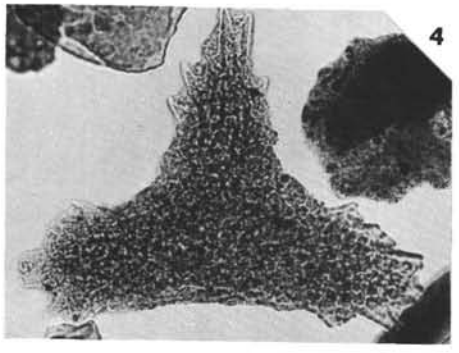
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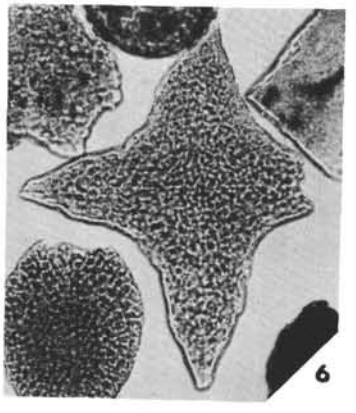
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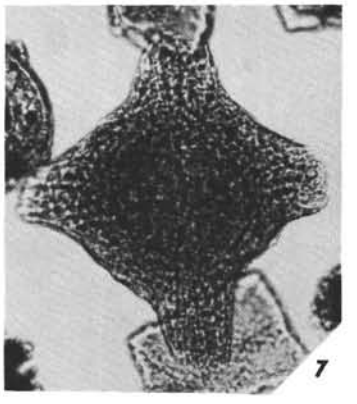
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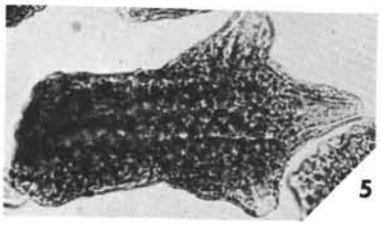
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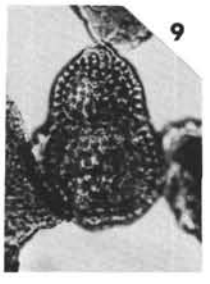
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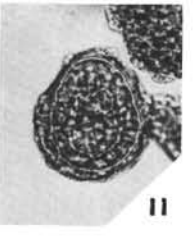
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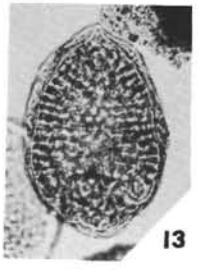
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