34. SILICEOUS MICROFOSSILS

34.1 CRETACEOUS AND QUATERNARY RADIOLARIA IN DEEP SEA SEDIMENTS FROM THE NORTHWEST ATLANTIC OCEAN AND MEDITERRANEAN SEA

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INTRODUCTION

Radiolaria, and siliceous microfossils generally (see the reports on silicoflagellates, ebridians, diatoms and phytolitharia) were encountered rather rarely in the cores recovered during Leg 13 of the Deep Sea Drilling Project. The presence of radiolarians in a more or less significant quantity was recorded in only a few cores from a few of the fifteen drilling sites. Samples reported on here are from the following five sites:

Site 120 – Gorringe Bank, north slope; 36° 41.39′N, 11° 25.94′W; water depth 1711 meters.

Site 121 – Alboran Sea, 36° 09.65′N. 04° 22.43′W; water depth 1163 meters.

Site 127 – Hellenic Trench, northeastern margin; 35° 43.90′N, 22° 29.81′E; water depth 4654 meters.

Site 128 – Hellenic Trench, southwestern margin; 35° 42.58′N, 22° 28.10′E; water depth 4640 meters.

Site 129 – Strabo Trench, northern margin; 34° 20.96′N, 27° 04.92′E; water depth 3048 meters.

At Site 120, located in the Atlantic Ocean, Radiolaria recovered are of Albian and lower Aptian age. At the other four sites, all located in the Mediterranean Sea, Radiolaria are of Quaternary age. A few fragmentary Miocene specimens encountered at Site 124 (associated with other siliceous microfossils) are not taken into account in this report.

RADIOLARIA AT LEG 13 SITES

Cretaceous Radiolaria

Site 120

Cretaceous radiolarians were found only at this site, the single Atlantic site of Leg 13. They are restricted to Cores 2 to 4, and are represented by two different assemblages of different age and mode of preservation: (a) an Albian, abundant and diversified assemblage, with the radiolarian shells pyritized; and (b) a Lower Aptian "assemblage", consisting only of rare specimens of *Cenosphaera minuta* preserved as silica.

These data are schematically represented below:

Sample Investigated	Age	Abundance	Chemical Composition of Shell
120-2-1, 71-72 cm	middle Albian	abundant	pyrite
120-2-1, 84-87 cm	middle Albian	abundant	pyrite
120-2-1, 114-116 cm	middle Albian	abundant	pyrite
120-2-1, 137-140 cm	middle Albian	few	pyrite
120-2 CC	middle Albian	abundant	pyrite
120-3 CC	lower Albian	common	pyrite
120-4-1, 76-78 cm	lower Aptian	rare (1 species)	silica

Albian Radiolaria. Although pyritized, the Albian radiolarians are well preserved. The replacement of silica by pyrite has preserved the finest details of the ornamentation (see Plates 1-4) and all other distinctive morphological features so that their identification is quite possible by means of the scanning electron microscope.

The Albian assemblage is dominated by large numbers of spherical forms with a smooth, rough, polygonal or tuberculate surface. This is followed by conical tower-shaped forms, frequently with costate or tuberculate surface. A superficial examination thus gives a false impression of the systematic composition of the assemblage. It would appear to be particularly formed of spumellarians, and subordinately of nassellarians. However, a thorough examination proves that most spherical forms are cryptothoracic tricyrtids (williriedellids).

The frequency of the spumellarians is less than 10 per cent. Among them the following taxa have been recognized:

Xiphosphaera umbilicata (Plate 1, Figure 1) is one of the most frequent spumellarian species.

Alievium is rarely represented by specimens. It is fairly similar to *A. superbus* (Squin.).

Crucella sp., is a very rare species. Superficially it is similar to *C. cachensis* (Pessagno, 1971, p. 53, Plate 9, Figures 1-3), in that it has a rather elevated central area with well developed lacuna, and four axially elliptical rays terminated in a spine.

In addition to these, there is a rare form, whose shell consists of a small, thick-walled sphere with a few large pores, and two or four spines. The specimens with two spines are roughly similar to *Stylosphaera squinaboli* (Tan Sin Hok, 1927, p.35, Plate 6, Figure 9).

Characteristically, the nassellarians are dominant in the Albian radiolarian assemblage. Most frequent are the cryptothoracic tricyrtids and multi-segmented forms. Species belonging to cryptocephalic dicyrtids or tricyrtids seem to be missing, although some forms with the cephalis almost completely encased in a large globular "abdomen" might be dicyrtids of the *Gongylothorax* type. The generic assignment of such forms may be established only by the investigation of their large cavity in order to see whether a completely encased thorax is present.

With regard to the high frequency of the williriedellids and multi-segmented nassellarians, this assemblage is similar to the Turonian or early Senonian assemblage described by Tan Sin Hok (1927), and the upper Cenomanian assemblage from Podu Dimbovitei (Romania), from which several new species and genera have recently been described (Dumitrica, 1970). As the age of these three assemblages is certainly different, their similarity is probably the result of a paleoenvironmental similarity.

A few species of williriedellids are illustrated and described in this report (Plates 1-4). Their number is much

greater, but it is hoped that the forms illustrated are sufficient to demonstrate the morphological and systematic diversity of these types. Some species seem to be related to those from the upper Cenomanian and Turonian deposits cited above, but most are new.

What was of most interest to me regarding the Albian forms was to rediscover by means of the scanning electron microscope the taxonomic characters previously investigated with the optical microscope, and taken into consideration when determining the generic subdivisions of this group. The characteristics included such as: the degree of encasement of the cephalo-thorax, the structure of the thorax, the presence or absence and structure of the sutural pore, and aperture. Unfortunately, limited time with the scanning electron microscope did not permit me to examine accurately all of these elements, especially the internal ones. At any rate, the two previously described structures of the sutural pore (Dumitrica, 1970) have also been recorded in the Albian williriedellids (Plate 1, Figures 3-4; Plate 2, Figure 3; Plate 3, Figures 3-6; Plate 4, Figures 1-2). ?*Williriedellum gilkeyi* (Plate 4, Figure 2) must be particularly mentioned because of its very distinct latticed plate connecting internally the distal rim of the sutural pore to the encased thorax. Beautiful images of the constricted aperture have been obtained as well (Plate 1, Figure 6; Plate 2, Figure 6; Plate 3, Figure 2). The specification of the systematic value of each enumerated element needs further detailed investigations, because the cryptothoracic nassellarians are not only the most interesting and characteristic Mesozoic radiolarians, but are also among the most difficult to study because of their encased chambers and superficial similarity to some spumellarians and cryptocephalic dicyrtids.

In the time available for this report, the following species of williriedellids have been investigated: ?*Williriedellum gilkeyi* n. sp., ?*Hemicryptocapsa* cf. *nodosa* (Tan Sin Hok), *Holocryptocapsa* cf. *cryptodon* (Dumitrica), ?*Holocryptocapsa* sp., *Cryptamphorella* cf. *conara* (Foreman). The doubtful generic of specific assignment of these taxa is due to the impossibility of investigating all morphological elements previously taken into account in systematics.

Among the multi-segmented nasselarians, most specimens belong to *Dictyomitra*. The term is herein applied to all open, costate, multisegmented (more than four or five segments) forms, without taking into consideration their shape (slender or broad conical, spindle-shaped, with or without expanded segments) or the number of pores on an intercostal row. The species of this genus were not examined in detail. At any rate, the Albian forms are either spindle-shaped or conical, and almost always have the last segment constricted. Most specimens show no sutural constrictions (Plate 4, Figure 6), so the number of chambers may be established only in longitudinal sections. The identification of the species is difficult because of their pronounced polymorphism. Morphologically they show a similarity with the specimens illustrated by Pessagno (1969, Plate 5, Figures C, D; Plate 6, Figure D) from the Albian of the Blake-Bahama Basin, or with some of Tan Sin Hok's Turonian species (Tan Sin Hok, 1927).

Apart from the costate forms, there are numerous specimens of multi-segmented nassellarians with tuberculate surface (Plate 4, Figures 3, 5). Similar forms of this type have been related by Rüst (1898), Squinabol (1903, 1904), Aliev (1965) and others to *Lithostrobus, Dictyomitra, Lithocampe* or other genera. It seems more convenient to unite them in an independent genus having as characteristics a simple cephalis and a multi-segmented conical body with tuberculate surface. Such forms are rather frequent in the upper Jurassic and Cretaceous (lower Cretaceous especially). It is interesting that this type of ornamentation is fairly often found in many spumellarians and nassellarians of Jurassic and Cretaceous age, and is much rarer in the Tertiary ones.

Other multi-segmented nassellarians fairly frequent in the Albian cores at Site 120, are of the type illustrated in Plate 4, Figures 4 and 7. They appear to be closely related to *Dictyomitra* but were not assigned to that genus in this report.

The list of all types of nassellarians at this site is too long to be described in this report. Most appear to be new, as are in fact almost all the types discussed above.

Quaternary Radiolaria

Site 121 (Table 1)

At this site Radiolaria are rare to few, and are well preserved. Their occurrence was recorded only in cores 1 and 3. The most frequent species are *Actinomma mediterranensis, Thecosphaera radians, Rhizosphaera* spp. with forms more or less similar to *Diploplegma*(?)*antarctica* (Petrushevskaya, 1967), and *Hexacontium* spp. Nassellarians are rare.

Site 127 (Table 2)

The cores recovered at this site and at Site 128, both located in the Hellenic Trench, provided most of the radiolarians described in this report. Their occurrence is restricted in both sites to some layers of sapropelitic oozes or sapropelitic "diatomites". Radiolarians, and particularly sponge spicules, are often present in the calcareous oozes as well, but their frequency in such sediments is so low (1-2 specimens in one sample) that for practical purposes they cannot be taken into account. On the other hand, the layers with a very high sapropel content are poor in siliceous skeletons.

At Site 127 the occurrence of radiolarians was recorded only in Core 5, Section 6, and in Core 14, Sections 2-5. In Core 5 *Clathrocycloma davisiana* is one of the most frequent species. In Core 14 the most common species are *Actinosphaera* (?) *haackei, Echinomma antarctica, Rhizosphaera* spp., *Rhopalastrum* spp., and *Carpocanistrum* spp. Diatoms and sponge spicules occur in a rather high frequency at some levels of these two cores. In addition, the phaeodarian species *Porospathis* sp., *Cadium marinum* and *C. melo* occur in Core 14.

Site 128 (Table 3)

The cores recovered at this site contain most of the Quaternary radiolarians recorded during this Leg. Their frequency varies from very rare to common, and their preservation is good. The radiolarians were encountered

only in Cores 2, 3, 8 and 11. Although this site is rather close to Site 127, the radiolarian assemblages are rather distinct, and thus difficult to correlate. This fact might be explained by the large intervals at which the cores were taken at each site. At Site 128 the assemblages are very different from core to core, indicating that a considerable number of changes occurred in the radiolarian faunas of this part of the Mediterranean Sea during the Quaternary. Higher frequencies of some species enable the following assemblages to be recognized:

1) Assemblage with *Tetrapyle octacantha,* characteristic for Cores 2 and 3 (Sections 4 and 5 only). A very distinctive species – *Trigonastrum regulare* – occurs only in this section, between 80 and 100 cm.

2) Assemblage with *Pseudocubus* cf. *vema* and *Clathrocycloma davisiana*, characteristic of Section 6, Core 3. Both species occur at some lower levels, too, but in very small frequencies.

3) Assemblage with *Actinomma* spp. (including *A. mediterranensis*), *Thecosphaera* spp. (including *T. radians*), *Actinosphaera* (?) *haackei,* and *Carpocanistrum* spp., encountered in Cores 8, 10 and 11.

GENERAL ASPECTS OF THE QUATERNARY RADIOLARIAN FAUNAS OF THE MEDITERRANEAN SEA

Although few, the cores bearing radiolarians recovered in Leg 13 are of considerable value. They contain data concerning the Quaternary radiolarian faunas of the Mediterranean Sea, including their changes as effected by ecological and paleoclimatical conditions.

Unlike the calcareous microfossils which occur within the whole Quaternary sequence, the occurrence of the radiolarians, as well as other siliceous microfossils (silicoflagellates, dinoflagellates – *Actiniscus,* ebridians, diatoms, sponge spicules), is quite sporadic. They are absent in all Quaternary sediments cored in the Western Mediterranean, except for the Alboran Basin, and are rather rare in the Eastern Mediterranean. In the latter, their occurrence is particularly coincident with sapropelitic layers, which seem to represent periods of high productivity.

After taking into account the most characteristic species, three main assemblages have been recognized in the Mediterranean Sea. From the youngest to the oldest they are as follows:

1) Assemblage with *Tetrapyle octacantha*

2) Assemblage with *Clathrocycloma davisiana* + *Pseudocubus* cf. *vema*

3) Assemblage with *Actinomma* spp., *Thecosphaera* spp., *Carpocanistrum* spp.

It is not yet clear whether these are dependent upon paleoclimatical conditions. The first would correspond to Recent or sub-Recent conditions. The *C. davisiana* and *P.* cf. *vema* assemblage suggests cool conditions.

According to this zonation the radiolarian cores are distributed as follows:

Assemblage	Site 121	Site 127	Site 128	Site 129 B
Assemblage with *Tetrapyle octacantha*	–	–	Cores 2 and 3 (Section 4 and 5)	Sample 3 CC
Assemblage with *Clathrocycloma davisiana,* + *Pseudocubus* cf. *vema*	–	Core 5	Core 3, Section 6	–
Assemblage with *Actinomma* spp., *Thecosphaera* spp. *Carpocanistrum* spp., etc.	Core 3	Core 14	Cores 8, 10, 11	–

Site 129B

Radiolarians were encountered only in Sample 3 CC which was taken from the top of the sediments. In addition to radiolarians, it contains foraminifera, pteropods and terrigenous material. Radiolarians are few and their preservation is moderate, most specimens showing partial dissolution. The assemblage consists of the following:

1) Frequent actinommiids including large skeletons probably belonging to *Rhizosphaera* (with spongy medullary shell and 1 to 3 cortical shells), *Hexastylus* sp., *Cenosphaera* sp., the last two taxa being probably actinommiids the inner shells of which have been dissolved

2) Few *Ommatartus tetrathalamus*

3) Rare *Heliodiscus asteriscus*

4) Frequent *Tetrapyle octacantha*

5) Rare spongodiscids represented by *Amphirhopalum wirchowii, Rhopalastrum muellerii*

6) Acanthodesmiids represented by rare *Tholospyris acuminata*, few *Acanthodesmia vinculata* and ?*Lithocircus annularis*

7) Other rare species such as *Theoconus carinatus, Lipmanella tribranchiata, Pterocanium* sp.

SYSTEMATICS

Order POLYCYSTINA Ehrenberg emend. Riedel

Suborder SPUMELLARIA Ehrenberg

Family COLLOSPHAERIDAE Müller

Collosphaerids are rather sparse in the Quaternary Mediterranean sediments recovered in Leg 13. The following four taxa are the only representatives of this family.

Genus COLLOSPHAERA Müller

Collosphaera huxleyi Müller
(Plate 18, Figure 4)

Collosphaera huxleyi Müller, Haeckel, 1862, p. 534, Plate 34, Figures 1 to 11; Popofsky, 1917, p. 241, test-figures 2-4; Plate 13, Figures 1-9; Strelkov and Reschetnjak, 1962, p. 127, 135, Figure 9.

Only one specimen, having a thin-walled shell perforated by numerous pores, irregular in size, shape and arrangement, was found in the Sample 128-3-5, 20-23 cm.

Collosphaera cf. macropora Popofsky
(Plate 18, Figures 5 and 6)

Collosphaera macropora Popofsky, 1917, p. 247, text-figures 5-6; Plate 14, Figures 2a-c.

Shell is spherical with 25 to 30 large irregular pores. Since the specimens of this type are extremely rare, there is a doubt that the two forms illustrated are conspecific. The specimen with broad intervening bars is rather similar to *c. macropora*, but differs from it in having many more pores on a hemisphere.

Dimensions: Diameter of shell is 120 to 125μ.

Genus POLYSOLENIA Ehrenberg, emend. Nigrini

Polysolenia spinosa (Haeckel)
(Plate 8, Figure 2)

Collosphaera spinosa Haeckel, 1862, p. 536, Plate 34, Figures 12 and 13.
Polysolena spinosa Nigrini, 1967, p. 14, Plate 1, Figure 1.

Species fairly rare in the Quaternary Mediterranean sediments, particularly recorded in 128-11 CC.

Genus SIPHONOSPHAERA Müller

Siphonosphaera polysiphonia Haeckel
(Plate 18, Figure 3)

Siphonosphaera polysiphonia Haeckel, 1887, p. 106; Nigrini, 1967, p. 18, Plate 1, Figures 4a and 4b.

Shell conforming well to description and illustration given by Nigrini. Sparse specimens have been found only in 128-11 CC.

Family ACTINOMMIDAE Haeckel, emend. Riedel

Genus CENOSPHAERA Ehrenberg

Cenosphaera minuta Pantanelli
(Plate 18, Figure 1)

Cenosphaera minuta Pantanelli, Rüst, 1888, Plate 22, Figure 1.

Description: The shell is smooth, thin-walled, spherical. Pores are circular, similar and about six on a radius. They are regularly disposed, with narrow intervening bars, about as narrow as the thickness of the wall.

Diameter: Diameter is 75 to 95μ. Measurements are based on fifteen specimens.

Remarks: Sparse specimens of this species were encountered in the lower Aptian at 120-4-1, 76-80cm. They resemble *C. minuta* illustrated by Rüst from the Albian coprolites of Zilli both in diameter (90μ after Rüst), and in number of pores on a radius (seven, after the same author).

Genus XIPHOSPHAERA Haeckel

Xiphosphaera umbilicata Rüst
(Plate 1, Figure 1)

Xiphosphaera umbilicata Rüst, 1898, p. 7, Plate 1, Figure 9.

Remarks: This species, with a tuberculate spherical shell and two polar spines, is rather frequent in 120-2-1, 71-116cm. Although of Albian age, its members are fairly similar in both shape and size to the specimen illustrated by Rüst from the upper Jurassic or lower Cretaceous Kieselkalk of Cittiglio (Italy). *X. umbilicata* would appear therefore to to be a long ranged-species.

Genus ACTINOMMA Haeckel

Actinomma mediterranensis Hollande and Enjumet
(Plate 20, Figure 3)

Actinomma mediterranensis Hollande and Enjumet, 1960, p. 110, Plate 54, Figures 2 to 4.

This is one of the most frequent species in a series of Quaternary Mediterranean samples. It was separately tabulated only for Site 121, where it is not accompanied by any other species of this genus, and where its members are certainly of the type described and illustrated by Hollande and Enjumet. For Sites 127 and 128 it was tabulated together with *Actinomma* sp., with which it mostly co-occurs.

Actinomma sp.
(Plate 5, Figures 1 to 4)

Shell is spherical, consisting of three concentric spheres, two medullary and one cortical. The inner medullary shell is small, spherical and has a small number of large polygonal pores. It is connected with the outer medullary shell by several short radial beams. The outer shell is spherical or subspherical, with equal, circular, or oval pores. The cortical sphere is widely spaced from the medullary shells, with which it is connected by about 25 three-bladed radial beams, some of which project beyond the surface of the cortical sphere. Pores are equal, circular, and hexagonally framed externally. Their structure is complicated by the usual development of six transverse thresholds arising centripetally from the wall of the pores. Apart from these outgrowths, small additional crests appear on the intervening bars, so that finally the surface of the cortical shell seems to be covered with numerous facets.

Dimensions: Diameter of the inner medullary shell is 15 to 16μ; of the outer medullary shell 35 to 37μ; and of the cortical shell 85 to 91μ.

Remarks: *Actinomma* sp. differs from *A. mediterranensis*, which is similar in size, by this superficial ornamentation, and by the greater number of radial beams connecting the outer medullary shell with the cortical one.

Genus THECOSPHAERA Haeckel

Thecosphaera radians Hollande and Enjumet
(Plate 5, Figures 5 and 6; Plate 6, Figure 3)

?*Thecosphaera paroniana* Carnevale, 1908, p. 9, Plate 1, Figure 8.
?*Thecosphaera spiralis* Carnevale, 1908, p. 9, Plate 1, Figure 9.
Thecosphaera radians Hollande and Enjumet, 1960, p. 111, Plate 53, Figure 4.

Remarks: This species is rather frequent in many Mediterranean samples. It was tabulated together with an unidentified species with which it seems to be mostly accompanied.

Genus ECHINOMMA Haeckel

Echinomma Haeckel, 1881.
Cromyechinus Haeckel, 1881.

In my opinion, the fourth thin-walled shell of *Cromyechinus* has little or no systematic value. It represents only an additional lattice shell of the mature or aged specimens of *Echinomma*. The fourth shell is comparable with the lattice-mantle of *Spongurus* (stage *Spongocore*) for example, or with many other similar cases.

Echinomma antarctica (Dreyer) ?
(Plate 20, Figure 4; Plate 21, Figure 1)

?*Prunopyle antarctica* Dreyer, 1889, p. 24, Plate 5, Figure 75.
Prunopyle antarctica Riedel, 1958, p. 225, Plate 1, Figures 7 and 8.
Cromyechinus antarctica Petrushevskaya, 1967, p. 25, Figure 13, I-IV; Figure 14, I-VII.
Cromyechinus borealis Petrushevskaya, 1967, Figure 13, VIII-IX.

Remarks: In the Mediterranean samples, *E. antarctica* (?) is a rather frequent species. The complete, four-shelled specimens are very rare.

Genus ACTINOSPHAERA Hollande and Enjumet

In default of an adequate genus, the following two species are assigned to *Actinosphaera*. Like the type species of this genus, they possess a delicate primitive microsphere with large polygonal meshes which are connected to the cortical shell by a number of thread-like radial bars. The latter do not penetrate the cortical wall to form radial spines. In adult specimens the microsphere is surrounded by a spongy or a delicate median sphere (Plate 19, Figure 9). Intermediate stages, with bi- or trifurcate radial bars (Plate 19, Figure 8), or with an incipient median shell (Plate 20, Figure 2), have been observed as well. Specimens possessing a simple microsphere are much more frequent than those with a median shell, but most frequent are the specimens lacking inner shells. In such cases sometimes there are only conical spines arising centripetally from the inner side of the cortical shell.

Actinosphaera acanthophora (Popofsky)
(Plate 20, Figures 1 and 2)

Haliomma acanthophora Popofsky, 1912, p. 101, text-figure 13.

Description: Cortical shell is spherical or slightly oval, with circular or subcircular pores irregularly arranged, separated by intervening bars with the external side roundish. Numerous short conical spines arise from the surface of the cortical shell. In some adult specimens some spines are connected with each other by thin tangential bars arising very near the surface of the cortical shell and appearing to constitute an incipient additional cortical shell. The inner skeleton is formed of a delicate microsphere with large meshes and is surrounded in some specimens by an incipient median shell or by a sponge network.

Dimensions: Diameter of the cortical shell without spines is 115 to 145μ; maximum length of spines is 15μ.

Actinosphaera (?) haackei (Dreyer)
(Plate 19, Figures 5 to 9)

?*Prunopyle haackei* Dreyer, 1889, Plate 7, Figure 26

Description: Cortical shell is ovate, commonly thick-walled, with circular or subcircular pores irregularly scattered. Surface is rough and is covered with lamellar crests irregularly ramified and free or connected with each other to form a labyrinthine system. At one or both poles the lamellar crests may develop exaggeratedly, constituting one or two opposite bunches of multilamellar spines. Three types of inner skeleton have been recorded in this species (Plate 19, Figures 6, 8, 9): (a) a simple skeleton consisting of a delicate microsphere connected to the cortical shell by a number of thread-like radial bars; (b) an intermediate skeleton (Figure 8), the radial bars of which are bi- or trifurcate, and (c) a double-shelled inner skeleton (Figure 9) where the microsphere is surrounded by a delicate median spherical shell consisting of large, irregular meshes.

Dimensions: Transverse diameter of the cortical shell is 100 to 160μ; length of the cortical shell is 115 to 170μ; and diameter of the microsphere is 15 to 20μ.

Remarks: Assignment of the Quaternary Mediterranean forms of the illustrated type to this taxon is only a provisional solution. At any rate this species, as it is here understood, possesses a high polymorphism which is expressed in terms of: size of the cortical shell, presence or absence of the polar bunches of spines, and in their number, in the thickness of the cortical wall, and others. The large shells, similar to that illustrated in Figure 9, seem generally to be much thinner-walled, and much less ovate than the small ones.

Genus HAECKELIELLA Hollande and Enjumet

Haeckeliella macrodoras (Haeckel)

Haliomma macrodoras Haeckel, 1887, p. 238, Plate 28, Figure 6.
Haeckeliella macrodoras Hollande and Enjumet, 1960, p. 119, Plate 56, Figures 1 to 6.

A single specimen was found in 128-2 above 0 section.

Haeckeliella inconstans n. sp.
(Plate 7, Figures 1 and 2; Plate 18, Figures 7 to 22)

Description: Shell is composed of two concentric lattice-spheres, a macrosphere and a cortical sphere. The macrosphere is thin-walled, 80 to 90μ in diameter, with polygonal pores irregularly arranged and separated by slender intervening bars. One or more inner wands may sometimes extend centripetally without reaching the center. Cortical shell is thick-walled. It is connected with the macrosphere by forty, fifty or more thin radial beams that extend beyond the cortical shell as stout, cylindrical, or three-bladed spines of variable length and usually with their distal ends irregularly ramified. Their length, aspect in cross section (circular or three-bladed), and type of distal ramifications while varying with specimens are similar in the same specimen. The cortical shell has quite irregular pores, in size, shape and arrangement. Pores are seldom simple, they are often complicated by centripetal ingrowths from the pore-walls, which end by dividing them into two or more secondary pores (Plate 18, Figure 9).

Holotype: Plate 7, Figures 1 and 2; Plate 18, Figure 7. Quaternary, 127-14-5, 26-29cm.

Dimensions (based on fourteen specimens): Diameter of the macrosphere is 80 to 90μ, inner diameter of the cortical shell is 115 to 130μ, and outer diameter of the cortical shell is 140 to 162μ. Length of cortical spines is 25 to 170μ and most frequently 50 to 90μ.

Remarks: This new species, the second of the genus, differs from the type species by its thick-walled cortical sphere, by length and type of ramification of the radial spines, and by lacking a tripod at their base. It was found only in 127-14-5.

Genus DRUPPATRACTUS Haeckel

Druppatractus variabilis n. sp.
Plate 6, Figure 4; Plate 20, Figures 6 and 7

Description: Skeleton consisted of two ellipsoidal shells. The inner shell is pear-shaped, with circular pores, and is connected with the cortical shell by numerous three-bladed radial spines. The cortical shell is variable with age. The young specimens, such as that illustrated in Plate 20, Figure 6, have circular, or subcircular, equal, or unequal, and hexagonally framed pores. The wall becomes thicker and thicker with age because of an exaggerated development of the lamellar hexagonal frames limiting the pores. The lateral surface of the lamellar frames is rough or thorny because of several centripetal ingrowths from the pore-walls which may unite at about ten microns from the inner side of the cortical shell to form an incomplete additional shell. The distal ends of the lamellar frames are frayed and unequally developed; they are much longer at the corners of the frames, where they tend to form three-bladed spines (Plate 6, Figure 4). In the very aged specimens, the length of these short spines overtops the additional cortical shell by 5 to 7μ.

The two polar spines are short, dissimilar, and three-bladed. They become almost indiscernible in the aged specimens, where the ellipsoidal shape of the cortical shell is less obvious.

Holotype: Plate 20, Figure 6; Quaternary, 127-14 CC

Dimensions: Length of the inner shell is 43 to 47μ; transverse diameter of the inner shell is 30 to 34μ; transverse inner diameter of the cortical shell is 60 to 68μ; longitudinal inner diameter is 65 to 70μ; transverse diameter of the additional cortical shell is 83 to 90μ, and maximum transverse diameter of the aged shells is 93 to 100μ. Measurements are based on twenty specimens.

Remarks: *D. variabillis* is absent in most samples. It becomes fairly frequent in 127-14 CC and 128-11 CC which are at the deepest levels of the Quaternary sequences drilled in the Hellenic Trough. It is closely related to *D. irregularis* (Popofsky, 1913) by its pear-shaped inner shell.

Druppatractus(?) sp.
(Plate 20, Figure 5)

Description: Shell is ellipsoidal consisting of two concentric lattice-shells with two dissimilar polar spines. The inner shell is somewhat ellipsoidal. It is rather thin-walled, perforated by equal circular pores, and is connected with the outer shell by numerous radial beams. The outer shell is ellipsoidal, thick-walled, with pores subdivided by centripetal ingrowths from the pore-walls.

Remarks: Only a few specimens of this species were found in 127-14-5, 26-29cm. As their inner shell is partly corroded, I suppose they were originally three-shelled forms, the innermost shell of which was subsequently dissolved. Superficially these specimens are similar to *Amphisphaera pluto* (Haeckel, 1887), *Xiphatractus radiosus* (Haecker, 1908), *Stylatractus neptunus* (Riedel, 1958) or to *Stylatractus* sp. (Petrushevskaya, 1957).

Genus XIPHATRACTUS Haeckel

Xiphatractus spumeus n. sp.
(Plate 20, Figure 9)

Description: The skeleton consists of three oval concentric shells disposed at about equal distance from one another and connected by numerous radial beams. The innermost shell is pear-shaped with large circular pores. The median shell is oval, with large, circular, hexagonally framed pores. The outermost shell is oval, rough, and is armed with two dissimilar, short, pyramidal, polar spines. The pores are large, circular, equal, and hexagonally framed. In the aged specimens, the pores are more or less closed by a lattice network originating in several centripetal ingrowths from the pore-walls.

Dimensions: Equatorial diameter of the innermost shell is 32 to 35μ; of the median shell it is 63 to 67μ, and of the outermost shell it is 105 to 118μ. Polar diameter of the outermost shell is 110 to 130μ.

Remarks: Although there is a striking similarity between the innermost and median shells of this species, and the young shells of *Druppatractus variabilis*, they are independent taxa. *X. spumeus* is generally rare in the Mediterranean samples, its frequency reaching several percentages (up to 7%) only at a few levels.

Genus AMPHISPHAERA Haeckel

Amphisphaera cristata Carnevale
(Plate 20, Figure 10)

Amphisphaera cristata Carnevale, 1908, p. 14, Plate 2, Figure 7.

Description: The shell is spherical and consists of three lattice-shells, two medullary closely spaced, and one cortical. This latter is connected by several radial bars that do not penetrate the cortical

shell except for the two opposite ones that form two long, strong, conical, polar spines. The outer medullary shell has small circular pores. The cortical shell is thick-walled, with equal, closely spaced and hexagonally framed circular pores.

Dimensions: Diameter of the inner medullary shell is 18 to 20μ; of the outer medullary shell it is 36 to 38μ, and of the cortical shell it is 100 to 120μ.

Remarks: This species is rather rare in the materials investigated.

Genus CROMYATRACTUS Haeckel

Cromyatractus elegans Dogel
(Plate 20, Figure 8)

?*Amphisphaera elegantula* Lucchese, 1927, p. 86, Plate 1, Figure 19.
Ellipsoxiphium palliatum Haecker, 1908, Plate 85, Figure 587.
Cromyatractus elegans Dogel, in Petrushevskaya, 1969c, p. 138, Figure 4(2).

Description: The shell is ellipsoidal and consists of three or four lattice-shells, two spherical medullary, and one or two ellipsoidal cortical. The former and the latter lie rather closely together, but a larger space separates these two groups. The outer medullary shell has circular pores and is connected to the cortical shell by two strong polar spines and four or more thin bars located approximately in the equatorial plane. The former penetrate the cortical shell forming two unequal conical polar spines, whereas the latter do not. Slender by-spines arise here and there from the outer medullary shell without reaching the cortical shell with their distal ends. The latter is ellipsoidal, thick-walled, and has circular or subcircular pores hexagonally framed by high crests. Short spines arise from each corner of the hexagons, and between them a thin-walled additional shell may lie. In the studied material this shell is either absent, or quite incomplete.

Dimensions: Diameter of the inner medullary shell is 15μ; of the outer medullary shell, 40μ, and of the equatorial diameter of the cortical shell, 130μ. Polar diameter is 145μ.

Subfamily ARTISCINAE Haeckel, emend. Riedel

Genus OMMATARTUS Haeckel, emend Riedel

Ommatartus spp.
(Plate 6, Figure 6; Plate 11, Figures 7 and 9)

At least three species belonging to this genus have been recorded in the Quaternary Mediterranean samples. Only one has been identified as *Ommatartus tetrathalamus* (Haeckel) (Plate 11, Figure 7). However, in this report all of them have been tabulated under the designation *Ommatartus* spp. They are present in almost all the radiolarian samples, but the distribution of each species shows wide variations with samples.

Family HELIASTERIDAE Hollande & Enjumet

Genus HELIASTER Hollande & Enjumet

Heliaster hexagonium Hollande & Enjumet
(Plate 19, Figures 1 to 4.)

Heliaster hexagonium Hollande and Enjumet, 1960, p. 92, Plate 39, Figures 1 to 5; Plate 41, Figures 1 to 4)
?*Coscinomma amphisiphon* Haeckel, 1887, p. 222, Plate 26, Figures 1, 1a, lb.

Description: The shell consists of two main parts, a spherical cortical shell and an inner skeleton. The cortical shell is large and has regular circular or oval pores which are hexagonally framed by a darker network. Bristle-shaped radial spines of unequal length usually arise from one corner of each hexagon. The inner skeleton is composed of thorny, delicate thread-like bars. Commonly, there are five main bars, four disposed in a cross, and the fifth one, always simple, perpendicular to them. The former originate in the corners of a very small rosette, and the latter in its center. On the site opposite the fifth bar there is a primitive shell ordinarily consisting of four arches starting at an equal distance from the main cross bars. They are simple or simply anastomosed, and constitute the origin of four or more radial bars.

Dimensions: Diameter of the shell without spines is 200 to 250μ.

Remarks: This species seems to be conspecific with *Coscinomma amphisiphon* or with other species of the same genus. Although *Coscinomma* has been described as a one-shelled genus, its shell is quite similar to the cortical shell of *Heliaster*. The structure of *H. hexagonium*, on the other hand, is of *Tetrapetalon*-type, the only difference being in the size of the four-petalled rosette. In *H. hexagonium* the latter is small, so that usually the four crossed bars appear to be connected in a point. Thus, the difference between the two genera seems of specific rather than generic level.

Family PHACODISCIDAE Haeckel

Genus HELIODISCUS Haeckel

Three species belonging to this genus, *H. asteriscus* Haeckel (Plate 7, Figure 7), *H. echiniscus* Haeckel, and *Heliodiscus* sp., occur fairly sporadically in the Quaternary Mediterranean samples. Their occurrence is separately tabulated.

Family SPONGODISCIDAE Haeckel, emend. Riedel

Genus SPONGODISCUS Ehrenberg

Spongodiscus mediterraneus Haeckel
(Plate 9, Figure 5; Plate 10, Figures 5 and 6)

Spongodiscus mediterraneus Haeckel, 1862, p. 461, Plate 12, Figures 14 and 15.

Remarks: *S. mediterraneus* is the most frequent species of this genus in the Quaternary Mediterranean samples. It is coin-shaped, with a slight central swelling, that externally shows no visible concentric structure; this latter appears only in transverse or equatorial sections. The upper and the lower sides of the shell are latticed; between them lies a thick and compact spongy network.

Besides this species, others roughly belonging to *S. resurgens* Ehr. or to *S. osculosus* (Dreyer), with well developed pylome, have been recorded in many Quaternary Mediterranean samples. All are simply mentioned here and were tabulated under the name *Spongodiscus spp.*

Genus SPONGASTER Ehrenberg

Spongaster tetras Ehrenberg

Spongaster tetras Ehrenberg, 1872, Plate 6, Figure 8
Spongaster tetras tetras Nigrini, 1967, p. 41, Plate 5, Figures 1a and 1b:
Spongaster tetras irregularis Nigrini, 1967, p. 43, Plate 5, Figure 2.

Remarks: In the Mediterranean samples, both subspecies distinguished by Nigrini have been recorded. Since they were always found together in one and the same sample, and since between them there are gradual passages, the two subspecies are considered here as extreme forms within the natural range of variation of *Spongaster tetras*. The species, though generally infrequent, is present in many Mediterranean samples.

Genus SPONGURUS Haeckel

Spongurus Haeckel, 1862, p. 465.
Spongocore Haeckel, 1887, p. 345.
Type species. Spongurus cylindricus Haeckel

The genus *Spongocore* was erected by Haeckel for the *Spongurus* with an outer lattice-mantle. As this skeletal element does not seem to have a systematic value, the two genera are herein synonymized.

Spongurus cylindricus Haeckel,
(Plate 11, Figure 2; Plate 18, Figure 23)

Spongurus cylindricus Haeckel, 1862, p. 465, Plate 27, Figure 1.
Spongocore puella Haeckel, 1887, p. 347, Plate 48, Figure 6.
Spongurus tricolus Popofsky, 1912, p. 115, Plate 4, Figure 4.
?*Spongocore (Spongocorisca) puer* Campbell & Clark, 1944, p. 22, Plate 3, Figures 7 to 9.

Remarks: Detailed investigation of the skeleton of this species proved that it is not composed of a solid spongy network, as had been stated by Haeckel, but that its structure is more complicated. The skeleton consists of two opposite conical spongy arms arising from a central body composed of a few concentric shells, sometimes much reduced. Except at their distal ends, the arms are surrounded by a spongy patagium that gives the median part of the shell that spindle-shaped outline. The lattice mantle, when it exists, surrounds only the spongy patagium and is connected to the latter by numerous radial beams that do not extend beyond the surface of the mantle.

There is a difference between the structure of the spongy skeleton of the two opposite arms and that of the patagium. The arms are made of a more organized and more compact network and consequently are darker in the microscopic field. Apart from this structure, one of the arms is axially pierced by a distinct pylome.

Dimensions: Length of the shell is 200 to 280μ.

Genus RHOPALASTRUM Ehrenberg

Rhopalastrum Ehrenberg 1847 (type species *R. lagenosum* Ehr.).
Euchitonia Ehrenberg 1860 (type species *E. muelleri* Haeckel).
Rhopalodictyum Ehrenberg 1860 (type species *R. abyssorum* Ehr.).
Dictyocoryne Ehrenberg 1860 (type species *D. profunda* Ehr.).

Rhopalastrum abyssorum (Ehrenberg)
(Plate 11, Figure 4)

Rhopalodictyum abyssorum Ehrenberg, 1872, Plate 8, Figure 17; Ling & Anikouchine, 1967, p. 1490, Plate 191, Figure 7; Plate 192, Figure 7.
Dictyocoryne profunda Ling & Anikouchine, 1967, p. 1489. Plate 191, Figure 6; Plate 192, Figure 6.

Remarks: *R. abyssorum* is present in many Quaternary Mediterranean samples, and was tabulated together with other species of this genus under the name *Rhopalastrum* spp.

Genus AMPHIRHOPALUM Haeckel, emend. Nigrini

Amphirhopalum wirchowii (Haeckel)
(Plate 9, Figures 2 and 4; Plate 11, Figure 6; Plate 21, Figures 2 to 13)

Euchitonia wirchowii Haeckel, 1862, p. 503, Plate 30, Figures 1 to 4.

Description: The shell is bilaterally symmetrical, consisting of two paired arms and an opposite odd one which is a little longer. The angle between the paired arms is smaller than the one between them and the odd arm. Arms are elliptical in cross section, and arise from a central disc usually composed of two inner spherical shells and two outer annular ones. All are connected by numerous discontinuous radial beams. The upper and the lower calottes of the outer spherical shell are generally poreless and smooth (Plate 9, Figure 2), whereas the annular shells are porous.

Initially from the central disc arise two opposite arms, one corresponding to the odd arm and the other to the proximal part of the paired arms. The latter forks very soon giving rise to the paired arms. Their common, unforked part is, as a rule, composed of only a chamber; most frequently the fifth one. Arms are usually formed from four to six arcuate chambers which gradually expand distally. In some specimens, the distal ends of one or more arms may taper or become spongy, or even fork. This last case was noticed only in the odd arm of a specimen. A patagium may be sometimes present between the three arms. Finally, the whole shell may be enveloped in a thin-walled lattice-mantle.

Remarks: This species exhibits a wide variability (see Plate 21, Figures 2 to 13). Among its presumed members, those with low and numerous chambers (Plate 21, Figures 9 to 13) show a striking similarity to *Amphirhopalum ypsilon* illustrated by Nigrini (1971, p. 447, Figures 7b and 7c) from the lower part of the core SDSE-62.

Genus TRIGONASTRUM Haeckel

Trigonastrum regulare Haeckel
(Plate 10, Figures 1 to 4; Plate 11, Figures 1, 3, 5 and 8)

Trigonastrum regulare Haeckel, 1887, p. 539, Plate 43, Figure 16.

Description: The shell is bilaterally symmetrical, with three equal arms arising from a central structure made up of four to five concentric shells. Mostly, an odd arm and two paired ones may be distinguished, the space between the latter being rather narrow in comparison with the space between them and the odd arm. Arms are chambered, except for their distal ends which are spongy, they increase rapidly in breadth and are commonly forked at the fourth, fifth or sixth chamber. In some regular specimens, the arms are simply forked (Plate 11, Figures 5 and 8). In other cases, some or all branches fork at their turn.

The height of the chambers, measured along an arm, is quite variable. It ranges from higher, widely spaced (Plate 11, Figure 3) to short, densely disposed, almost spongy chambers (Plate 11, Figure 8).

A patagium was noted in almost all specimens investigated. It is rather thick, particularly in the median and distal part, and sometimes forms compact, globular or axially elongate structures (Plate 11, Figure 8). In the close vicinity of the arms, and especially of the central annular structure of the shell, the patagium is much rarefied.

Dimensions: Length of the arms measured from the center of the shell is 117 to 146μ.

Remarks: The similarity between the Mediterranean members of this species and the specimen illustrated by Haeckel is rather imperfect, in that the only consistent feature is that all have forked arms. The former differ in having a much wider angle between the branches of the arms (60-130, more frequent 75-90°). The species occurs only in 128-3-6, 80-100 cm.

Genus PORODISCUS Haeckel

Porodiscus spp.
(Plate 8, Figures 1 to 6; Plate 9, Figure 6)

Remarks: Several species of this genus have been recorded in the Mediterranean samples, but none were identified. All are designated in the tabulations under the name *Porodiscus* spp.

Suborder NASSELLARIA Ehrenberg

Family PLAGONIIDAE Haeckel

Genus PLAGIACANTHA Claparède

Plagiacantha arachnoides Claparède
(Plate 22, Figures 2 and 4)

Plagiacantha arachnoides Claparède, 1858, p. 462, Plate 22, Figures 8 and 9; Haeckel, 1887, p. 910; Joergensen, 1899, p. 72; Schroeder, 1914, p. 78, Figures 18 and 19.
Plagonidium rectum Cachon & Cachon, 1969, p. 244, Figure 5.

Description: The skeleton consists of the following five elements: median bar, dorsal, apical and primary lateral spines. The median bar is short and thick. The dorsal spine is three-bladed, usually simple, short, and with thorny edges. The apical and primary lateral spines are straight, three-bladed, equal and widely divergent. At about 10μ distance from the median bar they bear a verticil composed of three straight, divergent, three-bladed branches. The external ones are generally much shorter than the lateral ones which are about as long as the axial branch of each main spine. Usually the lateral branch of a spine is parallel to the adjoining lateral branch of the neighboring spine; each couple being sometimes connected by one or more parallel traverses.

Dimensions: Length of apical and lateral spines is up to 95μ.

Remakrs: *P. arachnoides* was found in very few samples. There were, however, more than twenty specimens examined from 128-3-6, 80 cm.

Plagiacantha (?) panarium n. sp.
(Plate 22, Figures 1, 3 and 5)

Description: Primary skeleton is of *P. arachnoides* type, with median bar, apical, dorsal and primary lateral spines. Dorsal spine is short, simple, or with a very small verticil. Apical and primary lateral spines are equally developed, with a verticil of two or three long, three-bladed spines; some of them extend obliquely upward, while others are laterally directed. An irregular lattice-network stretches between the apical spine, with its two lateral branches, and the upwardly directed branches of the lateral spines. This results in an inverted pyramidal shell with irregular wide meshes. Apart from this network, the branches of a spine are connected with the adjoining branches of the other two spines by a short arch.

Holotype: Plate 22, Figures 1 and 3. Quaternary, 128-3-6, 80 cm.

Dimensions: Height of skeleton is 80 to 100μ and length of spines is 70 to 80μ.

Remarks: *P.* (?) *panarium* differs from *P. arachnoides* by the presence of the lattice-network and arches connecting the lateral branches of the main spines. No transitional form between the two species was found. Species was recorded only in 128-3-6, 80 cm.

Genus PLECTACANTHA Joergensen

Plectacantha (?) sp.
(Plate 22, Figures 8 to 10)

A few specimens of this probably new species, characterized by an open cephalis, were found in 128-3-6, 80 cm.

Dimensions: Height of the cephalis is 85 to 90μ and its maximum diameter is 65 to 70μ.

Genus ENNEAPHORMIS Haeckel, 1881

Type species. Enneaphormis rotula Haeckel (established by Campbell, 1954).

The general features of the type species and the peculiarity of its cephalic structure are, in my opinion, sufficient reasons to reconsider this genus erected by Haeckel in 1881, but subsequently considered by him (Haeckel, 1887, p. 1246) as a subgenus of *Sethophormis*. Its cephalic structure (accurately described by Petrushevskaya [1968a]) and its thorax are features that oblige us to consider it as an independent genus.

Among all species described by Haeckel under this name, only *E. rotula, E. triloba, E. enneastrum* and *E. arachnium* belong to it. Some of them are probably synonymous.

Enneaphormis rotula Haeckel
(Plate 23, Figure 3)

Sethophormis rotula Haeckel, 1887, p. 1246, Plate 57, Figure 9.
Sethophormis triloba Haeckel, 1887, p. 1246.
Tetraphormis rotula Hülsemann, 1963, p. 28.
Tetraphormis triloba Hülsemann, 1963, p. 29, Figure 19.

The synonymy list refers only to adult specimens, the appearance of which are similar to that of the illustrated specimen, which was the only one found among the radiolarians of Leg 13. The specimen preserved no cephalic structure, but the numerous small spines situated on the inner side of the cephalic arches indicated that it must have had a cephalic cupola made of thin rods irregularly intersected in a polygonal network. Because of the four pairs of opposite branches of radial beams, the specimen corresponds to the description Haeckel gave for *E. triloba*. This species seems, however, to be synonymous with *E. rotula*, because it is improbable that the number (four or five) of paired ramifications of radial beams should be sufficient to separate one species from another.

Dimensions: Diameter of the cephalic ring is 86μ and of the thorax is 200μ. The length of the thoracic beams is 52 to 67μ. These dimensions are rather similar to those given by Haeckel for *E. triloba*.

The specimen was found in 128-8-1, 142 cm.

Genus PSEUDOCUBUS Haeckel

Pseudocubus Haeckel, 1887, p. 1010.
Obeliscus Popofsky, 1913, p. 279.
?Rhizoplecta Frenguelli, 1940, p. 77, Figure 20.

Diagnosis: The skeleton consists of a basal spicule formed from a median bar, an apical and a dorsal spine, and two lateral spines arising obliquely upwards; a short spine representing perhaps the vertical or axial spine may descend sometimes from the ventral end of the median bar. The apical and lateral spines are united by a ring formed of three solid primary arches (*ap* and *pp*). Four strong spines arise upwards from the ring, one in the prolongation of the apical spine, and the other three from the middle of the arches. They are connected at a certain distance by secondary arches, so that the whole structure looks like an inverted frustum of a tetragonal pyramid. Six other spines extend laterally from the six corners of the primary ring, three from the dorsal and lateral spines, and three from the middle of the arches *ap* and *pp*. All spines arising both laterally and vertically from the primary ring may be united by arches or closed in a lattice cap-like shell.

Remarks: By its structure, this genus finds a particular place among the Nassellaria with large cephalis. It is, perhaps, rather closely related to an unnamed form illustrated by Petrushevskaya (1969b, Figure 2, VII-VIII), and having the same system of ascending spines originating in a primary ring formed of the arches *ap* and *pp*. The difference is that the type illustrated by Petrushevskaya possesses five instead of four ascending spines. Three of them (the apical and the two lateral originating in the middle of the arches *ap*) have the same position as in *Pseudocubus*, but the other two, arising from the lateral spines, find no homology in this genus. In spite of these differences, and of a few others relating to the spines extending laterally from the primary ring, the whole scaffolding of this new form suggests a close relationship with *Pseudocubus*.

Pseudocubus cf. vema (Hays)
(Plate 12, Figures 1 to 6; Plate 22, Figures 6 and 7.)

?Pseudocubus vema (Hays), Keany and Kennett, Plate 4, Figures 10 and 11.

Description: Hemispherical lattice shell enclosing a stout skeletal structure of the *Pseudocubus*-type. Median bar, lateral, dorsal and axial (vertical?) spines are short, thin, and oval in cross section. The apical spine is thicker and three-bladed. The primary ring enclosing these spines is made up of very stout three-bladed elements as well as the ten spines extending laterally or vertically from it. The shape of the primary ring is generally hexagonal, but its sides are disposed in a zigzag fashion. At its lower corners, it has lateral spines and the apical spine with a lateral branch of it (the former upwardly, the latter laterally directed). At its upper corners there are three pairs of spines, each having one spine laterally and the other upwardly directed. All these spines are connected at a certain distance from the primary ring by secondary arches. They constitute the scaffolding upon which a hemispherical lattice shell with irregular meshes and irregularly anastomosed nervures is built.

Dimensions: Diameter of the shell is 120 to 130μ. Height of the shell is 60 to 70μ.

Remarks: This species is one of the most frequent in a series of samples at Site 128. It is distinguished from *P. obeliscus* by its having a cephalic lattice shell, and by its very stout three-bladed spines. It might be considered as an adult form of the latter. However, even the individuals lacking a lattice shell, namely the young forms, possess a stout, three-bladed scaffolding. The Mediterranean specimens are distinguished from the Antarctic ones, as illustrated by Keany and Kennett, by their very irregular lattice shell and by their three-bladed bars. Unfortunately, I do not know to what extent the latter forms correspond to *Helotholus vema* described by Hays.

Genus AMPHIPLECTA Haeckel

Amphiplecta cylindrocephala n. sp.
(Plate 24, Figures 4 and 5)

Description: The shell consists of two segments. The cephalis is long, cylindrical and has a wide apical opening surrounded by a coronal of spines. The cephalic structure consists of median bar, apical, dorsal, vertical and lateral spines. Dorsal and lateral spines extend into the thoracic wall. The thorax is flatly conical. Both the cephalis and the thorax have large, oval or polygonal pores of irregular size and arrangement, although on the cephalis they tend to be disposed in longitudinal rows, and have small spines arising here and there from the intervening bars.

Holotype: Plate 24, Figure 5; 128-3-5, 20-25 cm.

Dimensions: Length of shell with apical spines is 120 to 130μ, of the cephalis it is 70 to 80μ, and of the thorax it is 50 to 70μ. Diameter of cephalis is 35μ and of the thorax, 140μ.

Remarks: This new species differs from *A. acrostoma* Haeckel by its very long cephalis, less spiny shell, and non-denticulate spines. A few specimens were found only in 128-3-5, 20-25 cm.

Genus ARACHNOCORYS Haeckel

Arachnocorys cf. circumtexta Haeckel
(Plate 25, Figures 10 and 11)

?Arachnocorys circumtexta Haeckel, 1862, p. 304, Plate 6, Figures 9 to 11; Haeckel, 1887, p. 1266; Popofsky, 1913, p. 365, Plate 33, Figure 4; Plate 36, Figure 1; Text-Figures 82 and 83.

Description: The cephalis is subspherical and rather thick-walled. It has numerous circular or subcircular pores of irregular size and arrangement, and a few bristle-shaped apical spines, simple or connected with one another by one or several transverse bars. Collar septum is rather narrow, with four collar pores. Apical spine is atrophied. Dorsal and primary lateral spines project in the thorax, where together with several additional descending apophyses arising

from the base of cephalis they constitute the scaffolding on which a spiny, irregular network is erected. The thorax is mostly short and cylindrical, with rounded irregular pores. The lattice network usually develops at some distance from the cephalis, so that the circumcephalic zone of the thorax is characterized by a number of large windows.

Remarks: *A.* cf *circumtexta* was particularly found in 128-3-5, 5-8 cm and 20-25 cm, where it is rather frequent. It differs from the specimens illustrated by Haeckel by the shape of thorax and by less obvious thoracic ribs.

Genus LITHOMELISSA Ehrenberg

Lithomelissa (?) ehrenbergii Bütschli
(Plate 25, Figures 6 and 7)

Lithomelissa ehrenbergii Bütschli, 1882b, p. 517, Plate 33, Figures 21a and b; Haeckel, 1887, p. 1204.

Description: The cephalis is large, ovate, and armed with a short excentric oblique apical horn. Inner cephalic structure consists of a short median bar, and of apical, dorsal, vertical and primary lateral spines, most of them projected beyond the skeletal surface. Apical spine is free through a long distance in the cephalic cavity. Arches connecting the apical spine with the lateral ones, and the latter, with the vertical one, are distinct and joined to the cephalic wall only with their median part. Collar structure is well defined externally. The thorax is shorter than cephalis, truncate, conical or hemispherical. The whole shell is rather thick-walled and perforated by circular or oval pores. Surface of cephalis and thorax is smooth in young specimens, but in the presumably mature ones the cephalis becomes as rough as in the illustrated specimens.

Remarks: This species is extremely rare in the Quaternary Mediterranean cores, its frequency reaching 2% only in 128-10-3, 5-8 cm.

Lithomelissa cf. thoracites Haeckel
(Plate 21, Figures 14 and 15)

?*Lithomelissa thoracites* Haeckel, 1862, p. 301, Plate 6, Figures 2 to 8; Petrushevskaya, 1962, p. 332, Figures 2 and 3.

Description: Cephalis is oval, smooth, with circular or subcircular pores. Collar septum has only three pores because of the absence of the vertical spine. Apical, dorsal and primary lateral spines project beyond the surface of the skeleton as stout three-bladed horns. Arches connecting the apical and the lateral spines are distinct. Thorax is conical or cylindrical, wider than cephalis, but usually as long. It is smooth and perforated by irregular subcircular pores. An additional external skeleton may be present in some specimens in the collar zone.

Remarks: *L.* cf. *thoracites* is fairly rare in the Mediterranean cores. In spite of the external similarity, it is probably not congeneric with *L.* (?) *ehrenbergii*, because of the presence of the vertical spine in the latter species.

Genus SETHOCONUS Haeckel

Sethoconus (?) dogieli Petrushevskaya
(Plate 23, Figures 1 and 2)

Sethoconus (?) *dogieli* Petrushevskaya, 1967, p. 95, Figure 53, I-II

Dimensions: Length of the shell without apical horn is 130 to 150μ, of the cephalis, 28 to 30μ, and of the thorax, 100 to 125μ. Diameter of cephalis is 30μ and maximum diameter of thorax is 110 to 127μ.

Genus CLATHROCYCLOMA Haeckel

Clathrocycloma davisiana (Ehrenberg)
(Plate 24, Figure 7)

Pterocodon davisianus Ehrenberg, 1872, Plate 2, Figure 10
Cycladophora davisiana Ehrenberg, 1872, Plate 2, Figure 11
Stichopilium davisianum Haeckel, 1887, p. 1437
Theocalyptra davisiana Riedel, 1958, p. 239, Plate 4, Figures 2,3, text-fig. 10
Cycladophora davisiana Petrushevskaya, 1967, p. 122, Figure 69, I-vii.

Remarks: The species was accurately described by both Riedel (1958), and Petrushevskaya (1967). A feature not remarked in the previous works is an external additional spongy skeleton that covers the thorax in a very few specimens.

The assignment of this species to *Clathrocycloma* is based on its morphologic similarity with the two species *C. capitaneum* and *C. parcum* recently described by Foreman (in press).

Genus HELOTHOLUS Joergensen

Helotholus cf. histricosa Joergensen
(Plate 23, Figures 4 and 5)

Helotholus histricosa (partim) Joergensen, 1905, p. 137, Plate 16, Figure 87a.

Description: Shell is conical and spiny, particularly in its upper half. The cephalis with its rounded apex is not separated from the thorax by a collar constriction. Inner skeleton is formed of median bar, apical, dorsal, vertical, axial, and primary lateral spines. The apical spine is vertical and gives a small cephalic spine not distinguished from the other cephalic spines. Axial spine is simple or branched distally. Thorax is wide open or a little constricted distally. Pores of the shell increase from cephalis to thorax, and are irregular in size, shape and arrangement.

Dimensions: Height of the shell is 75 to 85μ; maximum diameter of the thorax is 85 to 87μ.

Remarks: The description is based on three specimens found in 127-14-5, 83-86 cm.

Genus COROCALYPTRA Haeckel

Corocalyptra emmae Haeckel
(Plate 23, Figure 8)

Corocalyptra emmae Haeckel, 1887, p. 1323, Plate 59, Figure 4

Remarks: Similarity between the illustrated specimen, the only representative of this species found in the Mediterranean cores, and *C. emmae* seems to be fairly close, although it does show an incipient constriction at the upper part of the thorax.

Genus CECRYPHALIUM Haeckel

Cecryphalium sestrodiscus Haeckel
(Plate 23, Figure 11)

Cecryphalium sestrodiscus Haeckel, 1887, p. 1399, Plate 58, Figure 1

Dimensions: Diameter of the thorax is 95μ; of the abdomen, 135 to 170μ.

Remarks: Forms belonging to this species were found in several cores of Sites 127 and 128. Their thorax is characterized by 8 to 9 concentric rows of pores, whereas the abdomen has 4 to 8 concentric rows.

Genus LAMPROMITRA Haeckel

Lampromitra petrushevskae n. sp.
(Plate 23, Figures 6 and 7)

Description: Shell is flat, conical and formed of two segments. Cephalis is smooth, with rounded cupola, and with numerous irregular, small, subcircular pores. Dorsal and primary lateral spines are extended into the thoracic wall to form three strong straight ribs. Apical and vertical spines penetrate through the cephalic wall giving rise to short spines. Two other small cephalic spines may arise on one side and another of the cephalis from the two arches connecting the lateral spines with the apical one. Thorax broad conical with irregular polygonal pores, which are much larger in the middle part than in the upper or lower part. Collar stricture is not well defined, but the cephalis is distinguished from the thorax by its small pores. Peristome has a double coronal of short conical divergent spines, the upper obliquely ascending, the lower obliquely descending. Between them there is a single row of pores. Spines are simple or thorny.

Dimensions: Diameter of thorax without spines is 180 to 190μ.

Remarks: The description of this new species is based on eight specimens found in 128-3-5, 20-25 cm, and in 127-14-4, 112-115 cm. It is fairly closely related to *L. schulzei* (Haeckel, 1862), from which it differs by having a much smaller number of thoracic coronal spines, and only one row of coronal pores. It seems also rather similar to *Amphiplecta callistoma* (Haeckel, 1887).

Lampromitra tiara n. sp.
(Plate 23, Figures 9 and 10)

Description: Shell is inflated conical. Cephalis is conical, spiny, and not differentiated from the thorax by a collar stricture. Dorsal and primary lateral spines are prolonged into the thoracic wall. Thorax is wide, conical, with convex sides, and a double terminal coronal of spines, a laterally projected row, and a downwardly projected one. Pores of the cephalis and thorax are irregular, in size, shape and arrangement—however on the thorax they appear to be aligned in imperfect radial rows.

Dimensions: Height of shell without apical and peristomal spines is 90μ; diameter of thorax without peristomal spines is 150μ.

Remarks; Only one specimen of this species was found in 128-3-5, 20-25 cm. It is, however, sufficiently well differentiated from all other species of this genus.

Lampromitra erosa Cleve
(Plate 24, Figures 8 and 9)

Lampromitra erosa Cleve, 1900, p. 10, Plate 4, Figures 2 and 3.

Description: Shell is flatly conical and covered with scattered small spines. Cephalis is subspherical with irregular roundish pores. Apical horn is small, sometimes of similar size to by-spines. Dorsal and primary lateral spines form thoracic ribs. Thorax has irregular, roundish polygonal pores increasing in size from cephalis to peristome. The latter is fringed, with spines divided in a series of downwardly directed branches, and a series of laterally directed branches.

Dimensions: Maximum diameter of thorax with spines is 210μ. Nearly all specimens assigned to this species come from 128-3-5, 20-25 cm.

Family CARPOCANIIDAE Haeckel, emend. Riedel

Genus CARPOCANISTRUM Haeckel

Carpocanistrum (?) odysseus (Haeckel)
(Plate 15, Figure 10; Plate 24, Figure 2)

Sethocorys odysseus Haeckel, 1887, p. 1302, Plate 62, Figure 10
Carpocanistrum spp. Riedel and Sanfilippo, 1971, p. 1596, Plate 1G, Figure 7

Description: Shell is oval and with a slight collar constriction. Cephalis is hemispherical, with a short apical spine, and numerous small pores irregularly arranged. Primary lateral spines extend into the thoracic wall, sometimes projecting as very short external spines. Thorax is thick-walled, globular or oval and with circular pores quincuncially disposed. It is prolonged as a tubular hyaline peristome, about one third as broad as the thorax.

Dimensions: Height of cephalis is 17-20μ; of thorax, 71-75μ; of peristome, 18-24μ. Diameter of cephalis is 36 to 40μ; of thorax, 78-82μ; of peristome, 30-35μ.

Carpocanistrum spp.
(Plate 14, Figure 4; Plate 15, Figures 11 and 12; Plate 24, Figures 1,3)

No attempt at specific identification of these forms was made for this report. The illustrated specimens have been chosen to represent all possible species occurring in the Quaternary cores recovered from the Mediterranean Sea.

Family THEOPERIDAE Haeckel, emend. Riedel

Genus PTEROCANIUM Ehrenberg

Pterocanium charybdeum (Müller)
(Plate 13, Figures 3 to 6; Plate 25, Figure 9)

Podocyrtis charybdea Müller, 1856, p. 492
Pterocanium charybdeum Müller, 1858, p. 43, Plate 6, Figures 5 to 10.
Pleuropodium charybdeum Haeckel, 1887, p. 1336.

Description: Cephalis is small, hemispherical, with spiny surface, and a stout, three-bladed pyramidal horn. Pores are rather rare; most of the cephalic surface is covered with irregular pittings, probably representing infilled pores. Collar septum is simple, with four collar pores. Apical spine is thin and free inside the cephalis. Vertical spine also seems to be free of the shell wall inside the cephalis. Externally, it forms a short horn. Dorsal and primary lateral spines project into the thorax, where they are proximally free and then join to the inner surface of the thorax forming inner ribs. Thorax is campanulate, constricted along the three longitudinal ribs, and strongly swelled between. Beyond the thorax, the thoracic ribs become three stout, divergent, slightly convex, three-bladed feet, proximally latticed. Wall of the thorax is thick and rough with circular, hexagonally framed pores, and small by-spines on the upper part. Abdomen, when present, is lobate, thin-walled, with small, irregularly scattered pores.

Remarks: *P. charybdeum* was commonly encountered in the Quaternary samples of Sites 127 and 128.

Pterocanium sp.
(Plate 25, Figure 8)

This species seems to be closely related to *P. trilobum* as illustrated by Nigrini (1967). It occurs besides *P. charybdeum* in the Quaternary samples of Sites 127 and 128.

Genus LITHOPERA Ehrenberg

Subgenus LITHOPERA Ehrenberg

Lithopera (Lithopera) bacca Ehrenberg
(Plate 13, Figures 1 and 2; Plate 27, Figure 3)

Lithopera bacca Ehrenberg, 1872, Plate 8, Figure 1; Nigrini, 1967, p. 54, Plate 6, Figure 2.
Lithopera (Lithopera) bacca Sanfilippo and Riedel, 1970, p. 455, Plate 1, Figure 29.

Remarks: For a complete synonymy list see Nigrini (1967). In the Quaternary Mediterranean cores, this species appears only in 128-11-CC. A single specimen was found in 121-3-4, 15-18 cm. All specimens are oval and generally thick-walled. Some of them show a flattening of their antapical end, or even a slight constriction; probably an atavism that comes to confirm its origin in a three-segmented form (Sanfilippo and Riedel, 1970).

Genus STICHOPTERYGIUM Haeckel
Type species *Stichopterygium anomalum* (Haeckel) (not *Artopilium trifenestra* Haeckel)

Stichopterygium anomalum (Haeckel)
(Plate 27, Figure 11)

Eucyrtidium anomalum Haeckel, 1862, p. 323, Plate 7, Figures 11 to 13.
Artopilium anomalum Haeckel, 1887, p. 1442.
?*Eucyrtidium galea* Haeckel, 1862, p. 324, Plate 7, Figures 8 to 10.

Description: Shell is elongate and commonly formed of five segments. Cephalis is small, spherical, thick-walled and poreless but with pitted surface. Collar plate is simple and narrow, with four collar pores. Apical spine is free inside the cephalis and projects outside as a thin apical horn. Dorsal and primary lateral spines extend into the thoracic wall at two thirds or more of its length, where they form three large, latticed and carinated protuberances. Thorax is high pyramidal and covers the lower part of the cephalis. The first abdominal segment is nearly as broad as the thorax, but generally shorter than it. The other two segments decrease gradually in diameter to the distal opening. The wall of all postcephalic segments is thin, smooth, with circular or subcircular pores densely and irregularly disposed, especially in the last segments. The sutures between segments are circular or sinuous, but without external constrictions.

Dimensions: Length of shell without apical spine is 145 to 165μ; of thorax, 45 to 55μ, of the first abdominal segment, 30 to 37μ, and of the second, 20-27μ. Diameter of the cephalis is 23 to 24μ; of the thorax without protuberances, 75 to 80μ; of the first abdominal segment, 80 to 82μ, and of the second in its lower part, 65 to 70μ.

Remarks: This species, rather similar in shape to *Eucyrtidium*, is not closely related to it, because of its cephalis, which is similar to that of *Stichocorys*, *Cyrtocapsella* and other genera, and because of its thoracic protuberances. The species cannot be ascribed to *Artopilium* either, as Haeckel (1887) did. In fact, Haeckel himself doubted the assignment of this species to *Artopilium*, because he noted at the same time that *Artopilium anomalum* is "perhaps the type of a peculiar genus *Stichopterygium*" erected in 1881.

Erroneously, Campbell (1954) established *Artopilium trifenestra* Haeckel as the type species of this genus.

Genus EUCYTIDIUM Ehrenberg

Eucyrtidium spp.
(Plate 27, Figures 1 and 2)

Remarks: Although certainly several species of this genus (*E. calvertense* and *E. acuminata* among them) have been recognized in the Quaternary Mediterranean drill-cores, all are tabulated under the designation *Eucyrtidium* spp.

Genus LITHOCAMPE Ehrenberg

Lithocampe heptacola Haeckel
(Plate 24, Figures 10 and 11)

Lithocampe heptacola Haeckel, 1887, p. 1508, Plate 79, Figure 8.
Lithocampe sp. A, Petrushevskaya, 1968b, p. 1769, Figure 1, XIII.

Description: Shell is generally cylindrical, smooth and rather thick-walled. It commonly consists of six or seven segments, the last of which has a short tubular, hyaline or lattice peristome, about one third as broad as the maximum diameter of shell. Sutures are circular or sinuous, and externally marked by very slight or indefinite constrictions. The first two or three segments increase gradually in diameter; the following ones are of similar diameter, so that, except for the last segment, the shell is conical in the upper part and cylindrical in the middle and the lower part. Pores of cephalis and thorax and of the last segment are irregularly scattered; those of the other segments are generally equal and quincuncially disposed in 5 to 6 circular rows on each segment. Cephalis is porous, thick-walled and with a short apical horn. Collar opening is wide, with four collar pores. Apical spine is free inside the cephalis. Cephalic arches connecting the cephalic spines may be sometimes distinguished in some specimens (Plate 24, Figure 11). The lateral spines do not give rise to external spines, but sometimes they cause slight longitudinal constrictions on the thorax.

Dimensions: Length of shell is 160 to 175μ; maximum diameter is 63 to 73μ.

Family PTEROCORYIDAE Haeckel, emend. Riedel

Genus ANTHOCYRTIDIUM Haeckel

Anthocyrtidium sp.
(Plate 14, Figure 2)

Only two specimens of this unidentified species have been recorded in the Mediterranean Sample 128-11 CC.

Genus THEOCORYTHIUM Haeckel

Theocorythium ex gr. amicae (Haeckel)
(Plate 15, Figures 8 and 13; Plate 26, Figures 2, 4 and 5.)

?*Calocyclas amicae* Haeckel, 1887, p. 1382, Plate 74, Figure 2.
?*Theocorythium trachelium trachelium* Nigrini, 1967, p. 79, Plate 8, Figure 2; Plate 9, Figure 2.
?*Theocorythium trachelium dianae* Nigrini, 1967, p. 77, Plate 8, Figures 1a and 1b; Plate 9, Figures 1a and 1b.

No Quaternary specimen found in the Mediterranean samples recovered in this leg may, with any degree of certainty, be assigned to one of the species mentioned above. Almost all have a rather short abdomen with a constricted hyaline peristome which is armed with various numbers of teeth. The species was found in many Quaternary samples of Sites 121, 127 and 128, but its frequency is rather low.

Dimensions: Total length of shell without teeth and apical horn is 112 to 154μ; length of cephalis, 30 to 37μ, of thorax, 50 to 60μ, of abdomen, 38 to 70μ (usually 40 to 50μ). Diameter of cephalis is 26 to 29μ, of thorax, 72 to 81μ, of abdomen, 75 to 88μ.

Theocorythium vetulum Nigrini
(Plate 26, Figure 3)

Theocorythium vetulum Nigrini, 1971, p. 447, Plate 34.1, Figures 6a and 6b.

Remarks: The specimens with a long, conical abdomen are rather rare in the Mediterranean samples. Although ascribed to this species, to which they are superficially similar, I should be rather inclined to consider them as extreme members of a species which include specimens with both short (*T.* ex gr. *amicae*) and long abdomen (*T. vetulum*).

Dimensions: Total length of shell without apical horn and terminal teeth is 160 to 185μ; of thorax, 50 to 55μ; of abdomen, 70 to 80μ. Breadth of thorax is 78 to 80μ; of abdomen 95 to 97μ.

Genus LAMPROCYCLAS Haeckel

Lamprocyclas aegles (Ehrenberg)
(Plate 14, Figure 1; Plate 15, Figures 1 to 5; Plate 26, Figures 7 and 8.)

Podocyrtis aegles Ehrenberg, 1854, Plate 35B, B IV, Figure 18.
Lamprocyclas aegles Haeckel, 1887, p. 1391.
Lamprocyclas maritalis Haeckel, 1887, p. 1390, Plate 74, Figures 13 and 14.
?*Phormocampe lamprocyclas* Haeckel, 1887, p. 1457, Plate 77, Figure 16.

Remarks: Most Mediterranean specimens are characterized by a strong, thick-walled skeleton and a knobbed apical horn.

Genus THEOCONUS Haeckel

Theoconus carinatus (Haeckel)
(Plate 25, Figure 1; Plate 26, Figure 6)

?*Eucyrtidium zancleum* Müller, 1858, p. 41, Plate 6, Figures 1 to 3; Haeckel, 1862, p. 321.
?*Theoconus zancleum* Haeckel, 1887, p. 1399.
Eucyrtidium carinatum Haeckel, 1862, p. 322, Plate 7, Figures 4 to 7.
Pterocorys carinata Haeckel, 1887, p. 1316
?*Lithornithium clausum* Popofsky, 1913, p. 393, text-Figures 111-116.
Lithornithium clausum Petrushevskaya, 1968a, p. 1306, Figure 2, XII
Stichopilium campanulatum Haeckel, 1887, p. 1438, Plate 77, Figure 11
?*Eucyrtidium hertwigii* Haeckel, 1887, p. 1491, Plate 80, Figure 12.

Description: Shell is smooth, conical to slightly ovate and formed of three segments. Cephalis is conical to ovate, trilocular, with numerous subcircular pores, and armed with a stout, edged, pyramidal horn about as long as cephalis. Apical spine is marked on the outer surface of the cephalis by a longitudinal rib. Dorsal and primary lateral spines are extended, or not, in thorax as ribs, spines, or wings. Thorax is campanulate, with circular to subcircular pores arranged in about twenty imperfect longitudinal rows on half a diameter. Abdomen is longer than the thorax. It is cylindrical, or ovate, and with a slightly constricted peristome. Pores of the abdomen are similar in size and arrangement to those of the thorax, except for the lower part, where they are smaller, irregular and irregularly scattered. Lumbar stricture is rather imperfect. A specimen with a little longer abdomen shows an incipient postlumbar stricture, similar to that illustrated by Haeckel for *Eucyrtidium hertwigii*.

Dimensions: Length of shell with apical horn is 195 to 220μ; of cephalis, 35μ; of thorax, 50 to 60μ; of abdomen, 65 to 100μ. Breadth of the cephalis is 25 to 30μ; of the thorax, 90 to 95μ, and of the abdomen. 100 to 110μ.

Remarks: Although of fairly low frequency, this species is common to many Mediterranean samples of Sites 127 and 128.

Theoconus aff. gamphonycha (Joergensen)
(Plate 26, Figure 1)

?*Pterocorys gamphonyxos* Joergensen, 1899, p. 86.
?*Androcyclas gamphonycha* Joergensen, 1905, Plate 17, Figures 92 to 97.

Description: Shell is high or broad conical. Cephalis is cylindrical, trilocular, thin-walled, and armed with a stout pyramidal apical horn. Cephalic pores are small, unequal, circular, or subcircular. Vertical, dorsal and primary lateral spines do not extend beyond cephalic wall. Thorax is short and conical. Collar stricture is well marked. Abdomen is high or broad conical, armed with short, conical spines irregularly scattered on its lower half, and particularly around the peristome. The latter is wide open or a little constricted, but never hyaline. Thickness of the wall increases from the upper

part of the thorax to the lower part of the abdomen, and decreases a little at the distal end of the latter. Pores of the thorax are small and irregularly disposed in the upper part of the thorax, they increase gradually to its lower part, and particularly on the abdomen, where they are arranged in 9 to 10 longitudinal rows on half a diameter, with 5 to 7 in each longitudinal row. A row of smaller pores are scattered among the larger ones around the peristome.

Dimensions: Length of the shell with apical horn is 200 to 235μ; of cephalis without horn, 35 to 40μ; of thorax, 40μ; of abdomen, 92 to 115μ. Breadth of the cephalis is 25 to 33μ; of thorax, 75 to 80μ, and of abdomen, 120 to 130μ.

Remarks: The description is based on three specimens found in 121-3-4, 134-137cm. They differ from *T. gamphonycha* in having a conical abdomen.

Genus LIPMANELLA Loeblich & Tappan

Although the genus *Lipmanella* (=*Dictyoceras*) was characterized by Haeckel as having "three latticed free lateral wings on the sides of the thorax", the following two species, one having thoracic wings, the other thoracic spines, are assigned to it. They have a similar common element–the cephalis (see Plate 25, Figure 5). It is poreless, but with pitted surface, and armed with an apical horn. Collar septum is simple, with four collar pores. Apical spine is free inside the cephalis, and its base is situated at a level above the collar septum. At this level in the cephalis there is a threshold, below which the cephalic cavity becomes cylindrical. Collar septum is situated in the lower part of this cylindrical cavity. Thus, the cephalic structure of this genus seems to be of pterocoryid type. The structure of the thoracic apophyses does not appear to have the generic value given by Haeckel.

Lipmanella tribranchiata n. sp.
(Plate 25, Figures 3 to 5)

Description: Cephalis is globular, poreless, with pitted surface, and armed with a long conical horn. Cephalic structure is as described above. Collar stricture is distinct. Thorax and abdomen are delicate, thin-walled and commonly of similar breadth. Thorax is triangular and pyramidal. The three sides of the pyramid are smooth and with circular equal pores quincuncially arranged in oblique rows. The dorsal and primary lateral spines project almost horizontally from the cephalis forming three lattice wings. From the base of each wing descend two divergent crests which are connected with the latticed crests of the neighboring wings at the level of the lumbar suture. Below these crests, that form three U-shaped curves on the thorax, the primary shell of the thorax, and even abdomen, is covered by an additional spongy network. Pores of the abdomen are similar to those of the thorax.

Dimensions: Diameter of cephalis is 30 to 33μ; of thorax 110 to 140μ; and of abdomen 100 to 145μ. Length of thorax is 90 to 115μ and of the incomplete abdomen, 50 to 65μ.

Holotype: Plate 25, Figure 3, Holocene, 129B-3 CC.

Remarks: Description and dimensions are based on ten speci-specimens.

Lipmanella irregularis (Cleve)
(Plate 25, Figure 2)

Pterocorys irregularis Cleve, 1899, p. 32, Plate 4, Figure 1

Description: Cephalis is subspherical, poreless, with pitted surface, and armed with a slender apical horn. Thorax is inflated conical, with three pyramidal spines. Collar stricture is deep. Abdomen is cylindrical, about as broad as the thorax and with wide open truncate opening. Lumbar stricture is indefinite, seldom with additional network. Surface of the thorax and abdomen is smooth, except for some slender, irregularly scattered spines. Pores are small, irregular, roundish, and irregularly arranged.

Dimensions: Diameter of cephalis is 30 to 35μ; of thorax, 75 to 85μ; of abdomen, 70 to 88μ. Length of the thorax is 50 to 55μ; of abdomen, 40 to 50μ.

Remarks: L. irregularis is a relatively rare species in the Mediterranean cores; a higher frequency being recorded only in 128-3-5 and 6.

Family ARTOSTROBIIDAE Riedel

Genus ARTOSTROBIUM Haeckel

Artostrobium ex gr. auritum (Ehrenberg)
(Plate 15, Figures 6 and 7)

Lithocampe aurita Ehrenberg, 1854, Plate 22, Figure 25
Lithostrobus (?) *botryocyrtis* Petrushevskaya, 1967, p. 143, Figures 73, IV-VI; 80, VI.
Artostrobium auritum *Riedel and Sanfilippp, 1971, p. 1599, Plate 1H, Figures 5 to 8.*

Remarks: The species is rather rare in the Quaternary sediments recovered in Sites 127 and 128. Most specimens are thick-walled, with rough surface as a result of a dense network of irregularly anastomosed crests. The shell is elongate, almost cylindrical, and is often formed of six segments separated by rounded hyaline constrictions, except for the collar suture which usually is not marked externally by any constriction. Internally 5 to 7 long axial spines descend from the collar bars, reaching to the fifth segment.

Dimensions: Length of shell is 157 to 162μ; maximum breadth is 68 to 70μ.

Genus SPIROCYRTIS Haeckel

Spirocyrtis ex gr. scalaris Haeckel
(Plate 15, Figure 9)

Spirocyrtis sp. aff. *scalaris* Riedel and Sanfilippo, 1971, p. 1601, Plate 1G, Figures 1 to 23.

Remarks: The illustrated specimen is the only representative of this species found in the Quaternary sediments cored in the Mediterranean Sea.

Family ACANTHODESMIIDAE Haeckel, emend. Riedel

Although the Haeckelian systematics of this family is artificial enough, it is partly followed in this report. The systematics recently established by Goll (1968, 1969) seems to be unsatisfactory.

In the Mediterranean cores, the acanthodesmiids are very rare. In order to show their scarceness, all species recorded have been illustrated. Unfortunately, not all could be specifically identified. Almost all species previously described by Müller (1856, 1858) and Hertwig (1879) from the Mediterranean Sea basin have been recognized in the Quaternary cores, and accurately illustrated or redescribed, where necessary. None of the three species described by Haeckel has been found, unfortunately.

Genus ZYGOCIRCUS Bütschli

Zygocircus productus (Hertwig)
(Plate 27, Figures 7 to 10)

Lithocircus productus Hertwig, 1879, p. 69, Plate 7, Figure 4.
Zygocircus productus Bütschli, 1882a, Plate 28, Figure 9; Haeckel, 1887, p. 948.
?*Zygocircus archicircus* Popofsky, 1913, p. 285, text-Figure 13.

Description: Shell is composed of a simple sagital ring, obliquely ovate to almost triangular and with three prominent edges. The inner edge is simple and smooth, the two lateral ones are armed with simple conical spines of variable length. Apical and vertical bars are distinct, particularly in the triangular forms. Median bar is very short and bears short, slender primary and secondary lateral spines, as well as a short dorsal and axial spine.

Dimensions: Height of sagital ring without spines is 100 to 123μ; breadth of sagital ring is 80 to 90μ.

Remarks: There is, as the four figures show, a fairly wide variability of the ratio between height and breadth of the sagital ring. The oval, elongate specimens are similar to *Z. productus* as illustrated by Hertwig, whereas the broader, triangular ones resemble *Z. archicircus* from which it differs only in having longer spines. The species is rather rare in the Mediterranean cores.

Genus ACANTHODESMIA Müller

Type species. Acanthodesmia vinculata (Müller)

Acanthodesmia vinculata (Müller)
(Plate 28, Figures 1 and 2.)

Lithocircus vinculatus Müller, 1856, p. 484
Acanthodesmia vinculata Müller, 1858, p. 30, Plate 1, Figures 4 to 7; Haeckel, 1887, p. 975.
?*Zygostephanus mülleri* Haeckel, 1862, p. 268, Plate 12, Figure 2.
Eucoronis challengeri Haeckel, 1887, p. 978, Plate 82, Figure 4.
Eucoronis nephrospyris Haeckel, 1887, p. 977, Plate 82, Figure 5.
?*Coronidium cervicorne* Haeckel, 1887, p. 974, Plate 82, Figure 1.
Giraffospyris angulata Goll, 1969, p. 331, Plate 59, Figures 4, 6, 7 and 9.

Remarks: Under the name *Giraffospyris angulata*, this species was accurately described by Goll (1969). In the Mediterranean sediments it is fairly rare, except for 129B-3 CC where it is one of the most frequent taxa.

Genus LITHOCIRCUS Müller

Lithocircus (?) sp.
(Plate 28, Figures 3 to 7)

?*Lithocircus annularis* Hertwig, 1879, p. 69, Plate 7, Figure 5 (non *L. annularis* Müller, 1856, p. 484; Müller, 1858, p. 29, Plate 1, Figure 1).

Description: Skeleton consists of a D-shaped or hexagonal sagital ring with sharp marginal ridges, and bearing six pairs of straight or curved divergent spines. Median bar is very short. It is without apical spine. Vertical spine is marked by a sharp triangular prominence between the furcal spines (in nomenclature of Petrushevskaya). Secondary lateral spines are well developed. Furcal and anterior pairs of spines arise in obliquely centrifugal direction, the other pairs arise laterally. Spines are simple, straight or curved, and triangular or lamellar in cross section. Between the opposite spines of each pair, there is a sharp edge transversely on the sagital ring.

Dimensions: Height of the sagital ring without spines is 70 to 80μ.

Remarks: The specimens investigated, all found only in 129B-3 CC, are rather similar in lateral view to *L. annularis*, as illustrated and described by Hertwig, although the shape of the sagital ring is less perfect. Hertwig, however, illustrated a quite different species than *L. annularis* Müller, which is recognized with difficulty. Hertwig's species seems to come from *Toxarium, Amphispyris, Microcubus* or other related Haeckelian genera, by a reduction of the lateral skeleton.

Genus THOLOSPYRIS Haeckel

Tholospyris acuminata (Hertwig)
(Plate 28, Figure 9)

Ceratospyris acuminata Hertwig, 1879, p. 70, Plate 7, Figure 2.
Lophospyris acuminata Haeckel, 1887, p. 1080.
Tholospyris tripodiscus Haeckel, 1887, p. 1079, Plate 89, Figure 1; Petrushevskaya, 1969a, p. 652, Figure 2, V.
Tholospyris fenestrata Haeckel, 1887, p. 1079, Plate 89, Figure 2.
Tholospyris cortinisca Goll, 1969, p. 325, p. 56, Figures 3, 5, 6 and 8.

Remarks: *T. acuminata* was found rarely in the Quaternary Mediterranean cores.

Genus NEPHROSPYRIS Haeckel

Nephrospyris renilla Haeckel
(Plate 28, Figure 8)

Nephrospyris renilla Haeckel, 1887, p. 1101, Plate 90, Figures 9 and 10.

Remarks: The representatives of this species are rather sparse and always incomplete in the samples investigated.

Genus CERATOSPYRIS Ehrenberg

?Ceratospyris hyperborea Joergensen
(Plate 28, Figure 11)

?*Ceratospyris hyperborea* Joergensen, 1905, p. 130, Plate 13, Figure 49.

Remarks: Only the illustrated specimen was found in the Mediterranean cores.

Ceratospyris muelleri Stöhr
(Plate 27, Figure 12)

Ceratospyris mülleri Stohr, 1880, p. 98, Plate 3, Figure 15.

Remarks: Very rare in the Mediterranean cores.

Ceratospyris (?) spp.
(Plate 27, Figures 5 and 6; Plate 28, Figure 10)

Remarks: The forms designated under this name certainly belong to three species. They are also extremely rare in the Mediterranean cores.

Family WILLIRIEDELLIDAE Dumitrica

Genus WILLIRIEDELLUM Dumitrica

Williriedellum (?) gilkeyi n. sp.
(Plate 3, Figures 4 and 6; Plate 4, Figures 1 and 2.)

Description: Cephalo-thorax is a little depressed in the abdomen. Cephalis is small, poreless, at least in its top. Collar suture is externally not defined. Thorax is porous, with its lower part hidden in the abdominal wall and cavity. It was not possible to determine whether it has basal thoracic apophyses. Lumbar suture is well defined by the sudden expansion of the abdomen. The latter is spherical, large, and with a surface covered with numerous small triangular or polygonal depressions limited by sharp crests and commonly having three or more pores. Sutural pore is large and is closed at its inner side by a depressed latticed plate connecting the abdominal wall to the depressed thorax (Plate 4, Figure 2). Aperture assumed but not seen because of the position of the illustrated specimen on the specimen holder.

Dimensions of the holotype: Diameter of abdomen is 128μ; of sutural pore, 18μ. Height of shell is 152μ.

Remarks: This species possesses, as far as it was possible to see, almost all the characteristics of *Williriedellum*. The only doubts concern the thoracic apophyses and the aperture, two elements with generic value. Their investigation is necessary to establish the exact generic assignation of this new species. It is common in 120-2-1, 71-140 cm.

The species is named for Robert Gilkey, logistics officer in the *JOIDES* Deep Sea Drilling Project.

Genus HEMICRYPTOCAPSA Tan Sin Hok, emend. Dumitrica

Hemicryptocapsa (?) cf. nodosa (Tan Sin Hok)
(Plate 1, Figure 6; Plate 2, Figures 1 and 2)

?*Tricolocapsa nodosa* Tan Sin Hok, 1927, p. 49, Plate 9, Figure 61

Description: Specimens have a tuberculate shell with simple, small and poreless cephalis. Collar suture is not defined externally. Thorax is porous and partly hidden in abdomen. Lumbar stricture is well marked. Abdomen is large, globular or a little oval, with tuberculate surface. Pores are small, circular and densely disposed. Sutural pore is indistinct and probably absent. Aperture is widely open and is surrounded in the illustrated specimen by seven tubercules, each of them with a small protuberance on the apertural side.

Dimensions: Diameter of abdomen is 140μ; height of shell is 190μ.

Remarks: Frequent in 120-2-1, 71-140 cm, the Albian specimens have a close superficial affinity to *Tricolocapsa nodosa*. Their assignment to this species remains doubtful without knowledge of the whole morphology of both Albian and Turonian forms. *Hemicryptocapsa* (?) cf. *nodosa* is rather similar in its shape and tuberculate abdomen to *H. tuberosa* Dumitr., from which it differs by the absence of the sutural pore and by its wide aperture situated in a depressed area.

Genus HOLOCRYPTOCAPSA Tan Sin Hok

Holocryptocapsa (?) cf. cryptodon (Dumitrica)
(Plate 2, Figures 3 to 6)

?*Hemicryptocapsa cryptodon* Dumitrica, 1970, p. 73, Plate 14, Figures 90, 91a-c.

Remarks: Shell is rather similar to *H. cryptodon* in its shape, in the morphology of its abdominal pores, in the degree of encasement of its cephalis, etc., but it differs in having a larger abdomen, a greater number of pores (22-23 on a half equator) and a much thinner abdominal wall. As in *H. cryptodon*, the cephalis of the illustrated specimen is poreless and almost completely encased in the abdominal wall and cavity. Its place on the shell is marked only by a small poreless prominence. The sutural pore is distinct, but its structure is not yet clear. Very interesting and characteristic for this species is the structure of the abdominal pores. The scanning electron micrographs (Plate 2, Figure 6) add some details to what was known before. One could suppose that it is the result of a subsequent dissolution of the intervening crests, but the generality of this type of structure proves its primary origin. A similar structure was illustrated by Tan Sin Hok for *Sphaeropyle chonopora*, a species with which *H. cryptodon* might be synonymous. Aperture is narrow and has the same structure of pores. The thorax could not be investigated but it is supposed to be porous and to bear basal apophyses.

This species is frequent in 120-2-1 and 120-3 CC.

Dimensions: Diameter of abdomen is 155μ; height of shell is 167μ.

Holocryptocapsa (?) sp.
(Plate 3, Figures 1 to 3, and 5)

Remarks: This probably new species is superficially similar to *Hemicryptocapsa* cf. *pseudopilula* Tan (Dumitrica, 1970), in the labyrinthic aspect of the superficial ornamentation of the abdomen. The difference is in the degree of encasement of its cephalis. The thorax could not be seen but it is supposed to exist inside the abdomen. The possibility that this species should belong to *Gongylothorax* is not, however, excluded.

Dimensions: Diameter of abdomen is 110μ; of aperture, 10μ.

Genus CRYPTAMPHORELLA Dumitrica

Cryptamphorella cf. conara (Foreman)
(Plate 1, Figures 2 to 5)

?*Hemicryptocapsa conara* Foreman, 1968, p. 35, Plate 4, Figures 11a, b.

?*Cryptamphorella conara* Dumitrica, 1970, p. 80, Plate 11, Figures 66a-c.

Remarks: This species is one of the most frequent in 120-2-1, 71-140 cm; 120-2 CC and 120-3 CC.

Dimensions: Height of shell is 130 to 140μ; diameter of abdomen is 100 to 130μ and of the sutural pore is 19-23μ.

Order PHAEODARIA Haeckel
Family POROSPATHIDAE Borgert

Genus POROSPATHIS Haeckel

Porospathis sp. aff. P. holostoma (Cleve)
(Plate 15, Figure 14)

Remarks: Fragments of different sizes, never complete specimens, have been found in the small fraction (smaller than 62μ) of the following samples: 127-14-4, 112-115cm, 127-14-5, 2-5cm, 11-14cm, 20-21cm, 26-29cm, 54-56cm. Their ornamentation is similar to that of *P. holostoma* or *P. tabulata*. Since the most frequently cited species is *P. holostoma*, these fragments might belong to it.

Family CADIIDAE Haeckel

Genus CADIUM Bailey

Cadium marinum Bailey
(Plate 15, Figure 15)

Cadium marinum Bailey, Butschli, 1882, Plate 32, Figure 15; Haecker, 1908, p. 281, Plate 51, Figure 416; Reschetnjak, 1966, p. 174, Figure 106.

Remarks: This species occurs fairly often in the slides, bearing forms smaller than 62μ. The species was found only in site 127, in the following samples: 127-14-4 (112-115cm, 144-147cm) and 127-14-5 (26-29cm, 67cm).

Dimensions: Dimensions of the illustrated specimen: length is 53μ, and diameter is 32μ.

Cadium melo (Cleve)

Cadium melo (Cleve), Haecker, 1908, p. 282, Plate 51, Figure 415.

Remarks: Only one broken specimen belonging to this species was found in 127-14-4, 112-115cm. It has a short cylindrical axial peristome with rolled brim and an oval shell about double that of *C. marinum*. It is ploughed with thick longitudinal ridges and with numerous delicate transverse bridges in the narrow intercostal ditches.

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TABLE 1
Distribution of Radiolaria at Site 121

Samples	Abundance and Preservation	*Collosphaera* cf. *macropora*	*Hexacontium* spp.	*Actinomma mediterranensis*	*Thecosphaera radians*	*Echinomma antarctica* ?	*Rhizosphaera* spp.	*Spongurus cylindricus*	*Ommatartus tetrathalamus*	*Heliodiscus asteriscus*	*Spongodiscus* spp.	*Porodiscus* spp.	*Cubotholus* sp.	*Rhopalastrum* spp.	*Amphirhopalum wirchowii*	*Sethoconus* (?) *dogieli*	*Lamprocyclas aegles*	*Theocorythium* ex gr. *amicae*	*Lithopera* (Lithopera) *bacca*	*Eucyrtidium* spp.	*Carpocanistrum* spp.	*Spirocyrtis* ex gr. *scalaris*	*Theoconus* aff. *gamphonycha*
121-1-1, 148-151 cm	R, G	+	+																				
121-3-4, 15- 18 cm	F, G		C	C	C	F	C	+	+	R	+	+	+	R	+	R	R	R	+	R	R	+	
121-3-4, 72- 75 cm	F, G		C	C	C	+	F		R	+	+	+	+	R			R							
121-3-4, 134-137 cm	R, G			F	F	R										R	F						R

TABLE 2
Distribution of Radiolaria and other Siliceous Micro-fossils at Site 127

Samples	Abundance and Preservation	*Actinosphaera acanthophora*	*Actinomma* spp.	*Thecosphaera* spp.	*Echinomma antarctica* ?	*Actinosphaera* (?) *haackei*	*Haeckeliella inconstans*	*Rhizosphaera* spp.	*Druppatractus variabilis*	*Druppatractus* (?) sp.	*Xiphatractus spumeus*	*Amphisphaera cristata*	*Ommatartus* spp.	*Heliodiscus asteriscus*	*Heliodiscus* sp.	*Spongodiscus* spp.	*Spongaster tetras*	*Spongurus cylindricus*	*Rhopalastrum* spp.	*Amphirhopalum wirchowii*	*Porodiscus* spp.	*Pseudocubus* cf. *vema*	*Helotholus* cf. *histricosa*	*Clathrocycloma davisiana*	*Cecryphalium sestrodiscus*	*Lampromitra petrushevskayae*	*Eucyrtidium* spp.	*Lithocampe heptacola*	*Carpocanistrum* spp.	*Theoconus carinatus*	*Artostrobium* ex gr. *auritum*	*Acanthodesmia vinculata*	*Zygocircus productus*	*Ceratospyris hyperborea*	*Porospathis* sp. aff. *P. holostoma*	*Cadium marinum*	*Cadium melo*	Diatoms (*Coscinodiscus* spp.)	Sponge spicules
127-5-6, 77-80 cm	R, G		R													R				R		+		R													
127-5-6, 126-129 cm	R, G		+																	+				R						R							
127-5-6, 136-139 cm	R, G				C										+				R					C												A	
127-5-6, 147-150 cm	R, G		F		F																			F												R	F
127-14-2, 77-80 cm	VR, G		+																																		
127-14-3, 4-7 cm	VR, M																					+															
127-14-3, 27-28 cm	R, G		+	+		R																															
127-14-3, 44 cm	R, G	+	R	F		C					F	R				R								F													
127-14-4, 112-115 cm	F, G			+	C	F		R						+					F							+	+					+			R	+		
127-14-4, 131 cm	F, G			+	F	F		+											R									F									
127-14-5, 11-14 cm	R, G				R	R	+	C						+	+				R	+									R	R			+			C	
127-14-5, 26-29 cm	F, G	R	F		C	F	F	F	R	R							+		R										R	R			+		R	C	
127-14-5, 54-56 cm	R, G		R	F		R													R										R	R	+		+			F	
127-14-5, 83-86 cm	F, G			R		R		R				+			F		+		R	R		R						+		F	+		+	+				
127-14-5, 133-135 cm	F, G		F	F	R	F	F	R				F			F		+	+	F	R	F							R		C				+		F	F	
127-14-5, 146-149 cm	C, G				+	F	+	R				F			F		+		R		F							+	+	F			R				C	F
127-14-CC	R, G			C		C			C				R															+									

TABLE 3
Distribution of Radiolaria and Other Siliceous Microfossils at Site 128

Samples	Abundance and Preservation	*Polysolenia spinosa*	*Siphonosphaera polysiphonia*	*Collosphaera* cf. *macropora*	*Collosphaera huxleyi*	*Actinomma* sp. + *A. mediterranensis*	*Thecosphaera* sp. + *T. radians*	*Echinomma antarctica* ?	*Rhizosphaera* spp.	*Actinosphaera acanthopora*	*Actinosphaera* (?) *haackei*	*Haeckeliella macrodoras*	*Druppatractus variabilis*	*Xiphatractus spumeus*	*Cromyatractus elegans*	*Ommatartus* spp + *O. tetrathalamus*
128-2, above 0 sect.	R, G											+				
128-2-2, 83-85 cm	VR, G															
128-2-5, 74-76 cm	VR, G															
128-3-4, 78-81 cm	VR, G															
128-3-4, 112-115 cm	VR, G							+	R							
128-3-5, 5-8 cm	C, G					F	F	F	R				R	R		
128-3-5, 20-25 cm	C, G				+			F								F
128-3-5, 41-44 cm	F, G								R							
128-3-5, 52-54 cm	R, G						R		F							
128-3-5, 135-138 cm	VR, G													+		
128-3-6, 10-13 cm	VR, G															
128-3-6, 19-22 cm	VR, G			+												
128-3-6, 80 cm	C, G															
128-3-6, 97-100 cm	F, G															
128-3-6, 107-110 cm	R, G															
128-3-6, 120-123 cm	VR, M															
128-8-1, 134-137 cm	R, G					C	R									
128-8-1, 105-108 cm	R, G					C	F									
128-8-1, 142 cm	R, G					C	F									
128-8-1, 144-147 cm	VR, M					R	+									
128-8-2, 23-26 cm	R, M					F	R									
128-10-2, 128-131 cm	R, M					F	R									
128-10-3, 5-8 cm	C, G					R	F						+	F		R
128-10-3, 40-43 cm	R, G					+	R							+		R
128-10-3, 78-81 cm	VR, G						+									+
128-10-3, 103-106 cm	VR, M															R
128-10-4, 4-7 cm	VR, M															
128-11-3, 47-50 cm	+, G															+
128-11-3, 126-129 cm	R, G						R									R
128-11-CC	C, G	R	R			C	C	F		F	F		R	R	R	F

Samples	*Heliaster hexagonium*	*Heliodiscus asteriscus*	*Heliodiscus echiniscus*	*Spongodiscus* spp.	*Spongaster tetras*	*Spongurus cylindricus*	*Rhopalastrum* spp.	*Amphirhopalum wirchowii*	*Trigonastrum regulare*	*Porodiscus* spp.	*Tetrapyle octacantha*	*Plagiacantha arachnoides*	*Plagiacantha* (?) *panarium*	*Plectacantha* (?) sp.	*Enneaphormis rotula*	*Pseudocubus* cf. *vema*	*Amphiplecta cylindrocephala*	*Arachnocorys* cf. *circumtexta*
128-2, above 0 sect.					R		R	R		F	F							
128-2-2, 83-85 cm							R											
128-2-5, 74-76 cm										+								
128-3-4, 78-81 cm																		
128-3-4, 112-115 cm										+	R							
128-3-5, 5-8 cm					R		F			F	C						+	
128-3-5, 20-25 cm						+	F			C	C						+	F
128-3-5, 41-44 cm					R	R	R			F	C							
128-3-5, 52-54 cm							R			R	F							
128-3-5, 135-138 cm																		
128-3-6, 10-13 cm																+		
128-3-6, 19-22 cm																		
128-3-6, 80 cm				R					R	R		R	+	+		C		
128-3-6, 97-100 cm				R					R			R				C		
128-3-6, 107-110 cm				R												F		
128-3-6, 120-123 cm																+		
128-8-1, 134-137 cm		R		R			R			+						+		
128-8-1, 105-108 cm				R			R											
128-8-1, 142 cm				R			R								+			
128-8-1, 144-147 cm				+			+											
128-8-2, 23-26 cm				R			R	+										
128-10-2, 128-131 cm				R			R											
128-10-3, 5-8 cm				C	R	R	R	+		C						+		
128-10-3, 40-43 cm				R	+		R			R								
128-10-3, 78-81 cm				+	+					+						+		
128-10-3, 103-106 cm				+			+									F		
128-10-4, 4-7 cm																+		
128-11-3, 47-50 cm																		
128-11-3, 126-129 cm	R					+	R											
128-11-CC	+			C	R	R	R	R		C	F							

Samples	*Lithomelissa* cf. *thoracites*	*Lithomelissa* (?) *ehrenbergii*	*Clathrocycloma davisiana*	*Corocalyptra emmae*	*Cecryphalium sestrodiscus*	*Lampromitra petrushevskayae*	*Lampromitra tiara*	*Lampromitra erosa*	*Pterocanium* sp. + *P. charybdeum*	*Stichopterygium anomalum*	*Eucyrtidium* spp.	*Lithocampe* cf. *hepiacola*	*Lithopera* (*Lithopera*) *bacca*	*Carpocanistrum* (?) *odysseus*	*Carpocanistrum* spp.
128-2, above 0 sect.					+				R						
128-2-2, 83-85 cm									+						
128-2-5, 74-76 cm															
128-3-4, 78-81 cm															
128-3-4, 112-115 cm															
128-3-5, 5-8 cm		F							F		R				F
128-3-5, 20-25 cm	R			+	+	+	+	+	C	R	R				F
128-3-5, 41-44 cm									F	R	R				
128-3-5, 52-54 cm															
128-3-5, 135-138 cm															
128-3-6, 10-13 cm															
128-3-6, 19-22 cm															+
128-3-6, 80 cm	R		C						R		F				
128-3-6, 97-100 cm	R		F						R		R				
128-3-6, 107-110 cm			F						+		+				
128-3-6, 120-123 cm															
128-8-1, 134-137 cm			+		+										
128-8-1, 105-108 cm															
128-8-1, 142 cm															
128-8-1, 144-147 cm															
128-8-2, 23-26 cm															
128-10-2, 128-131 cm															
128-10-3, 5-8 cm	R								R		R			R	R
128-10-3, 40-43 cm									R		+				R
128-10-3, 78-81 cm									+						
128-10-3, 103-106 cm															
128-10-4, 4-7 cm															
128-11-3, 47-50 cm															
128-11-3, 126-129 cm														+	
128-11-CC									R			R	R	R	F

Samples	*Anthocyrtidium* sp.	*Theocorythium* ex gr. *amicae*	*Lamprocyclas aegles*	*Theoconus carinatus*	*Lipmanella tribranchiata*	*Lipmanella irregularis*	*Artostrobium* ex gr. *auritum*	*Acanthodesmia vinculata*	*Zygocircus productus*	*Tholospyris acuminata*	*Nephrospyris renilla*	*Ceratospyris muelleri*	*Ceratospyris* (?) sp.	Diatoms	Sponge spicules
128-2, above 0 sect.				R				F			+				
128-2-2, 83-85 cm															
128-2-5, 74-76 cm															
128-3-4, 78-81 cm															C
128-3-4, 112-115 cm															F
128-3-5, 5-8 cm		R		R											
128-3-5, 20-25 cm				R	+	R		+		+	+	+	+		
128-3-5, 41-44 cm		R		R	+	R					+				
128-3-5, 52-54 cm															
128-3-5, 135-138 cm															C
128-3-6, 10-13 cm															C
128-3-6, 19-22 cm															
128-3-6, 80 cm						F								C	F
128-3-6, 97-100 cm						F	R							C	F
128-3-6, 107-110 cm						R	+							C	
128-3-6, 120-123 cm															
128-8-1, 134-137 cm				+			+								
128-8-1, 105-108 cm							R							F	
128-8-1, 142 cm							+							F	
128-8-1, 144-147 cm															
128-8-2, 23-26 cm															C
128-10-2, 128-131 cm															
128-10-3, 5-8 cm									R					C	
128-10-3, 40-43 cm														R	C
128-10-3, 78-81 cm															
128-10-3, 103-106 cm															F
128-10-4, 4-7 cm															C
128-11-3, 47-50 cm															
128-11-3, 126-129 cm															
128-11-CC	+	F	R					+							

PLATE 1

Albian Radiolaria (120-2-1, 116 cm)

Figure 1. *Xiphosphaera umbilicata* Rüst.

Figures 2-5. *Cryptamphorella* cf. *conara* (Foreman).
2. Lateral view.
3. The same in apical view.
4. The same, apical view of cephalis and sutural pore.
5. Other specimen in lateral view.

Figure 6. *Hemicriptocapsa* (?) cf. *nodosa* (Tan Sin Hok), antapical view showing the aperture.

PLATE 1

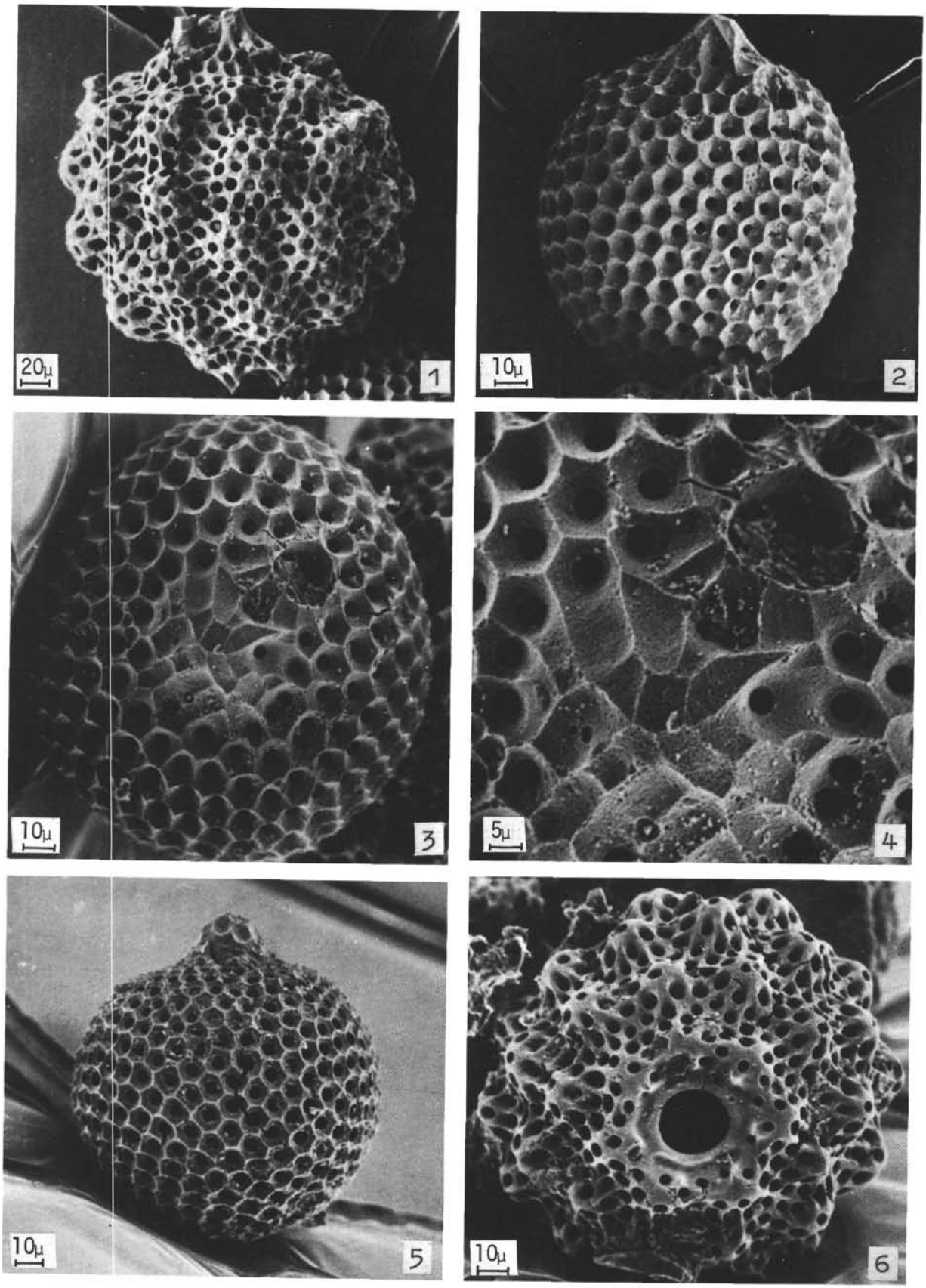


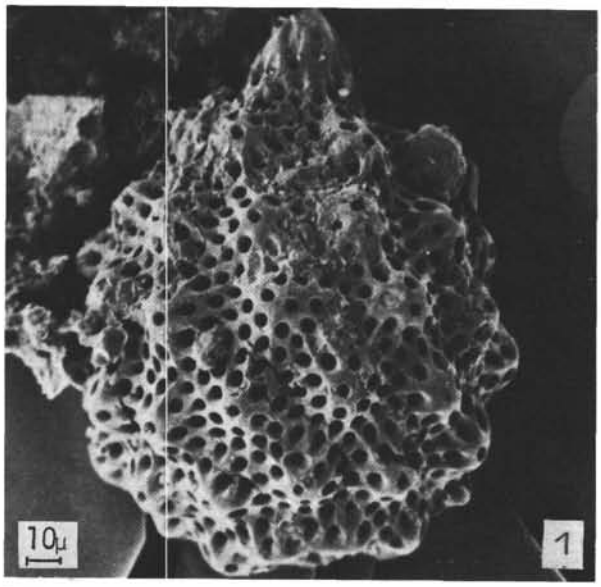
PLATE 2

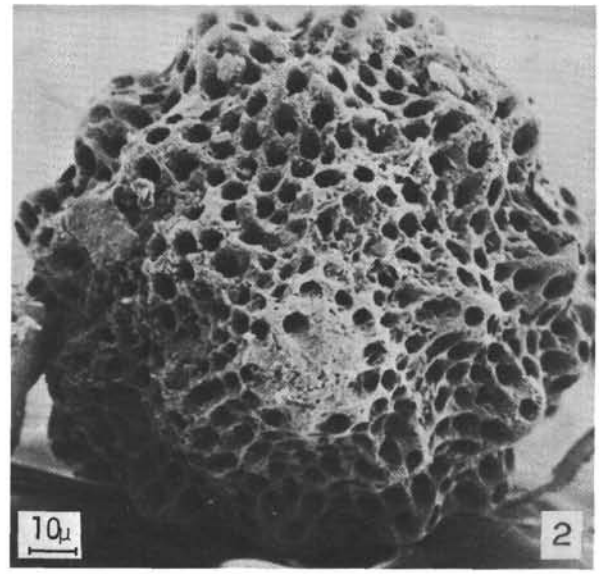
Albian Radiolaria (120-2-1, 116 cm)

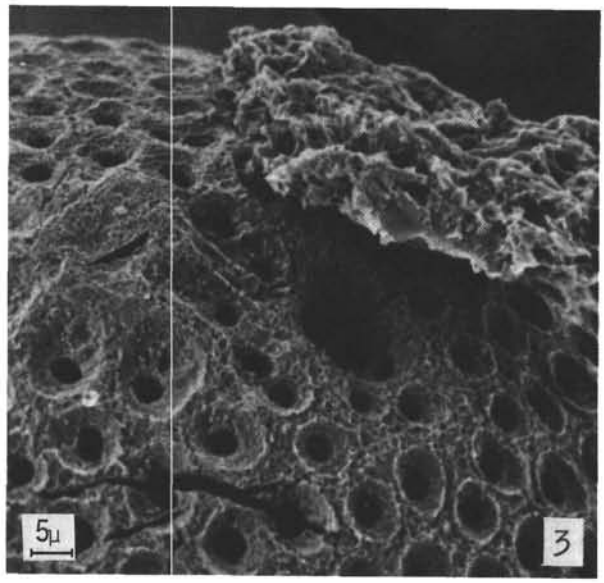
Figures 1, 2. *Hemicriptocapsa* (?) cf. *nodosa* (Tan Sin Hok).
1. The specimen illustrated in Plate 1, Figure 6. In lateral view.
2. The same, in apical view.

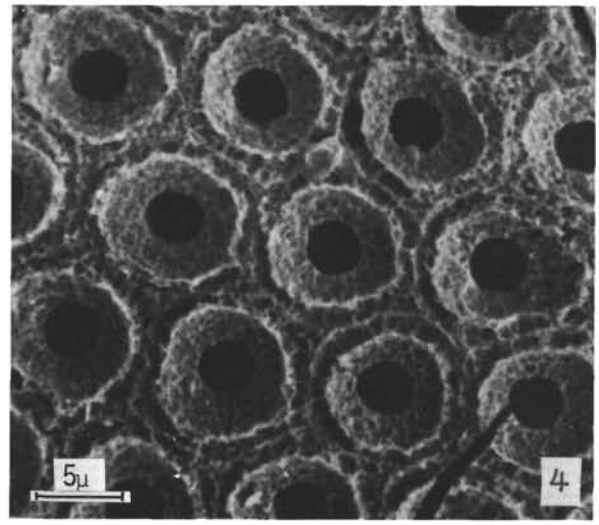
Figures 3-6. *Holocryptocapsa* (?) cf. *cryptodon* (Dumitrica).
3. Cephalis and sutural pore, in oblique–apical view.
4. The same specimen, fragment of the abdominal wall, much magnified, showing the particular morphology of pores.
5. The same specimen in lateral view.
6. The same in oblique-antapical view showing the very constricted aperture.

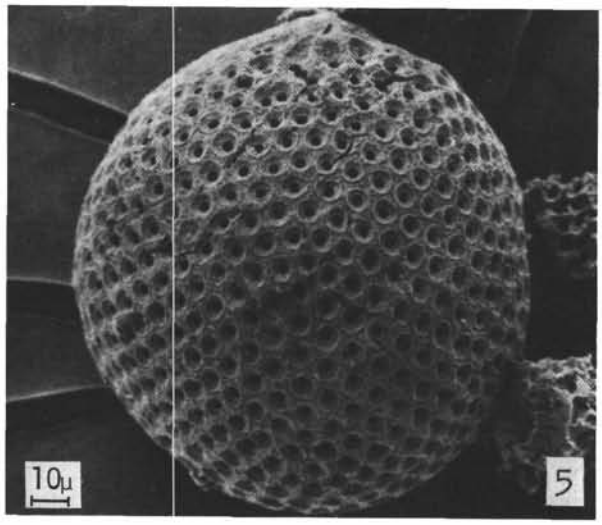
PLATE 2











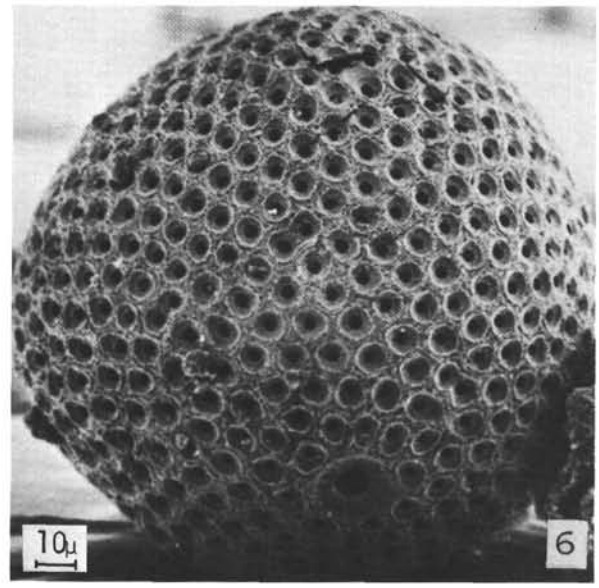


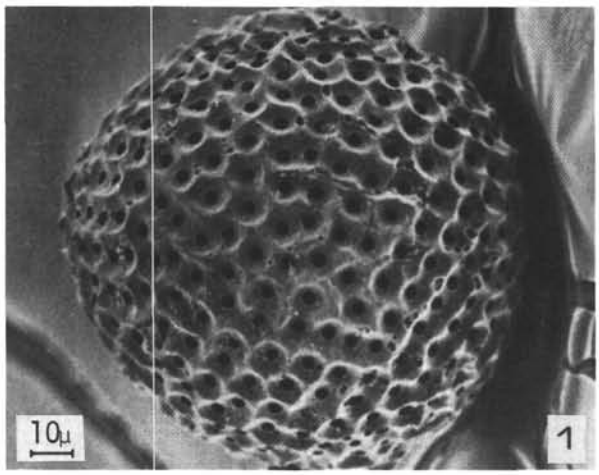
PLATE 3

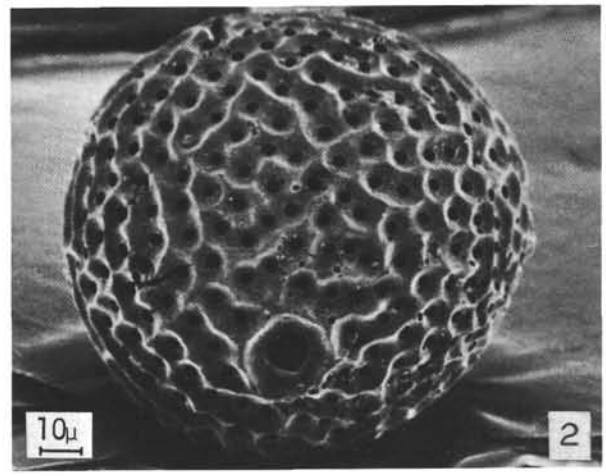
Albian Radiolaria (120-2-1, 116 cm)

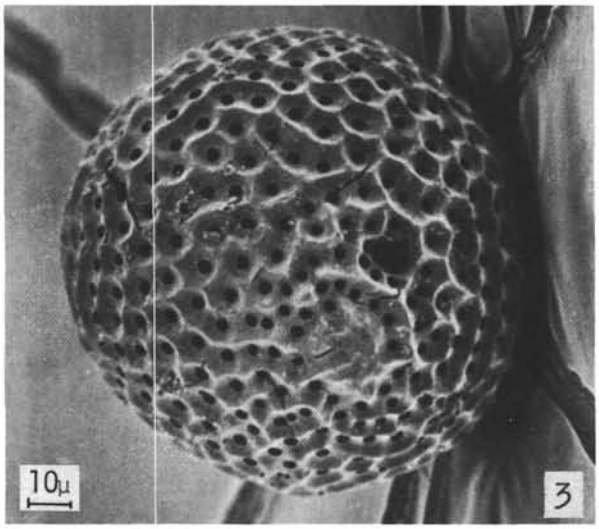
Figures 1-3, 5. *Holocryptocapsa* (?) sp.
1. A specimen in lateral view showing the completely encased cephalis.
2. The same in oblique-antapical view showing the very constricted aperture.
3. The same in apical view.
4. The same, detail of the cephalic zone, showing the poreless cephalis and the sutural pore.

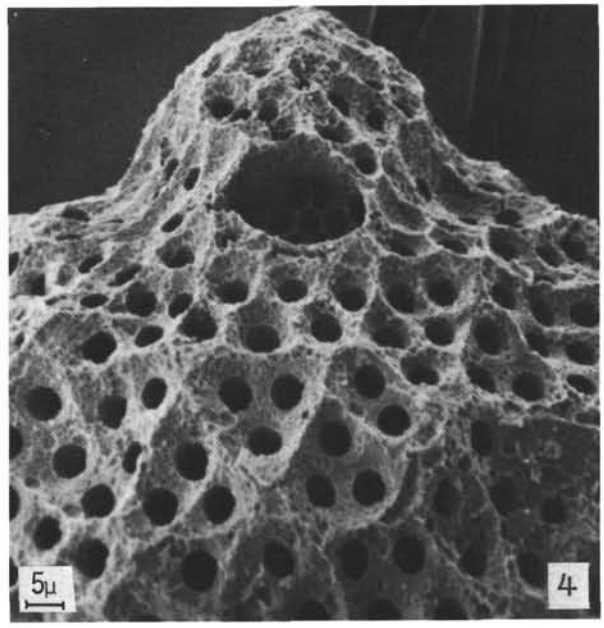
Figures 4, 6. *Williriedellum* (?) *gilkeyi* n. sp.
4. Holotype, the upper part of shell much magnified, in lateral view; a large sutural pore is distinguished.
6. The same in the same view.

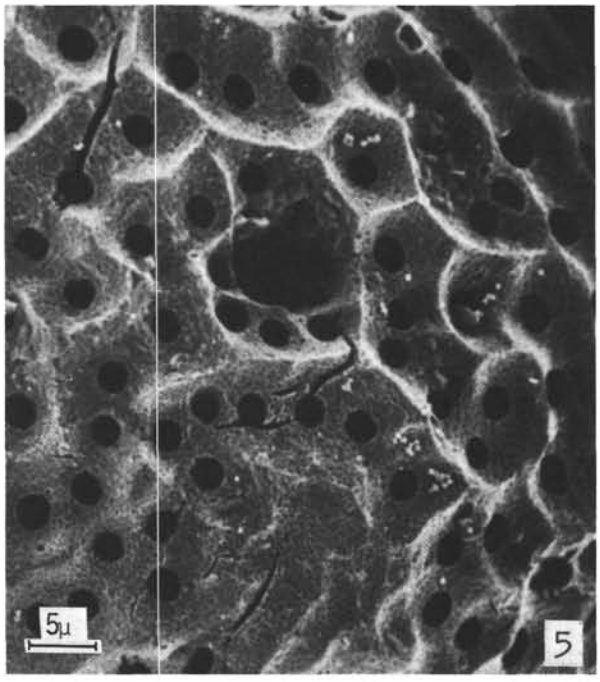
PLATE 3











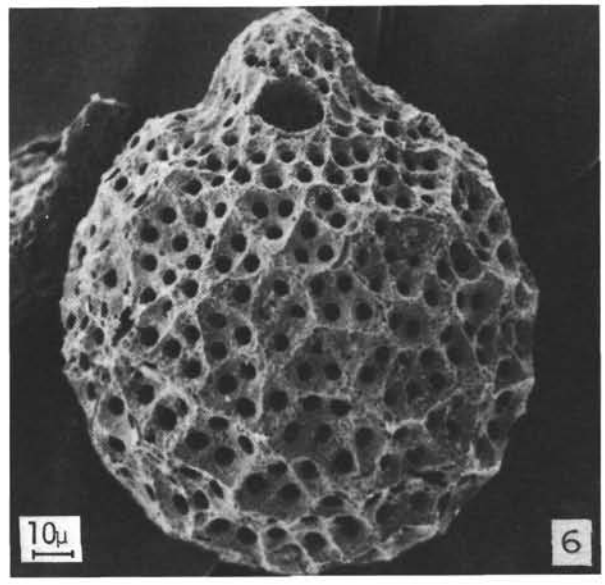


PLATE 4

Albian Radiolaria (120-2-1, 116cm)

Figures 1, 2. *Williriedellum* (?) *gilkeyi* n. sp.
1. Holotype in apical view.
2. The same; the sutural pore much magnified showing the latticed plate connecting its distal rim to the encased part of thorax.

Figures 3, 5. Theoperid with tuberculate surface, gen. and sp. indet.
3. Antapical view showing a latticed septum and a narrow septal opening.
5. The same specimen in lateral view.

Figures 4, 7. *Dictyomitra* (?) sp.
4. Antapical view showing a septum of Dictyomitra-type.
7. The same specimen in lateral view.

Figure 6. *Dictyomitra* sp.

PLATE 4

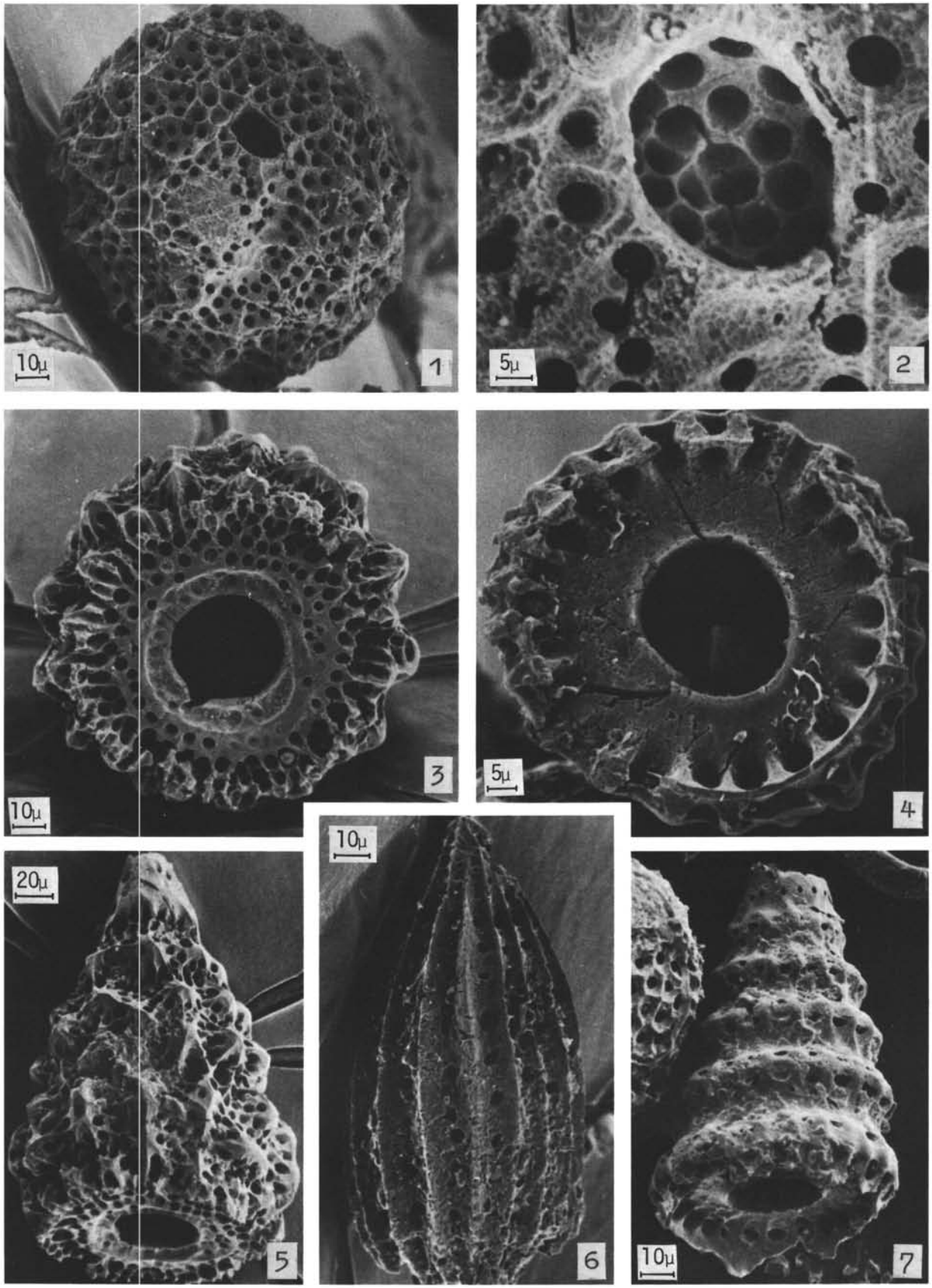


PLATE 5

Quaternary Radiolaria (128-11 CC)

Figures 1-4. *Actinomma* sp.
1. Specimen with broken radial spines.
2. The same, detail of surface.
3. Other specimen.
4. The same, detail of surface.

Figures 5, 6. *Thecosphaera radians* Hollande & Enjumet
6. The same, detail of surface

PLATE 5

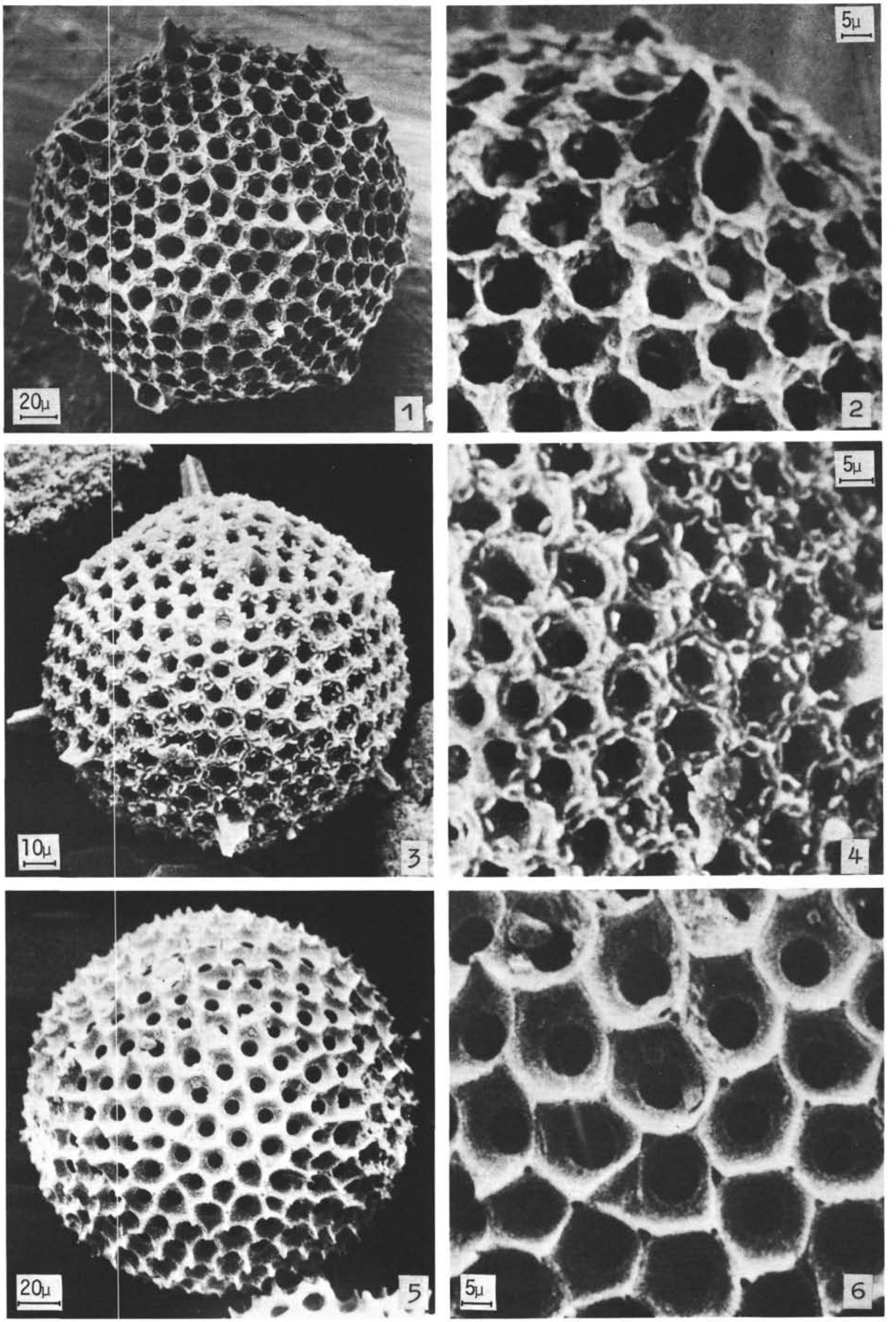


PLATE 6

Quaternary Radiolaria (128-11 CC)

Figures 1, 2. Medullary shell of *Thecosphaera* or *Actinomma*.

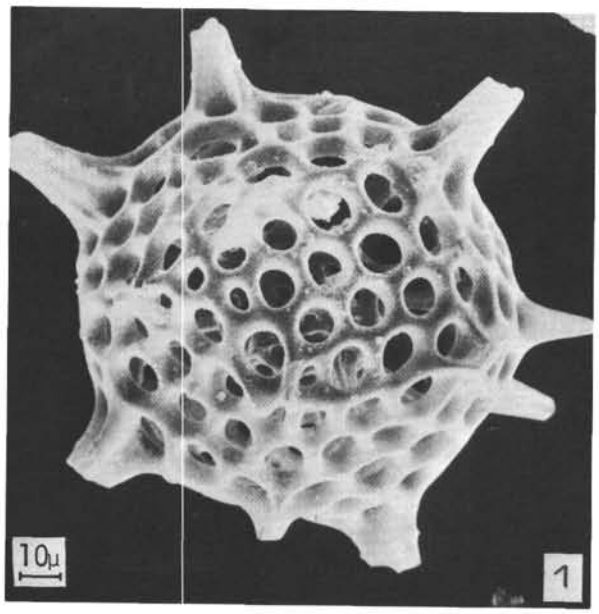
Figure 3. *Thecosphaera radians* Hollande & Enjumet.

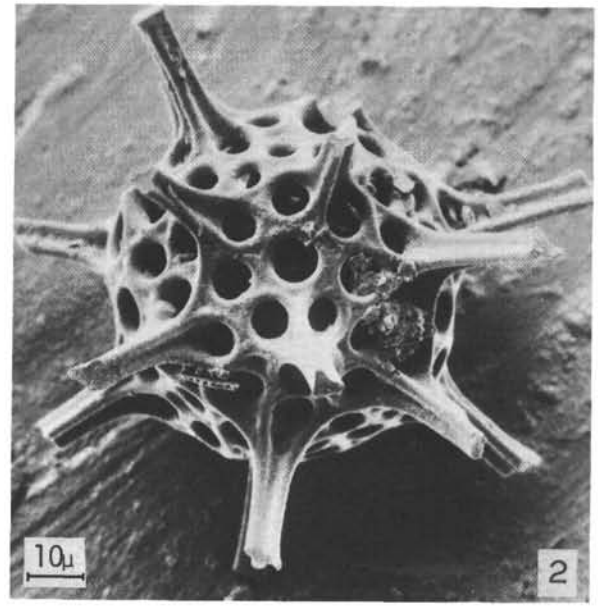
Figure 4. *Druppatractus variabilis* n. sp.; polar view.

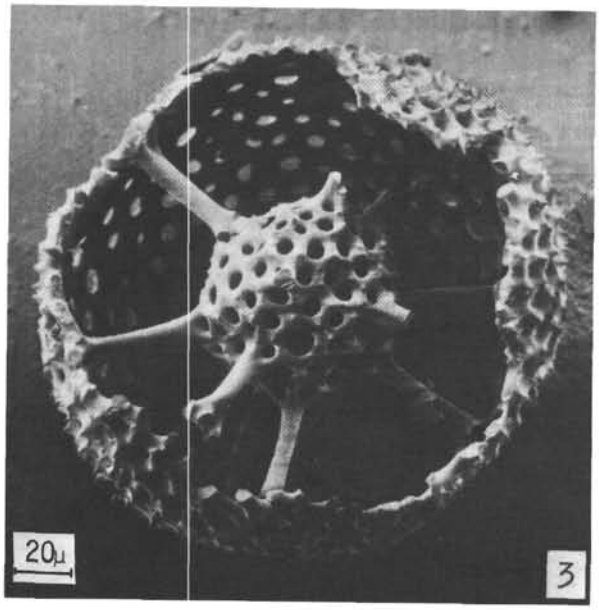
Figure 5. *Tetrapyle* (?) sp.

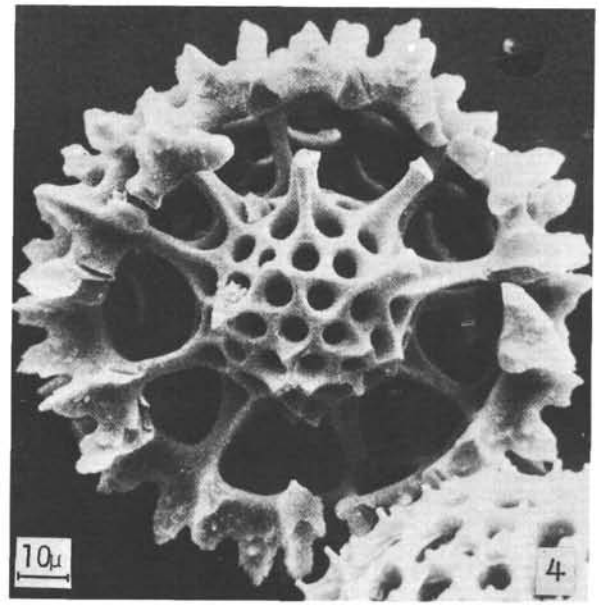
Figure 6. *Ommatartus* cf. *tetrathalamus* Haeckel.

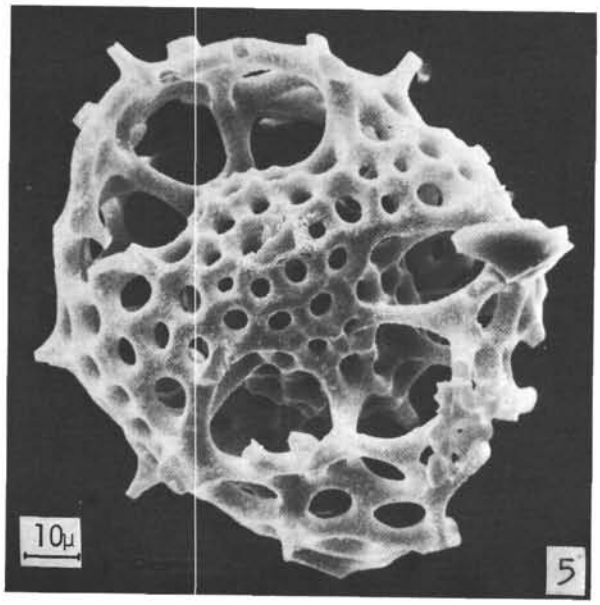
PLATE 6











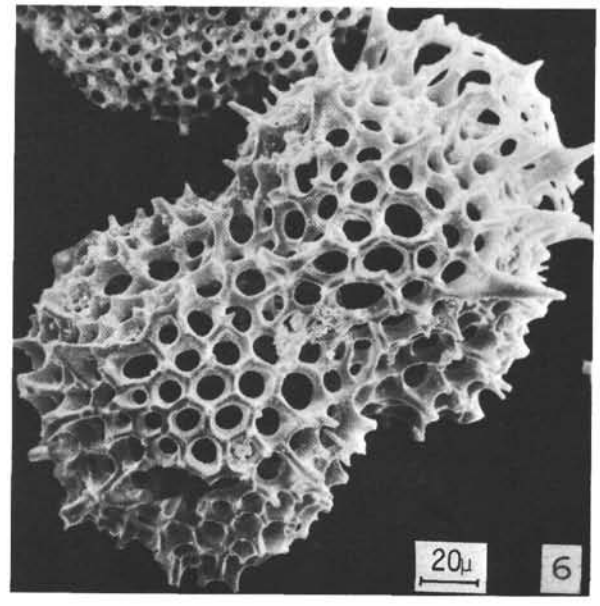


PLATE 7

Quaternary Radiolaria

(Figures *1, 2* 127-14-5, 26-29 cm; Figures *3, 5* 121-3-4, 72-75 cm; Figures *4, 6, 7* 121-3-4, 15-18 cm)

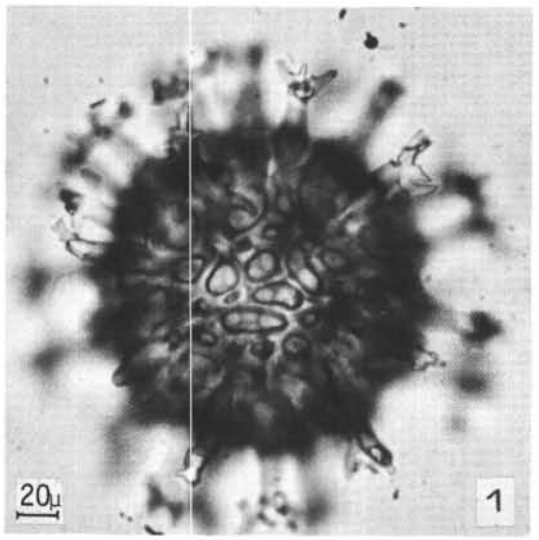
Figures 1, 2. *Haeckeliella inconstans* n. sp., holotype.
1. Focused on surface.
2. Focused on diameter.

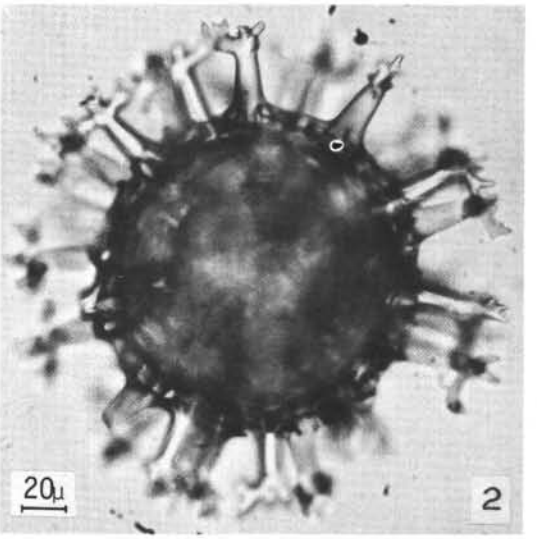
Figures 4-6. *Rhizosphaera* spp., all focused on diameter.

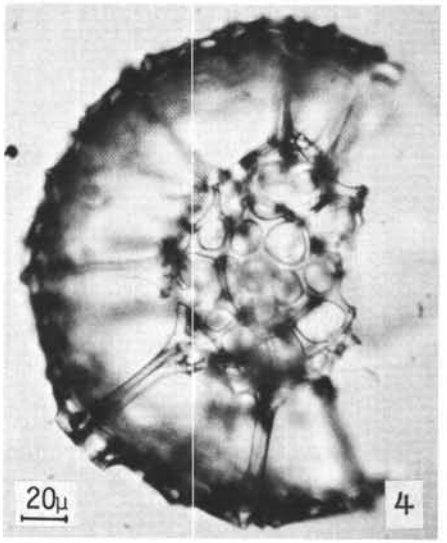
Figure 3. *Cubotholus* sp.

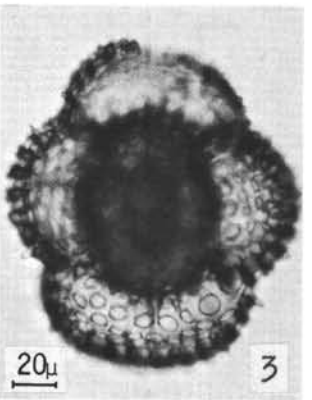
Figure 7. *Heliodiscus asteriscus* Haeckel.

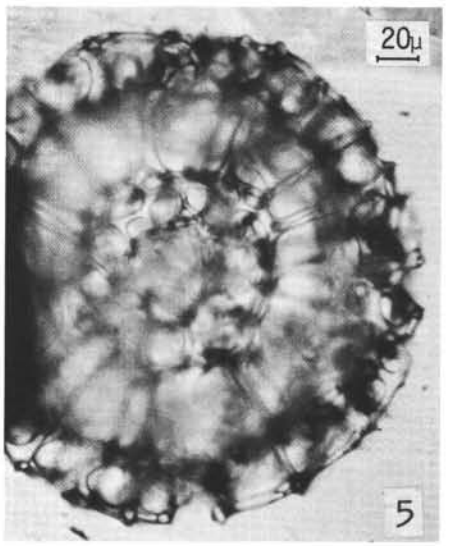
PLATE 7

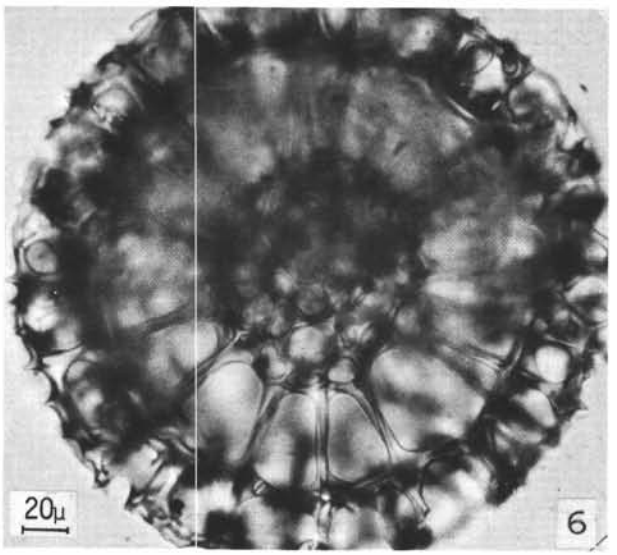












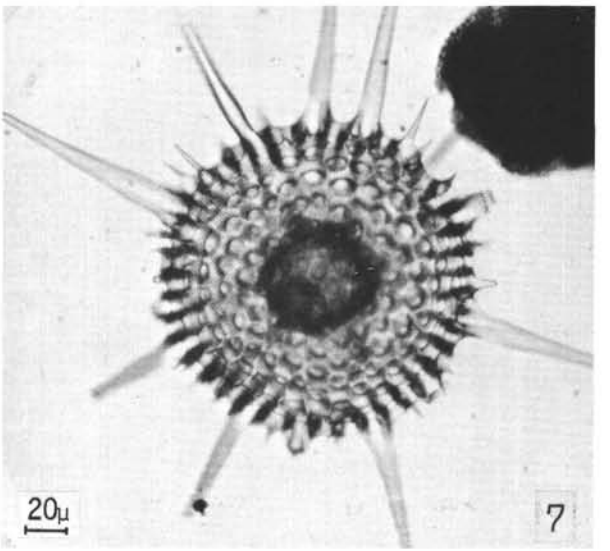
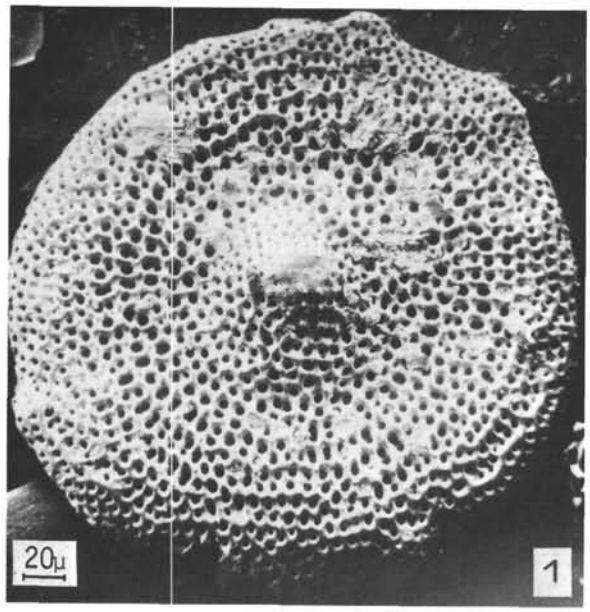


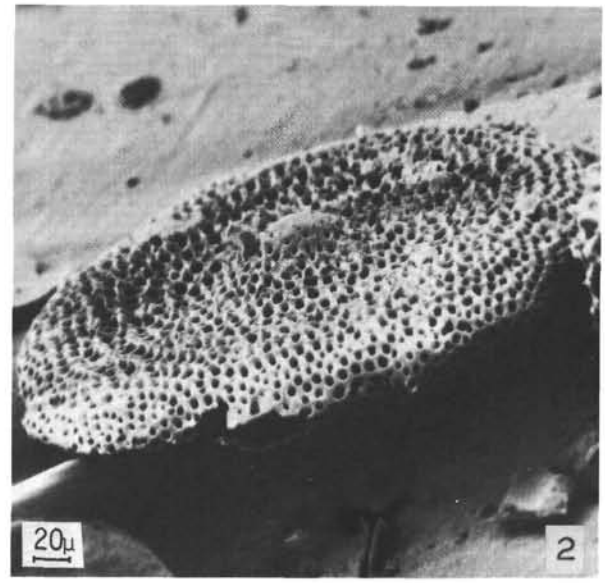
PLATE 8

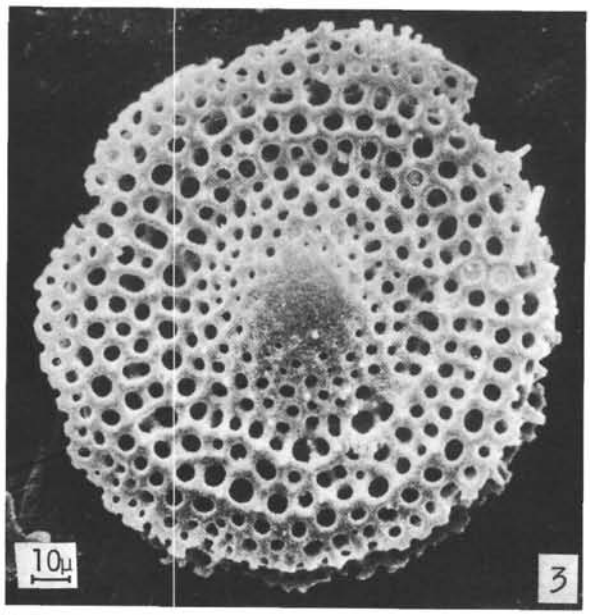
Quaternary Radiolaria (Figures *1-4* 128-11 CC;
Figures *5, 6* 128-10-3, 59-62 cm)

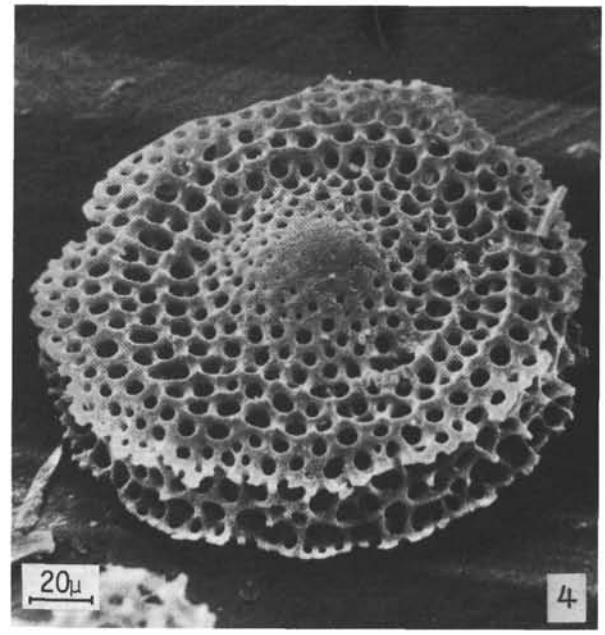
Figures 1-6. *Porodiscus* spp. Figures 2, 4, 6 represent other view of Figures 1, 3, 5. To note the poreless central area.

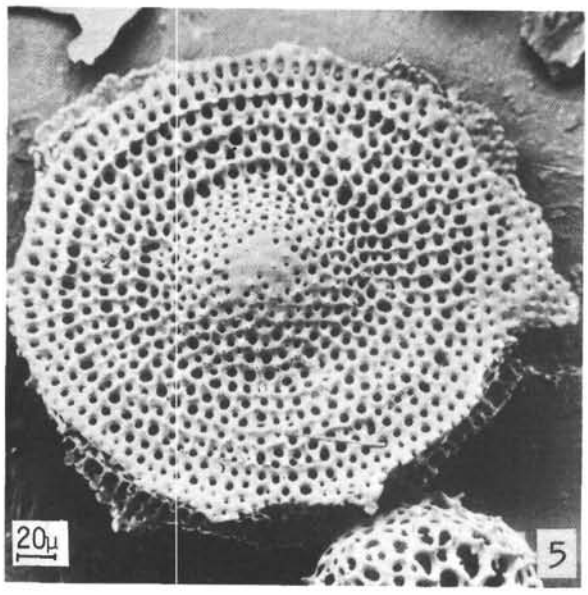
PLATE 8











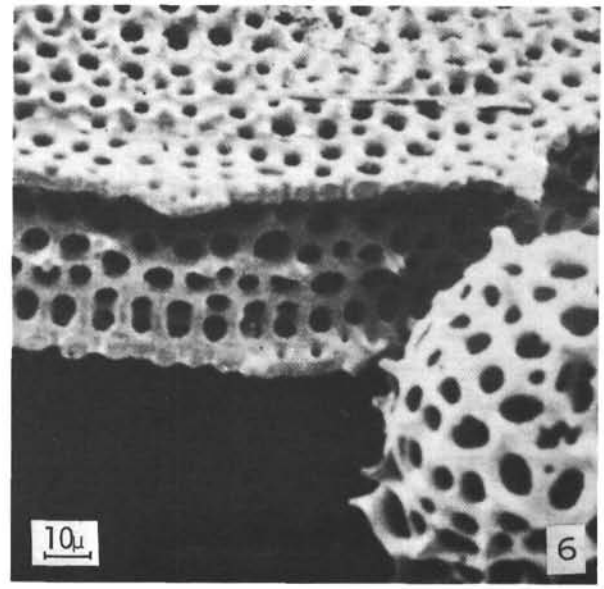


PLATE 9

Quaternary Radiolaria (128-11 CC)

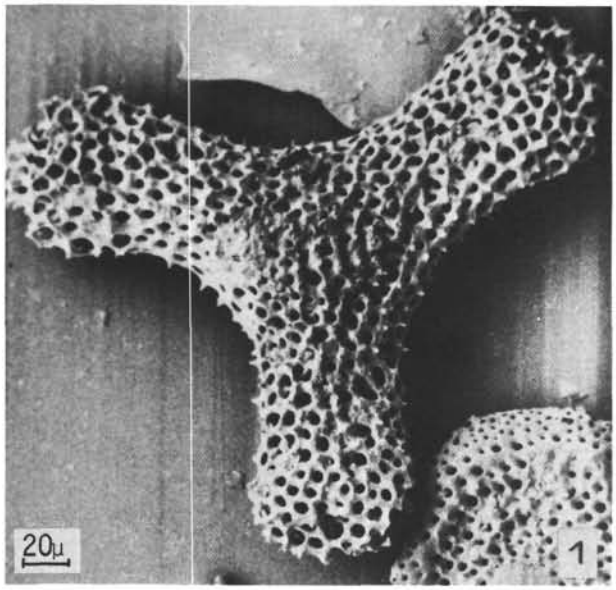
Figures 1, 3. *Rhopalastrum* sp., young specimen.
2. The same specimen, a portion of an arm much magnified.

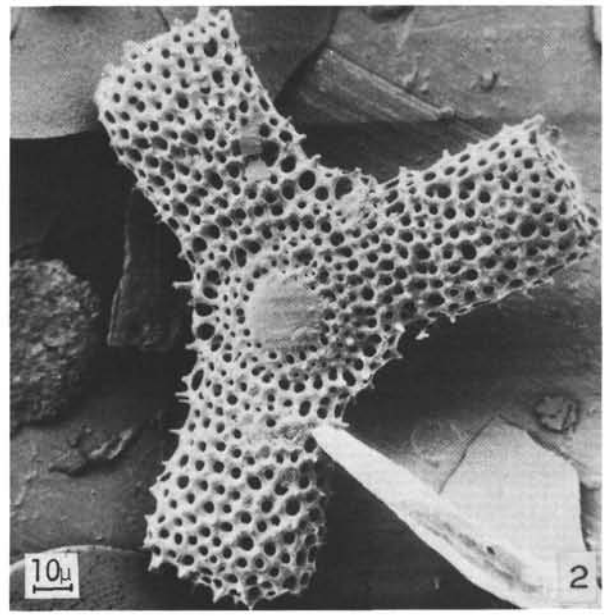
Figures 2, 4. *Amphirhopalum wirchowii* (Haeckel). To note the central poreless area.
4. The same, an arm much magnified.

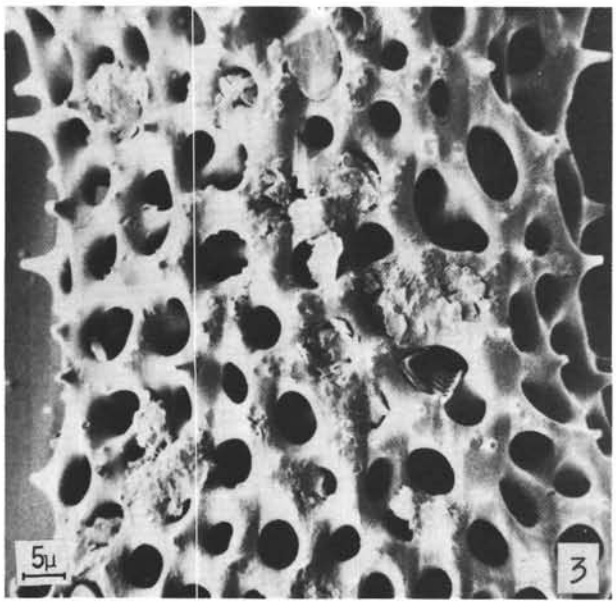
Figure 5. *Spongodiscus mediterraneus* Haeckel.

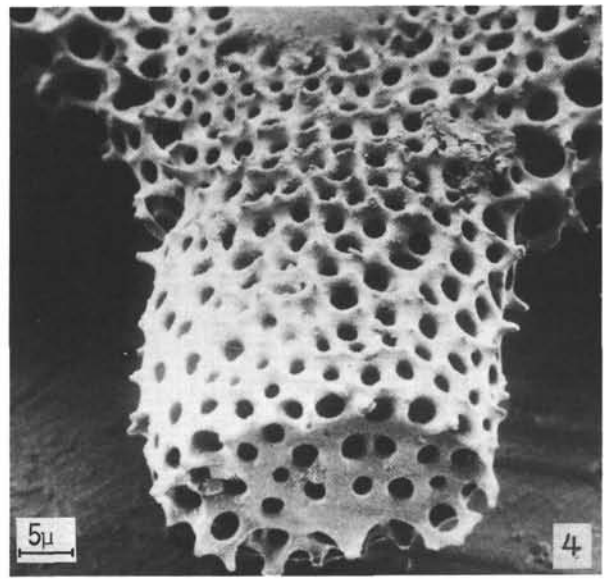
Figure 6. *Porodiscus* sp.

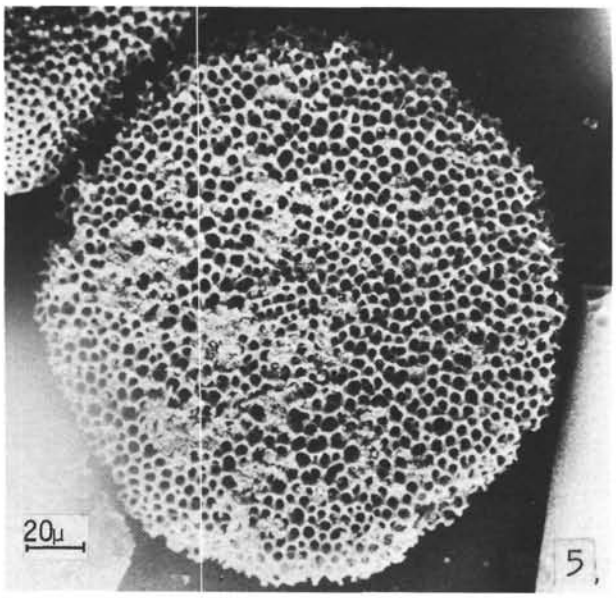
PLATE 9











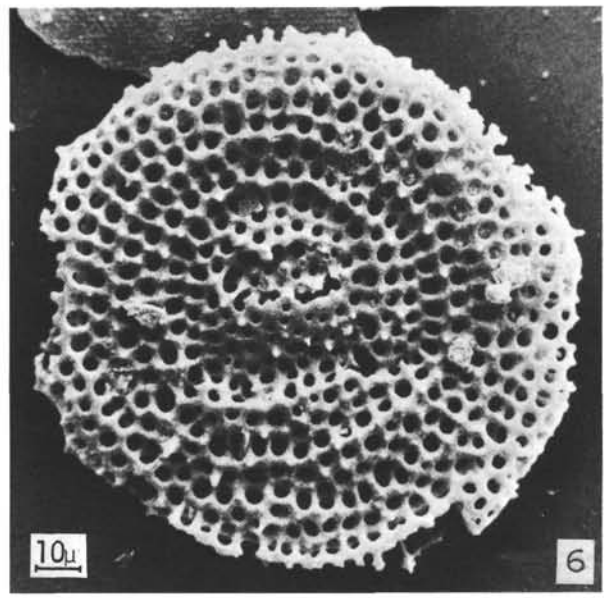


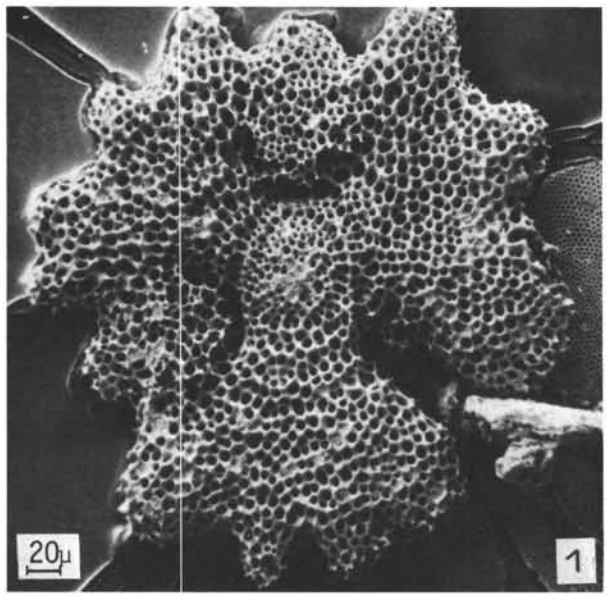
PLATE 10

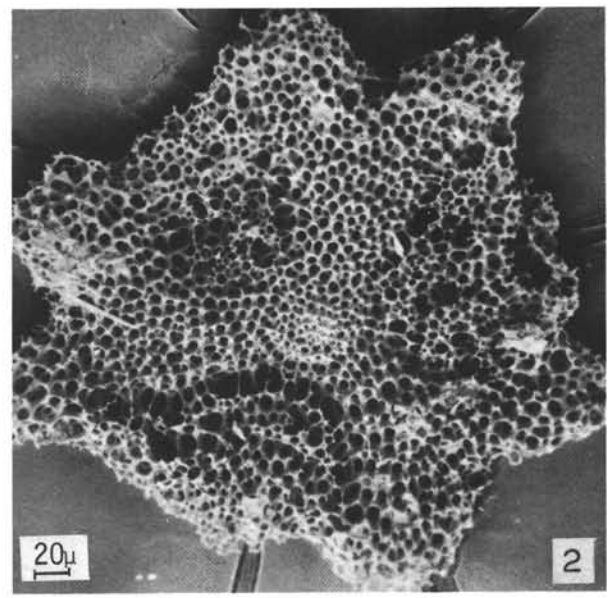
Quaternary Radiolaria (128-3-6, 80 cm)

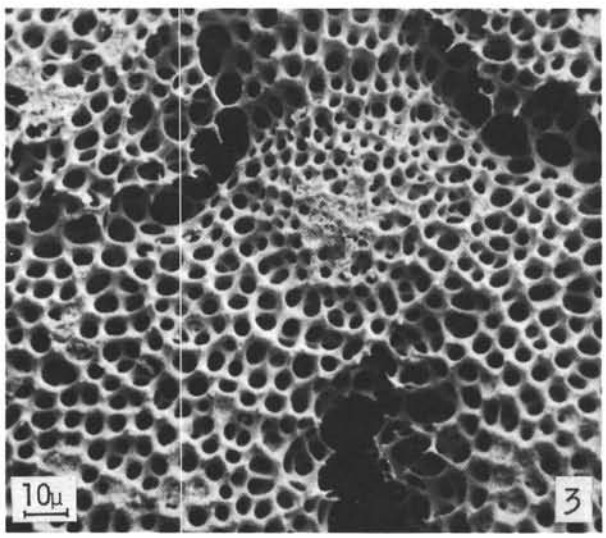
Figures 1-4. *Trigonastrum regulare* Haeckel.
3. The same, a portion of the shell much magnified.
4. The same, a portion of the shell much magnified.

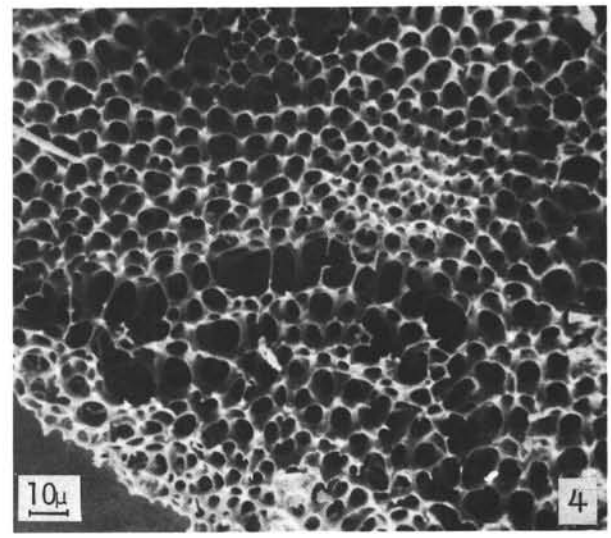
Figures 5, 6. *Spongodiscus mediterraneus* Haeckel.
6. The same, a portion of its broken margin, in lateral view, showing the inner spongy network and the upper and lower latticed plates.

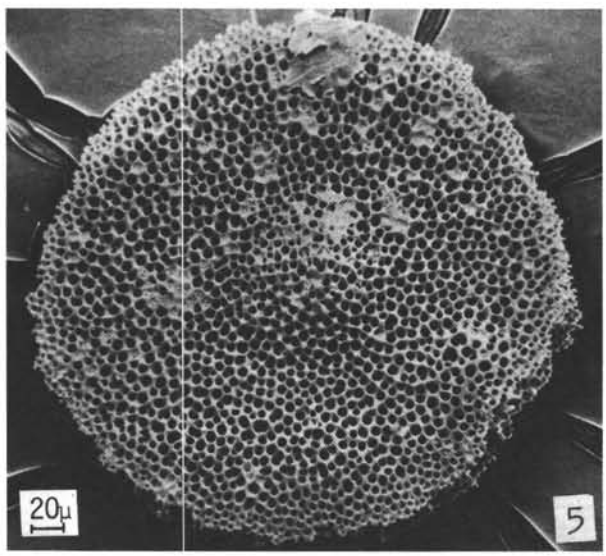
PLATE 10











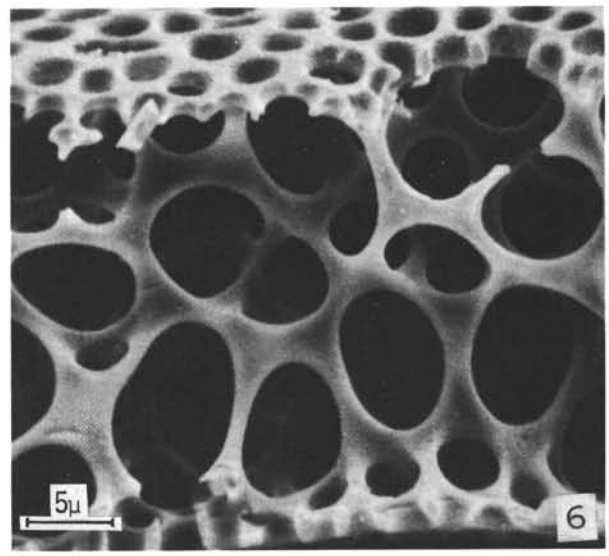


PLATE 11

Quaternary Radiolaria (Figures *1, 3, 5, 8* 128-3-6, 80 cm;
Figures *2, 4, 6, 7* 121-3-4, 15-18 cm;
Figure *9* 128-10-3, 5-8 cm)

Figures 1, 3, 5, 8. *Trigonastrum regulare* Haeckel.

Figure 2. *Spongurus cylindricus* Haeckel, with latticed mantle.

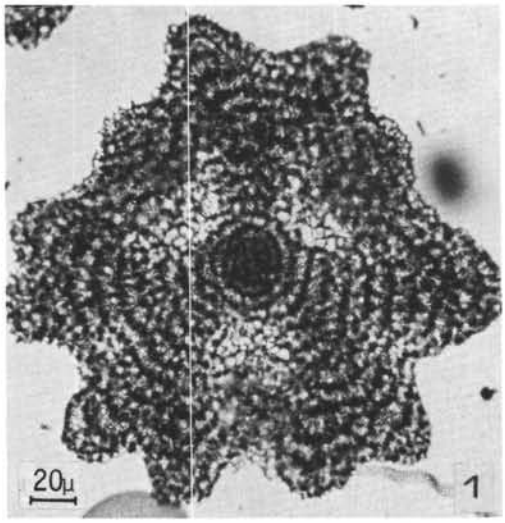
Figure 4. *Rhopalastrum abyssorum* (Ehrenberg).

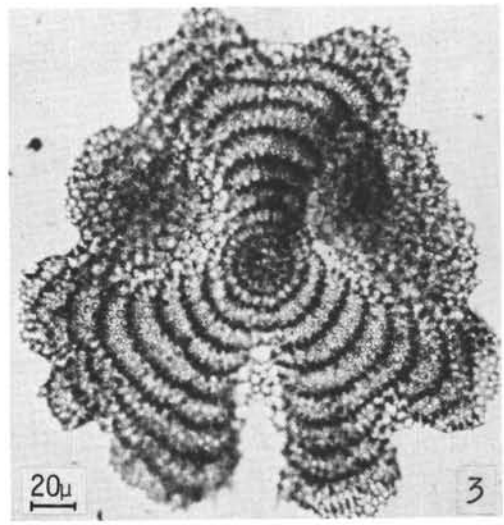
Figure 6. *Amphirhopalum wirchowii* Haeckel.

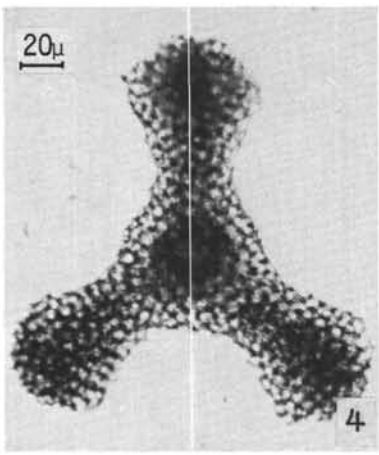
Figure 7. *Ommatartus tetrathalamus* (Haeckel), with incipient polar caps.

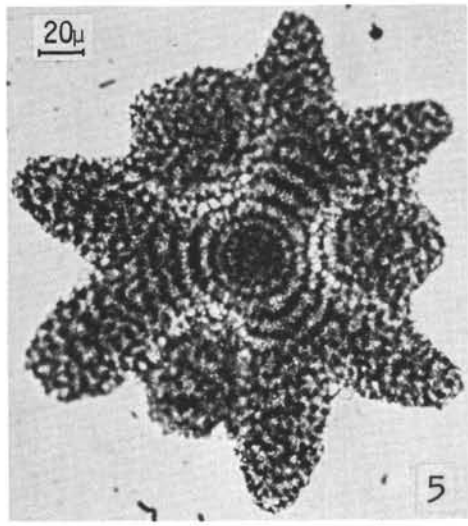
Figure 9. *Ommatartus* sp.

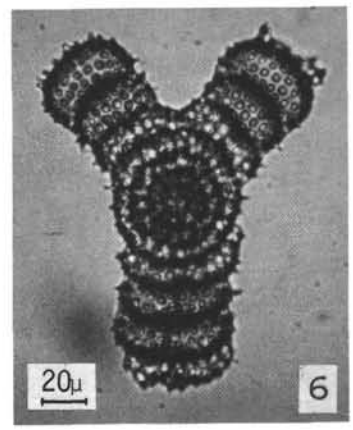
PLATE 11

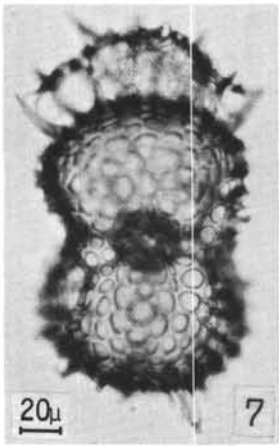


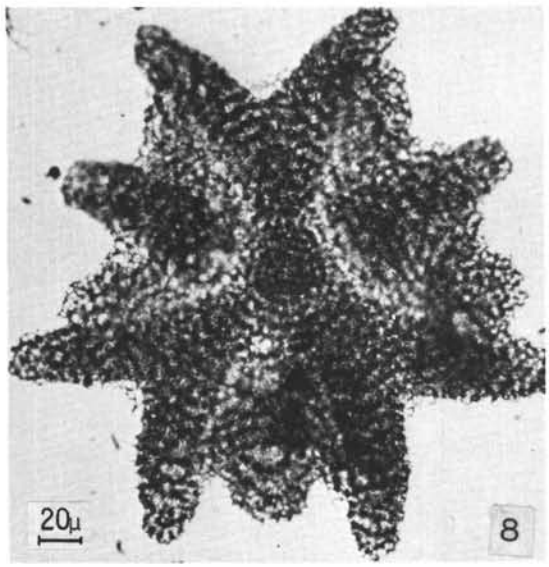












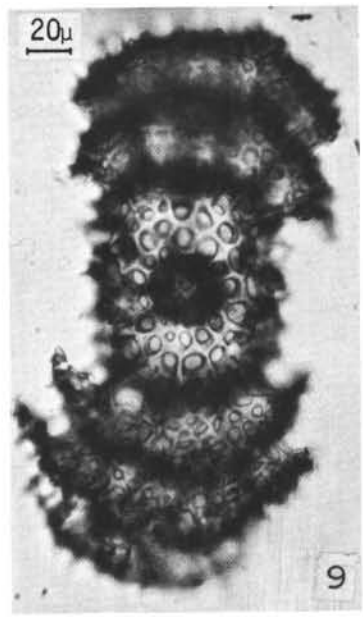


PLATE 12

Quaternary Radiolaria (128-3-6, 80 cm)

Figures 1-6. *Pseudocubus* cf. *vema* (Hays)

Figures 1-3, 5. The same specimen.
1. Lateral view.
2. Oblique-lateral view.
3. Central portion of the inner structure showing thin median bar, apical, dorsal and lateral spines, and three-bladed, thick primary arches.
5. Basal view.

Figures 4,6. Other specimen.
4. The central portion of the inner structure in oblique-basal view showing well developed dorsal and axial (vertical) spines.
6. Basal view of the same specimen.

PLATE 12

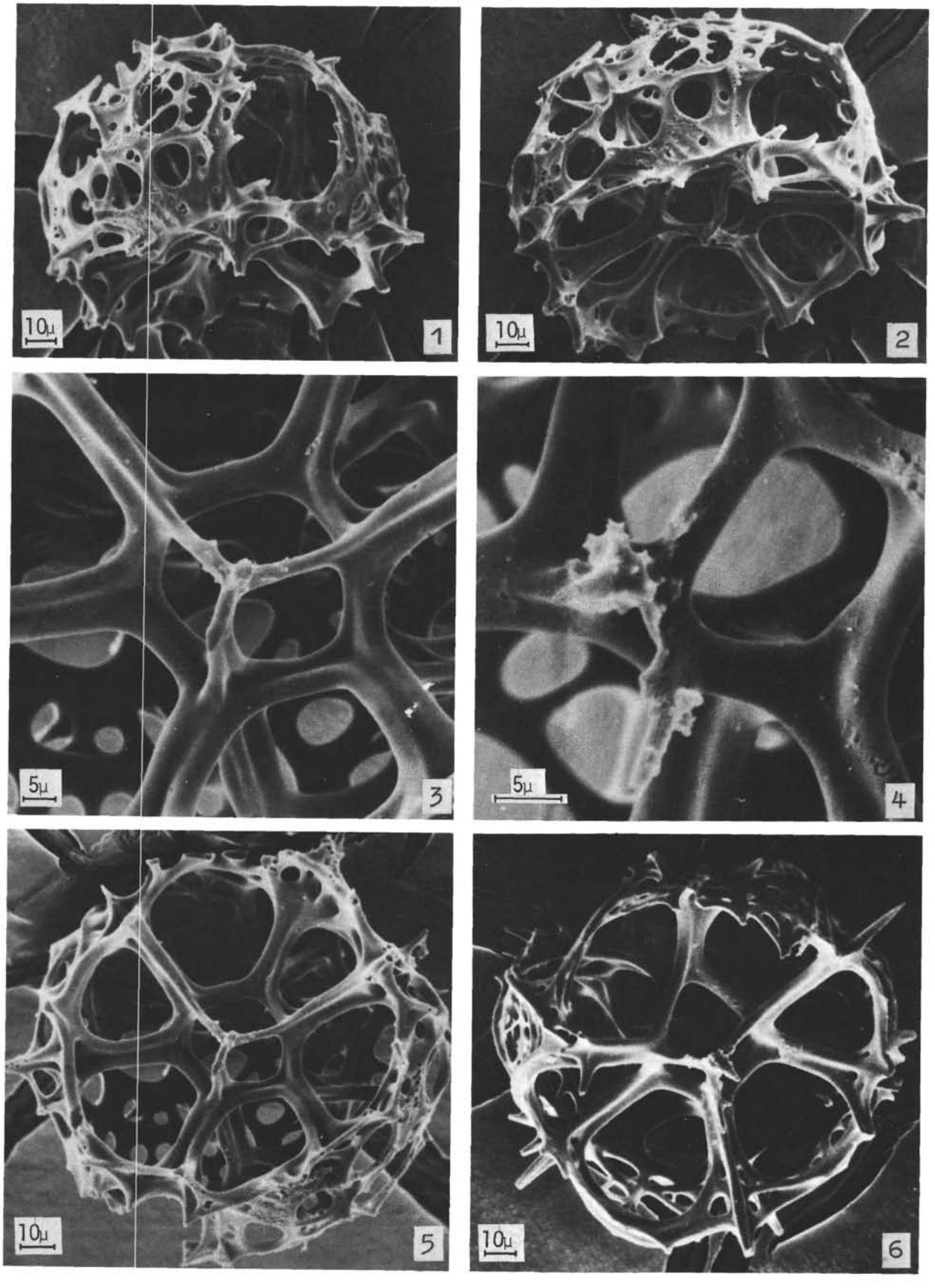


PLATE 13

Quaternary Radiolaria (Figures *1, 2* 128-11 CC;
Figures *3-6*. 128-3-6, 80 cm)

Figures 1, 2. *Lithopera (Lithopera) bacca* Ehrenberg.
1. Oblique-apical view showing a row of large collar pores.
2. Lateral view of the same specimen.

Figures 3-6. *Pterocanium charybdeum* (Müller).
3. Lateral view.
4. Basal view of the collar septum.
5. The same specimen, cephalis much magnified.
6. The same, in basal view.

PLATE 13

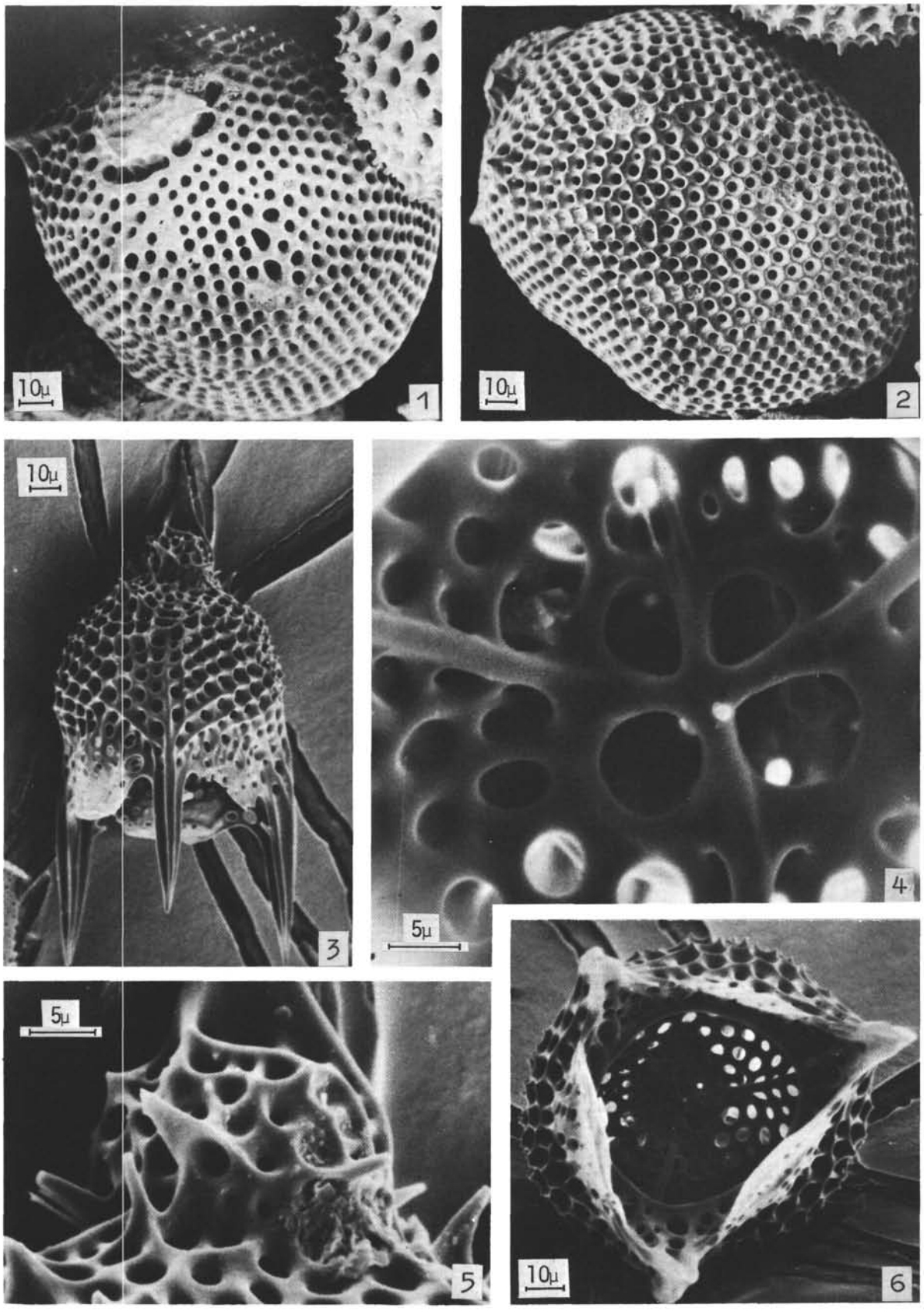


PLATE 14

Quaternary Radiolaria (128-11 CC)

Figure 1. *Lamprocyclas aegles* (Ehrenberg).

Figure 2. *Anthocyrtidium* sp.

Figure 3. ?*Theocorythium* sp., specimen with broken abdomen.

Figure 4. *Carpocanistrum* sp.

PLATE 14

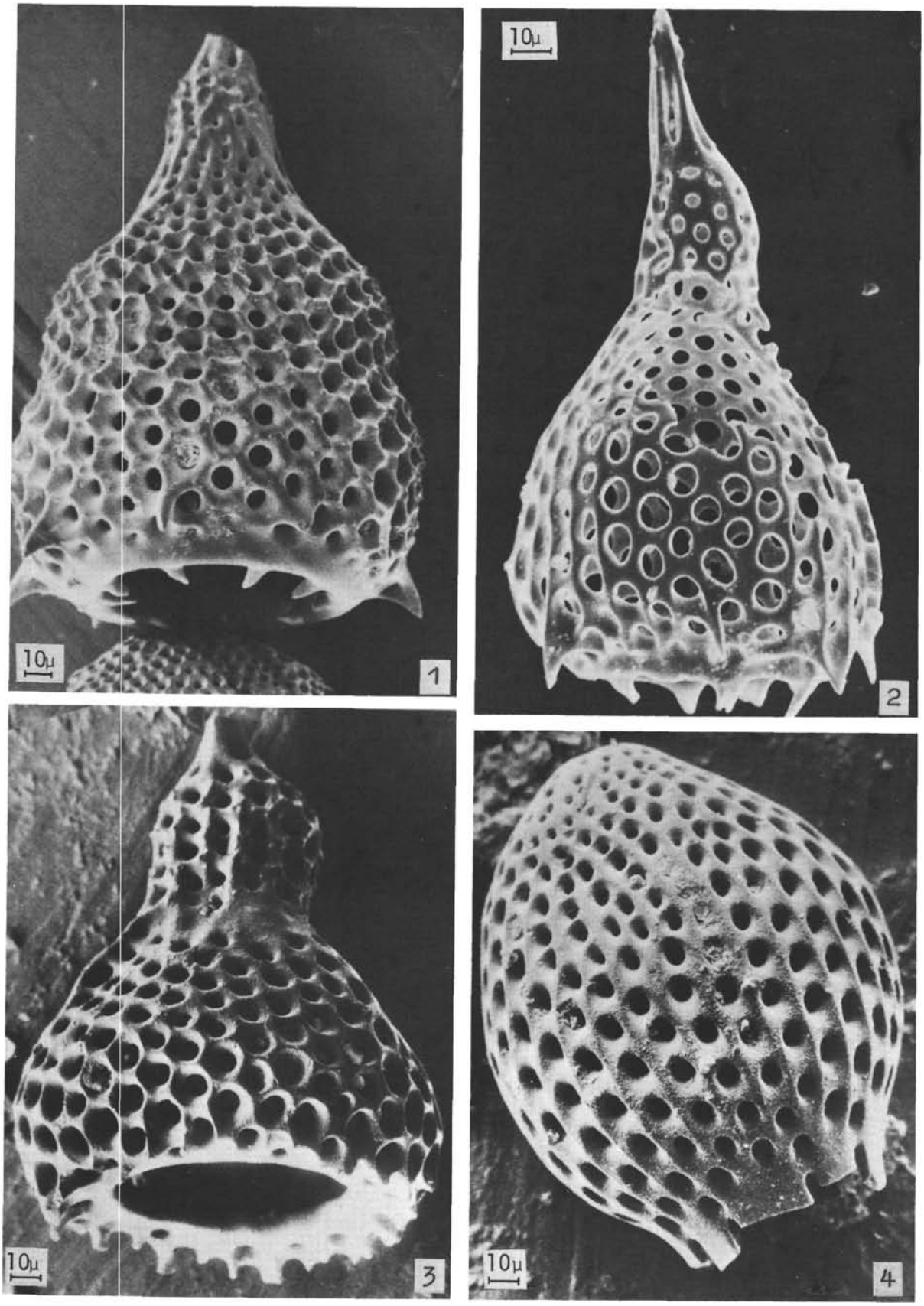


PLATE 15

Quaternary Radiolaria

Figures 1-5. *Lamprocyclas aegles* (Ehrenberg). 121-3-4, 15-18cm.
1, 3, 5. Focused on surface.
2, 4. The same specimens as 1 and 3, but focused on diameter.

Figures 6, 7. *Artostrobium* ex gr. *auritum* (Ehrenberg). 127-14-5, 26-29cm.

Figures 8, 13. *Theocorythium* ex gr. *amicae* (Haeckel)
8. 128-11 CC.
13. 121-3-4, 15-18cm.

Figure 9. *Spirocyrtis* ex gr. *scalaris* Haeckel, 121-3-4, 15-18cm.

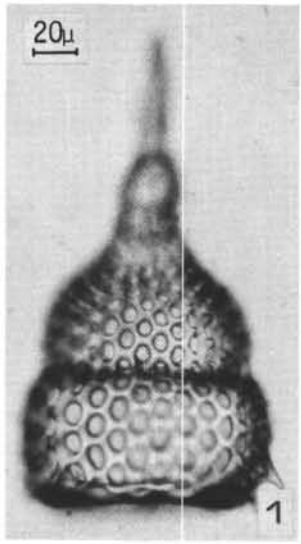
Figure 10. *Carpocanistrum* (?) *odysseus* (Haeckel), 128-10-3, 5-8cm.

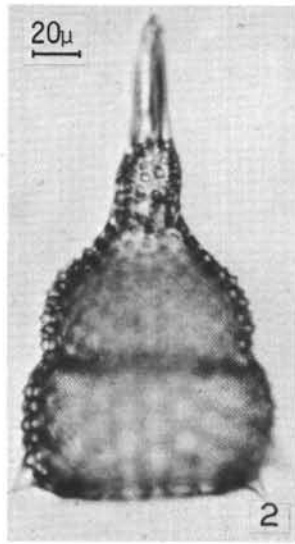
Figures 11, 12. *Carpocanistrum* spp., 127-14-5, 83-86cm.

Figure 14. *Porospathis* sp. aff. *P. holostoma* (Cleve), 127-14-5, 2-5cm.

Figure 15. *Cadium marinum* Bailey, 127-14-5, 26-29cm.

PLATE 15


20μ
1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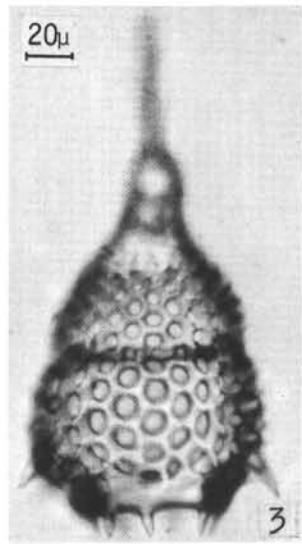
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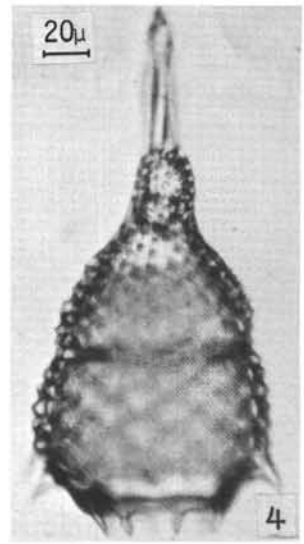
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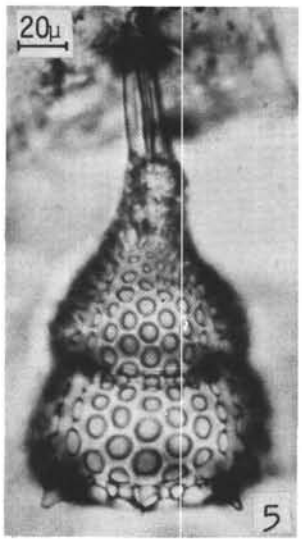
20μ
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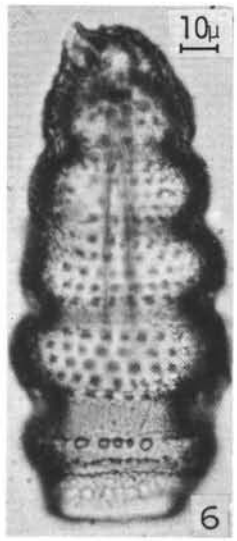
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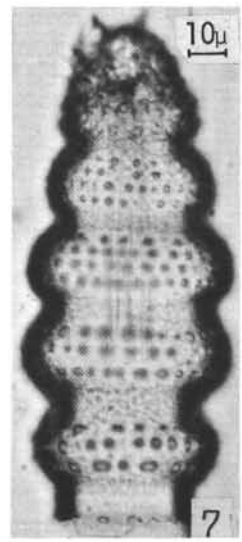
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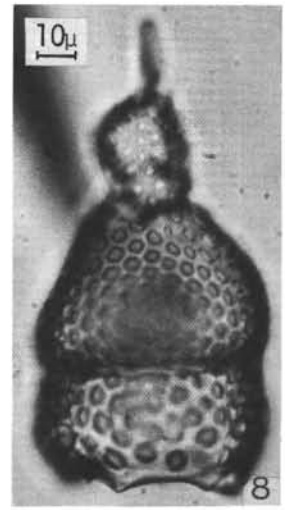
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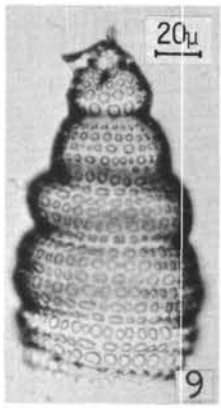
8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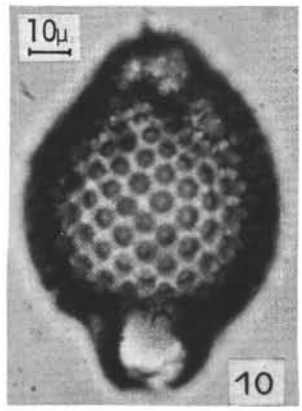
10μ
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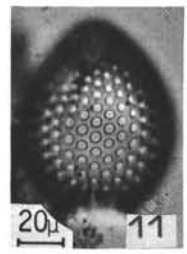
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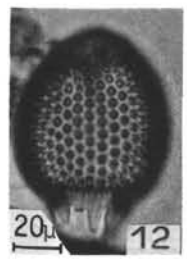
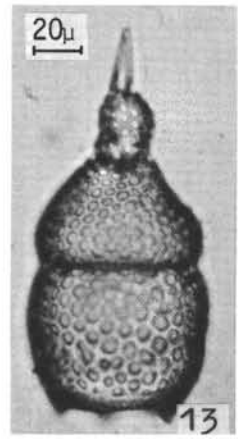

20μ
12


20μ
13


14

10μ


10μ
15

PLATE 16

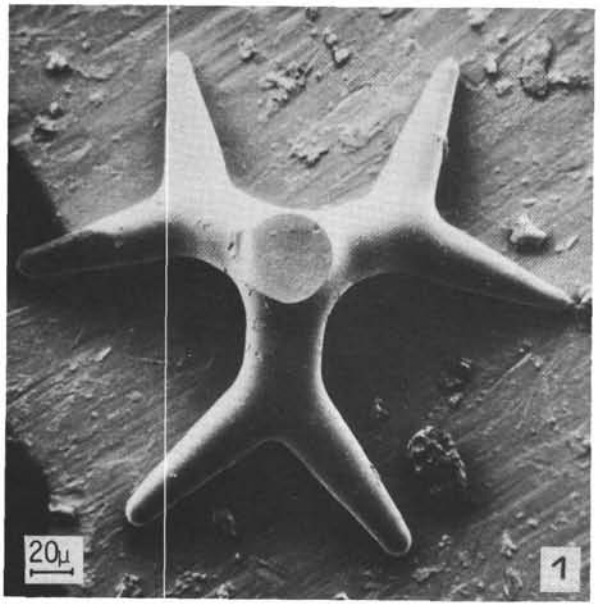
Quaternary sponge spicules (128-11 CC)

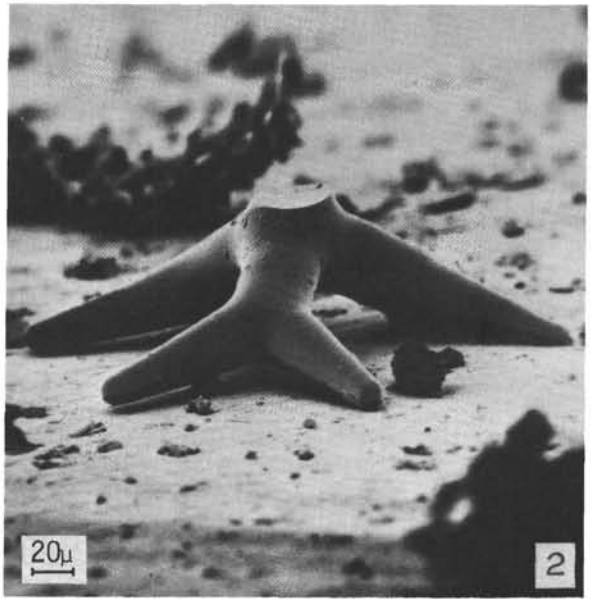
Figures 1, 2. Dichotriaene with broken axis.
1. Axial view.
2. The same in lateral view.

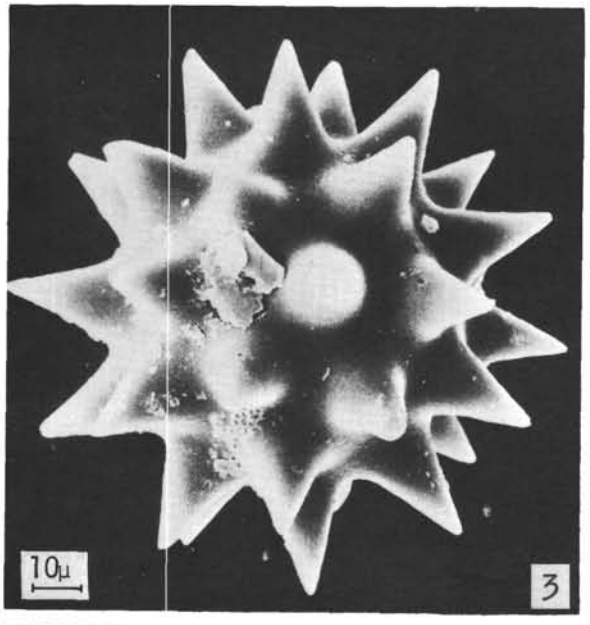
Figure 3. Sphaeraster.

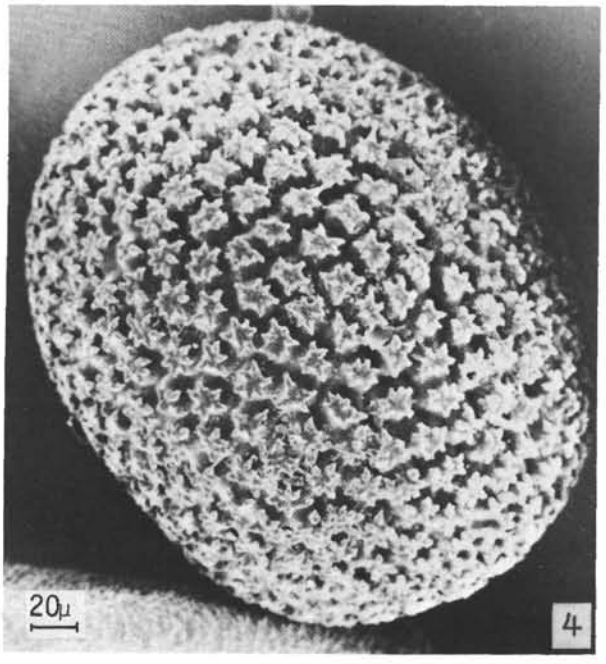
Figures 4-6. Sterraster.
5. The same, portion of surface much magnified.
6. The same, portion of surface much magnified.

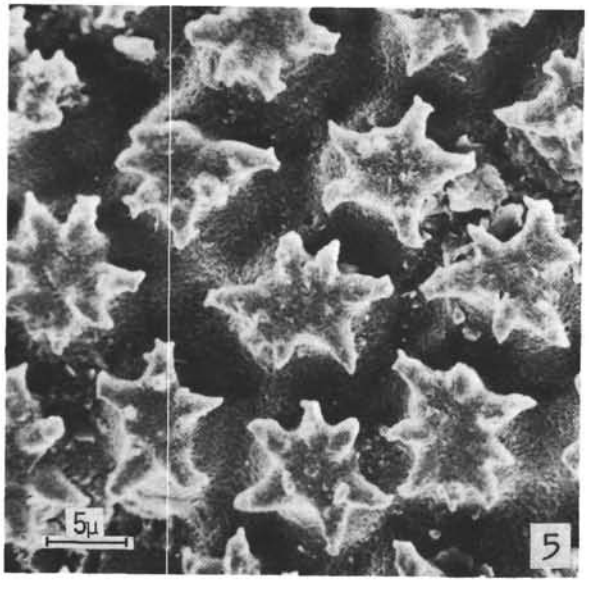
PLATE 16











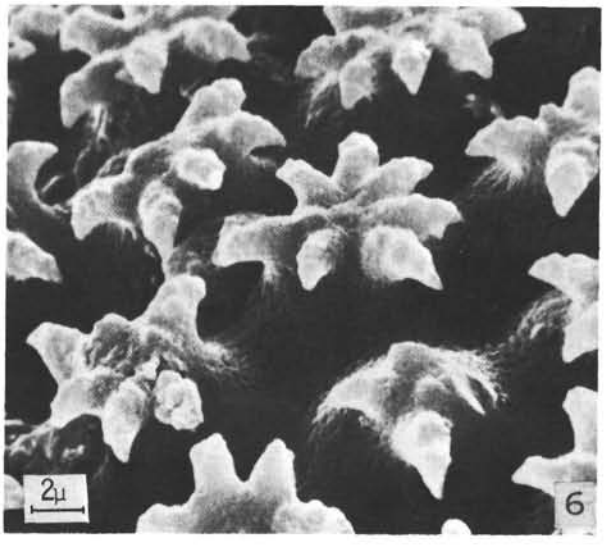


PLATE 17

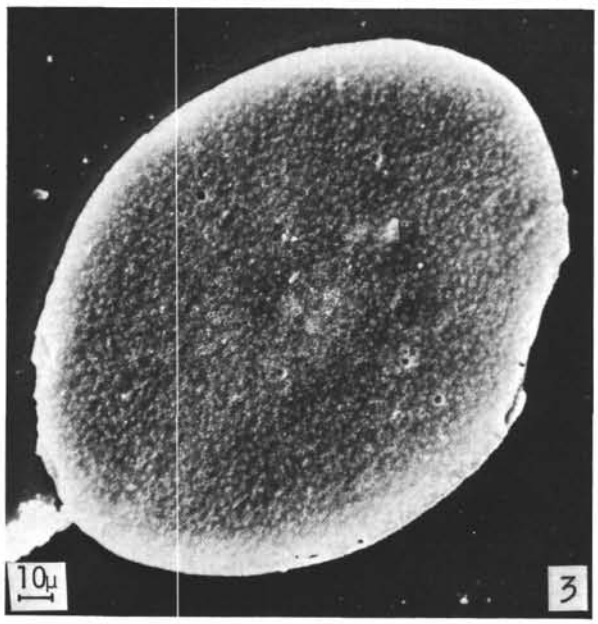
Quaternary silicoflagellates and sponge spicules

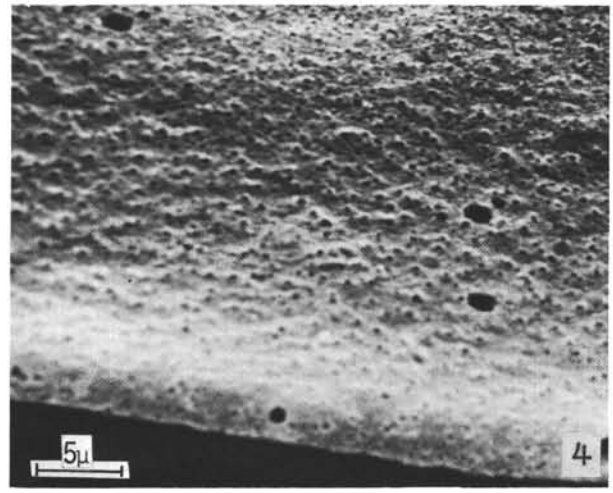
Figure 1. *Dictyocha messanensis* Haeckel, 128-10-3, 59-62cm.

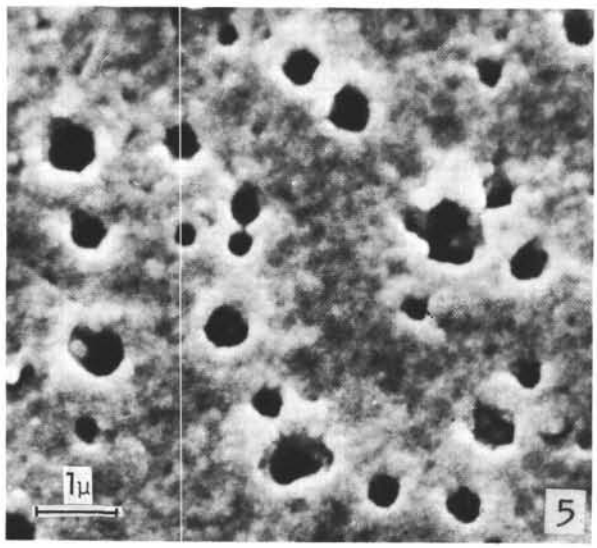
Figure 2. *Mesocena elliptica verrucosa* n. ssp., 128-10-3, 5-8cm.

Figures 3-6. Flattened sponge spicule. 128-11 CC.
3. Axial view.
4. The same, fragment.
5. The same, portion of surface much magnified.
6. The same, oblique-axial view showing a double-walled structure.

PLATE 17







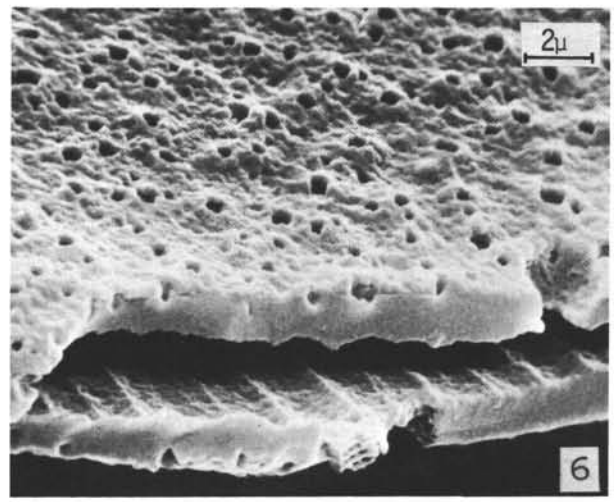


PLATE 18

Aptian and Quaternary Radiolaria

Figure 1. *Cenosphaera minuta* Pantanelli. 120-4-1, 76-80 cm., X325.

Figure 2. *Polysolenia spinosa* (Haeckel). 128-11 CC, X325.

Figure 3. *Siphonosphaera polysiphonia* Haeckel. 128-11 CC, X325.

Figure 4. *Collosphaera huxleyi* Müller. 128-3-5, 20-25cm, X325.

Figures 5, 6. *Collosphaera* cf. *macropora* Popofsky.
5. 121-1-1, 148-151cm, X325.
6. 128-3-6, 19-22cm. X325.

Figures 7-22. *Haeckeliella inconstans* n. sp. All X325.
7. Cortical shell of holotype, 127-14-5, 26-29 cm.
8. Paratype, macrosphere, 127-14-5, 26-29 cm.
9. Paratype, fragment of cortical shell, 127-14-5, 26-29 cm.
10. Paratype, fragment of shell with a long radial spine, 127-14-5, 133-135 cm.
11-22. Different types of radial spines, 127-14-5, 26-29 cm.

Figure 23. *Spongurus cylindricus* Haeckel, longitudinal section, 128-3-5, 41-55 cm, X 215.

PLATE 18

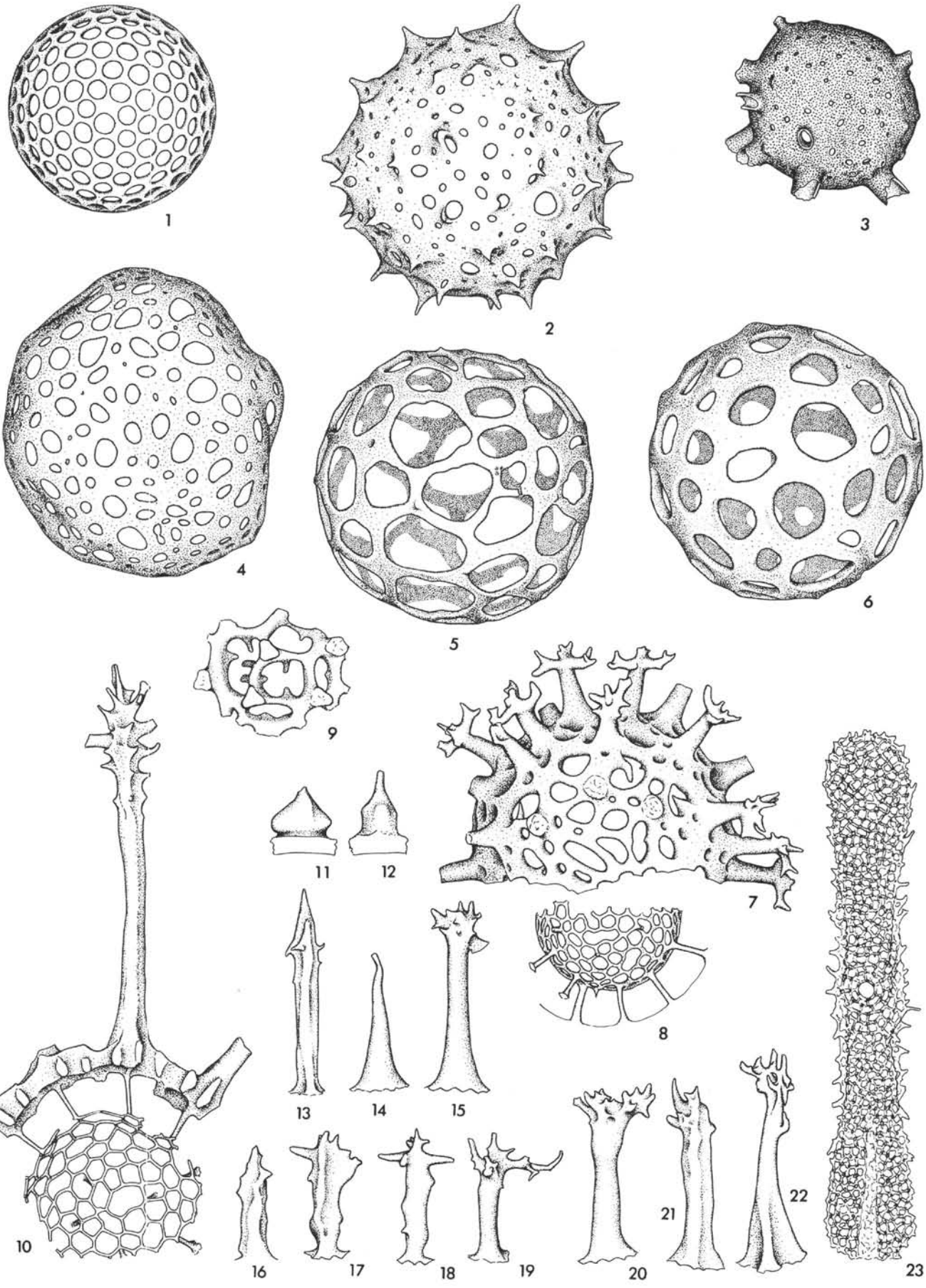


PLATE 19

Quaternary Radiolaria

Figures 1-4. *Heliaster hexagonium* Hollande & Enjumet. 128-11 CC.
1. Fragment of cortical shell, X325.
2-4. Microsphere; 2, 3: X325; 4: the microsphere illustrated in Figure 3, in other view and much magnified, X650.

Figures 5-9. *Actinosphaera* (?) *haackei* (Dreyer). X325.
5. Specimen with double bunches of lamellar polar spines, 127-14-3, 44 cm.
6. The same, microsphere.
7. Specimen with a single bunch of lamellar polar spines, 128-11 CC.
8. The same, microsphere.
9. Specimen without polar spines and with a sphere intermediate between microsphere and cortical sphere.

PLATE 19

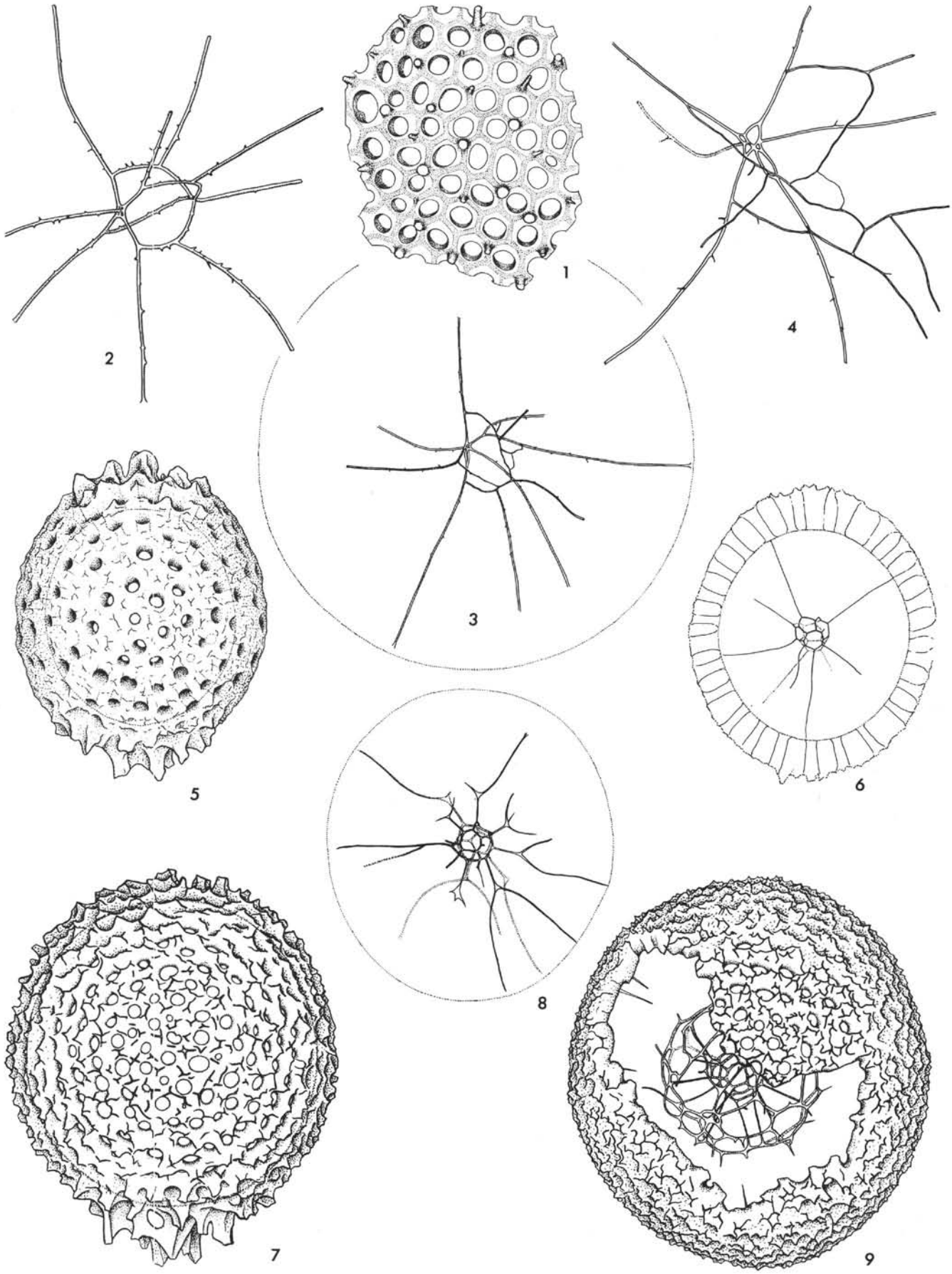


PLATE 20

Quaternary Radiolaria

Figures 1, 2. *Actinosphaera acanthophora* (Popofsky). 128-11 CC, X325.
2. Inner structure of the specimen illustrated in Figure 1.

Figure 3. *Actinomma mediterranensis* Hollande & Enjumet. 121-3-4, 15-18 cm, X325

Figure 4. *Echinomma antarctica* (Dreyer) ?, young specimen. 127-5-6, 136-139 cm, X325.

Figure 5. *Druppatratus* (?) sp. 127-14-5, 26-29 cm, X325.

Figures 6, 7. *Druppatractus variabilis* n. sp. X325.
6. Young specimen, 127-14 CC.
7. Microsphere, 128-11 CC.

Figure 8. *Cromyatractus elegans* Dogel. 128-11 CC, X325.

Figure 9. *Xiphatractus spumeus* n. sp. 127-14-3, 44 cm, X325.

Figure 10. *Amphisphaera cristata* Carnevale. 127-14-3, 44 cm, X325.

PLATE 20

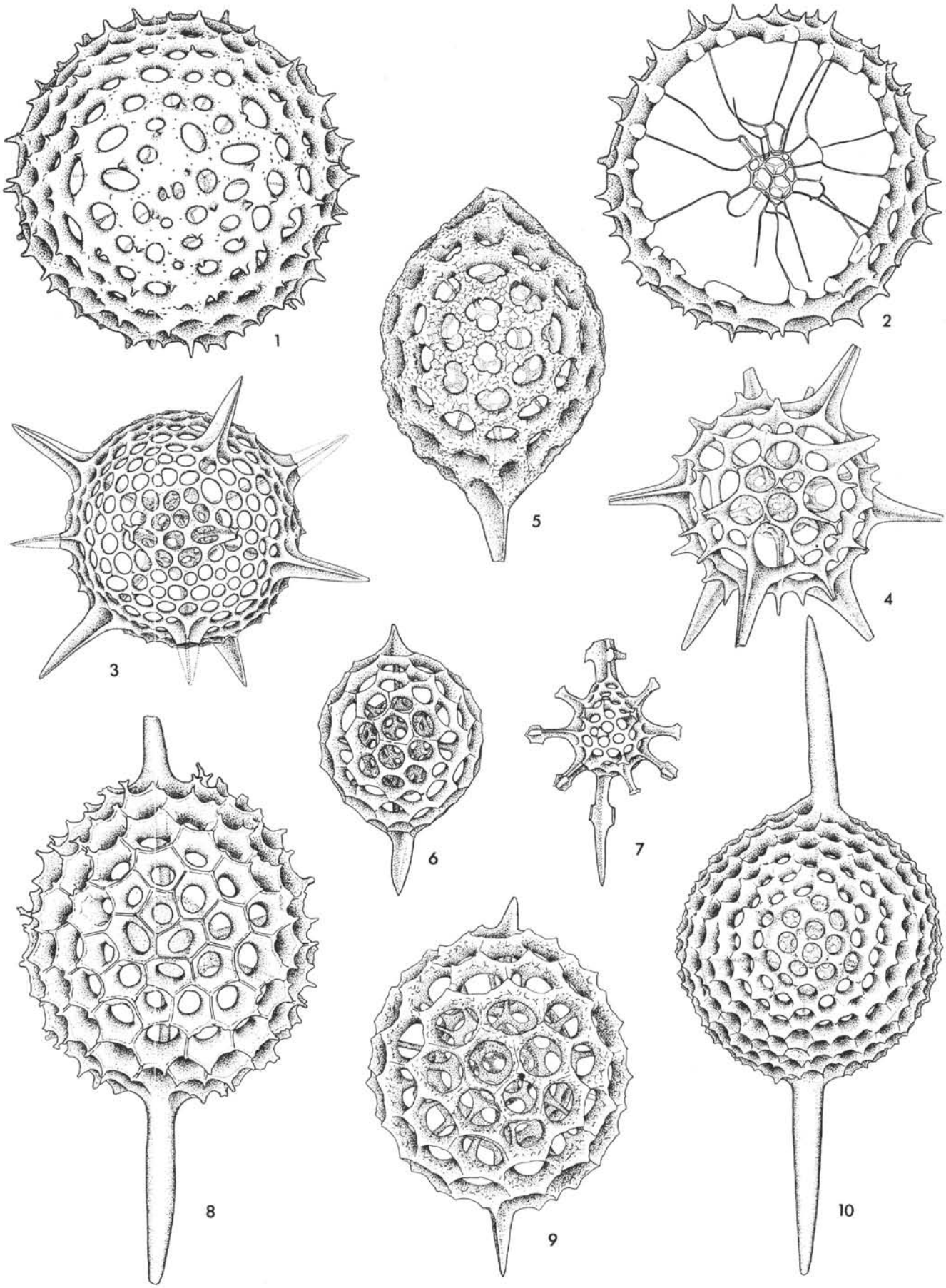


PLATE 21

Quaternary Radiolaria

Figure 1. *Echinomma antartica* (Dreyer)? 127-5-6, 136-139 cm, X325.

Figures 2-13. *Amphirhopalum wirchowii* (Haeckel), schematic figures illustrating the variability of species. X145.
2, 3, 8. 128-2 above 0 section.
4, 6, 7, 9-13. 128-11 CC.
5. 127-14-5, 133-135 cm.

Figures 14, 15. *Lithomelissa* cf. *thoracites* Haeckel, the same specimen in lateral and ventral view. 128-3-5, 20-25 cm, X325.

PLATE 21

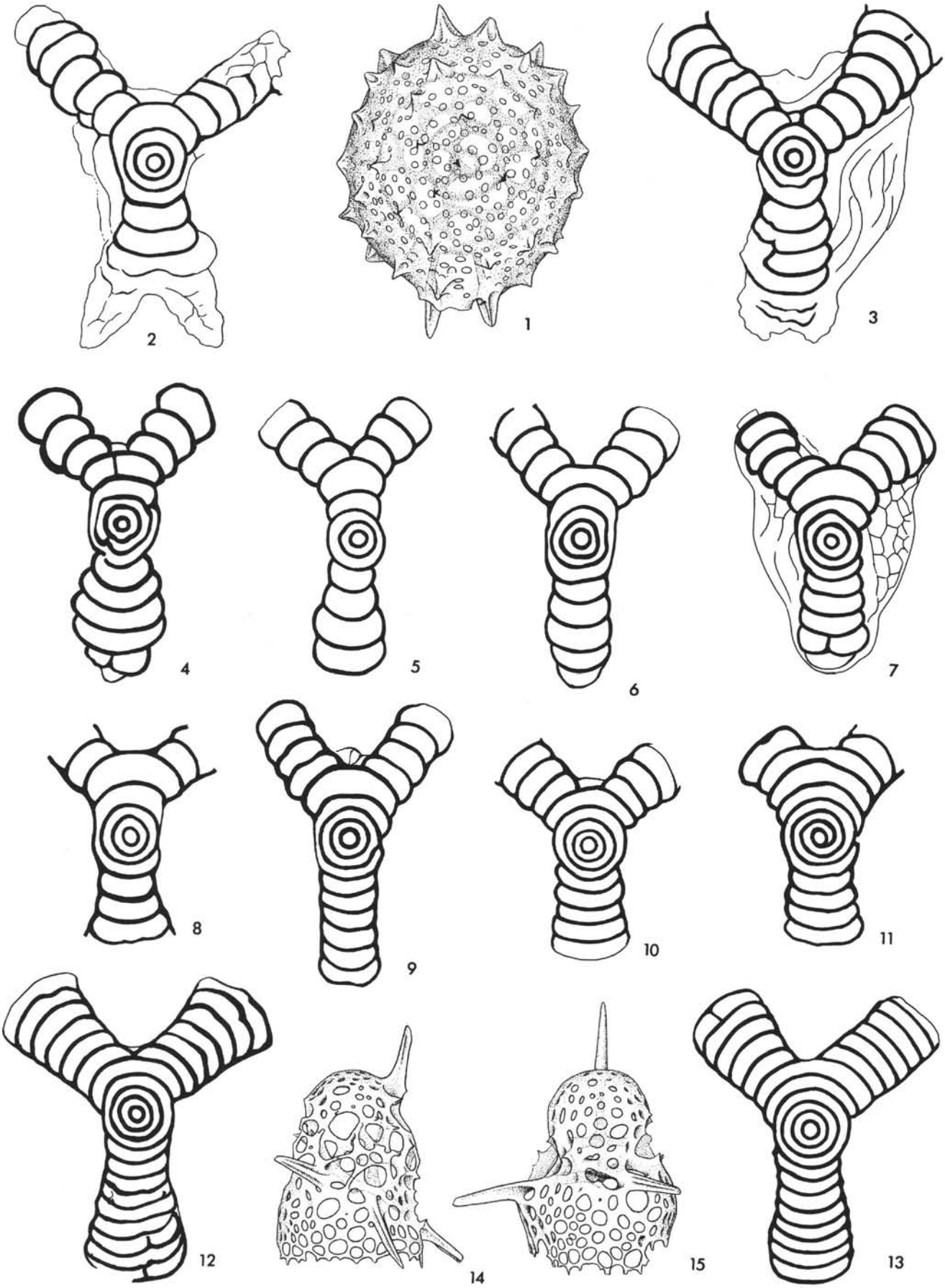


PLATE 22

Quaternary Radiolaria

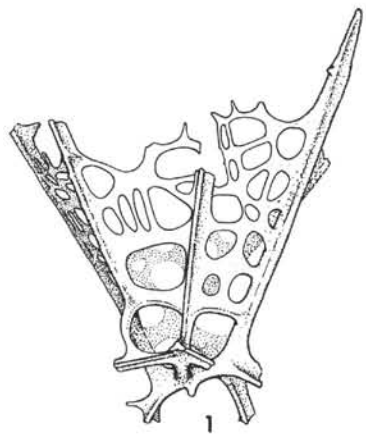
Figures 1, 3, 5. *Plagiacantha* (?) *panarium* n. sp. 128-3-6, 80 cm, X430.
1, 3. Holotype in lateral and dorsal view.
5. Paratype in lateral-dorsal view.

Figures 2, 4. *Plagiacantha arachnoides* Claparède. 128-3-6, 80 cm. X430.
2. Lateral view.
4. Almost apical view.

Figures 6, 7. *Pseudocubus* cf. *vema* (Hays).
6. Scheme of the cephalic structure.
7. Main elements of the cephalic structure, in lateral view, 128-3-6, 107-110 cm, X215.

Figures 8-10. ?*Plectacantha* (?) sp. 128-3-6, 80cm. X430.
8. Lateral view.
9. The same, in basal view.
10. Other specimen, in lateral view.

PLATE 22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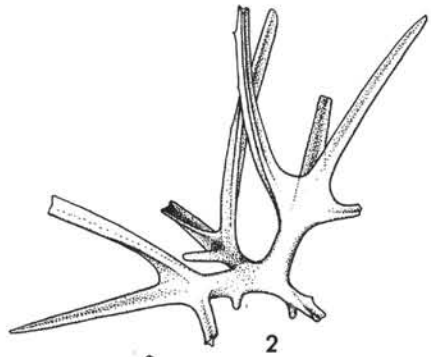
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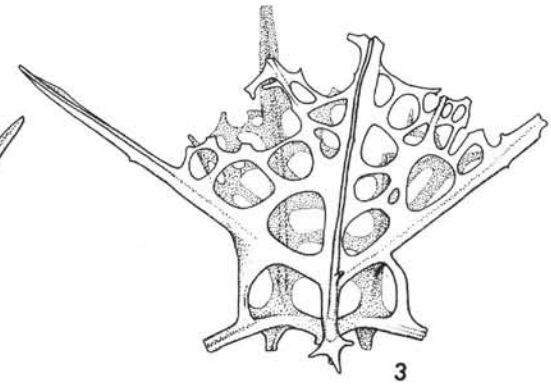
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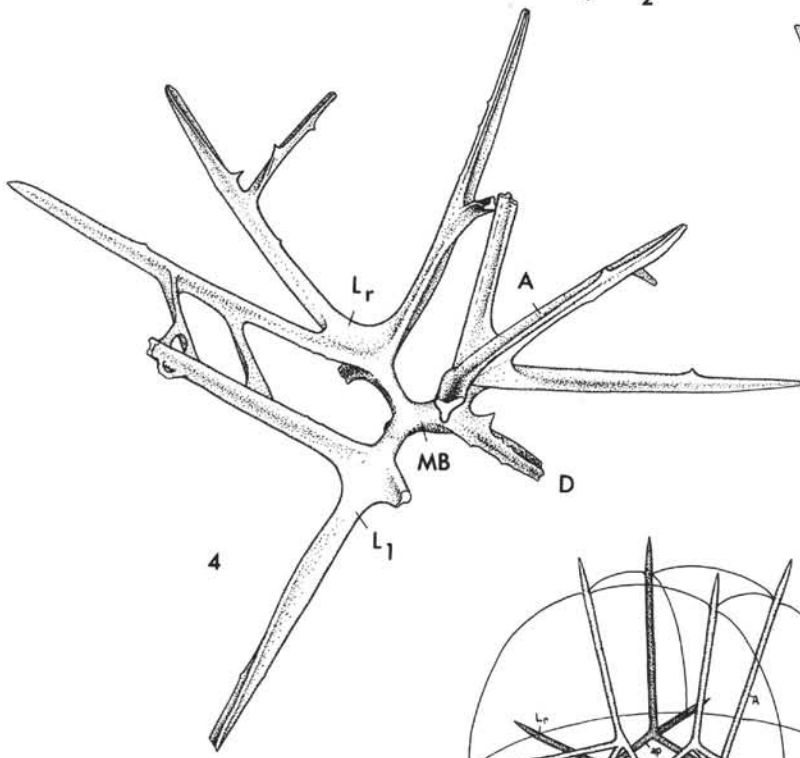

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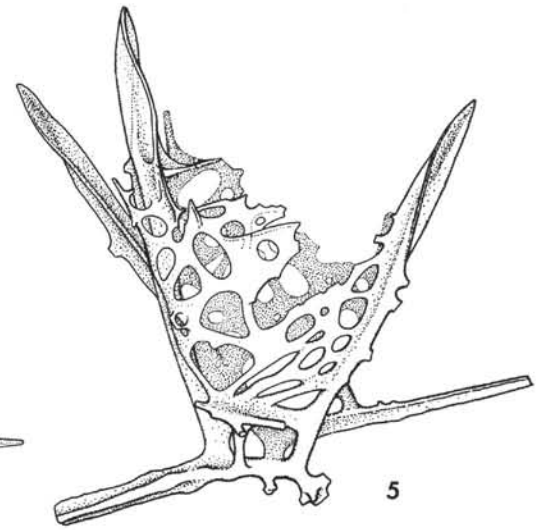
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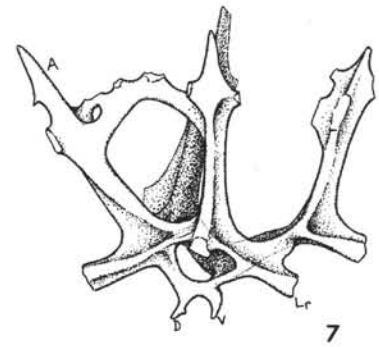

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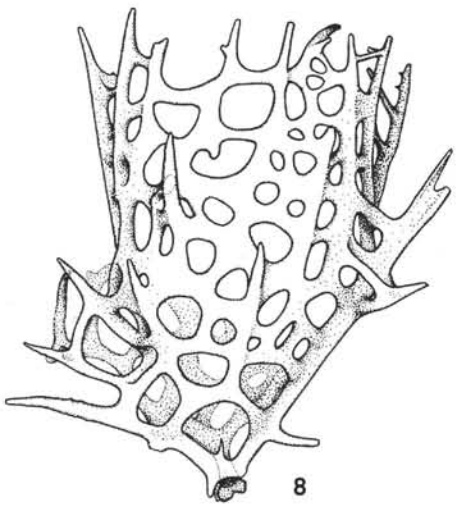
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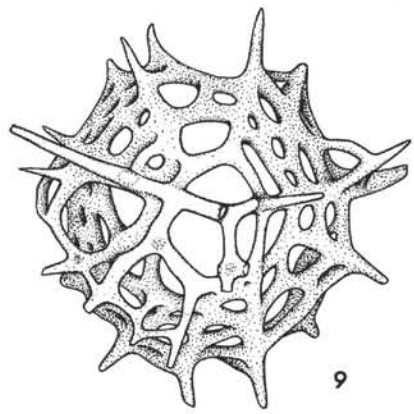
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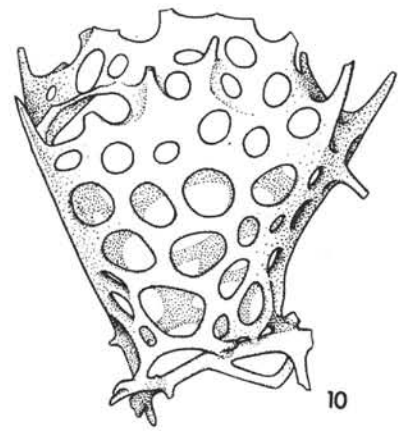
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PLATE 23

Quaternary Radiolaria

Figures 1, 2. *Sethoconus* (?) *dogieli* Petrushevskaya. 121-3-4, 15-18 cm, X 325.

Figure 3. *Enneaphormis rotula* Haeckel, broken specimen. 128-8-1, 142 cm, X325.

Figures 4, 5. *Helotholus* cf. *histricosa* Joergensen. 127-14-5, 83-86 cm, X325.

Figures 6, 7. *Lampromitra petrushevskayae* n. sp., holotype, in apical and lateral view. 128-3-5, 20-25 cm, X230.

Figure 8. *Corocalyptra emmae* Haeckel. 128-3-5, 20-25 cm, X325.

Figures 9, 10. *Lampromitra tiara* n. sp., holotype, in apical and lateral view. 128-3-5, 20-25 cm, X325.

Figure 11. *Cecryphalium sestrodiscus* Haeckel. 128-3-5, 20-25 cm, X325.

PLATE 23

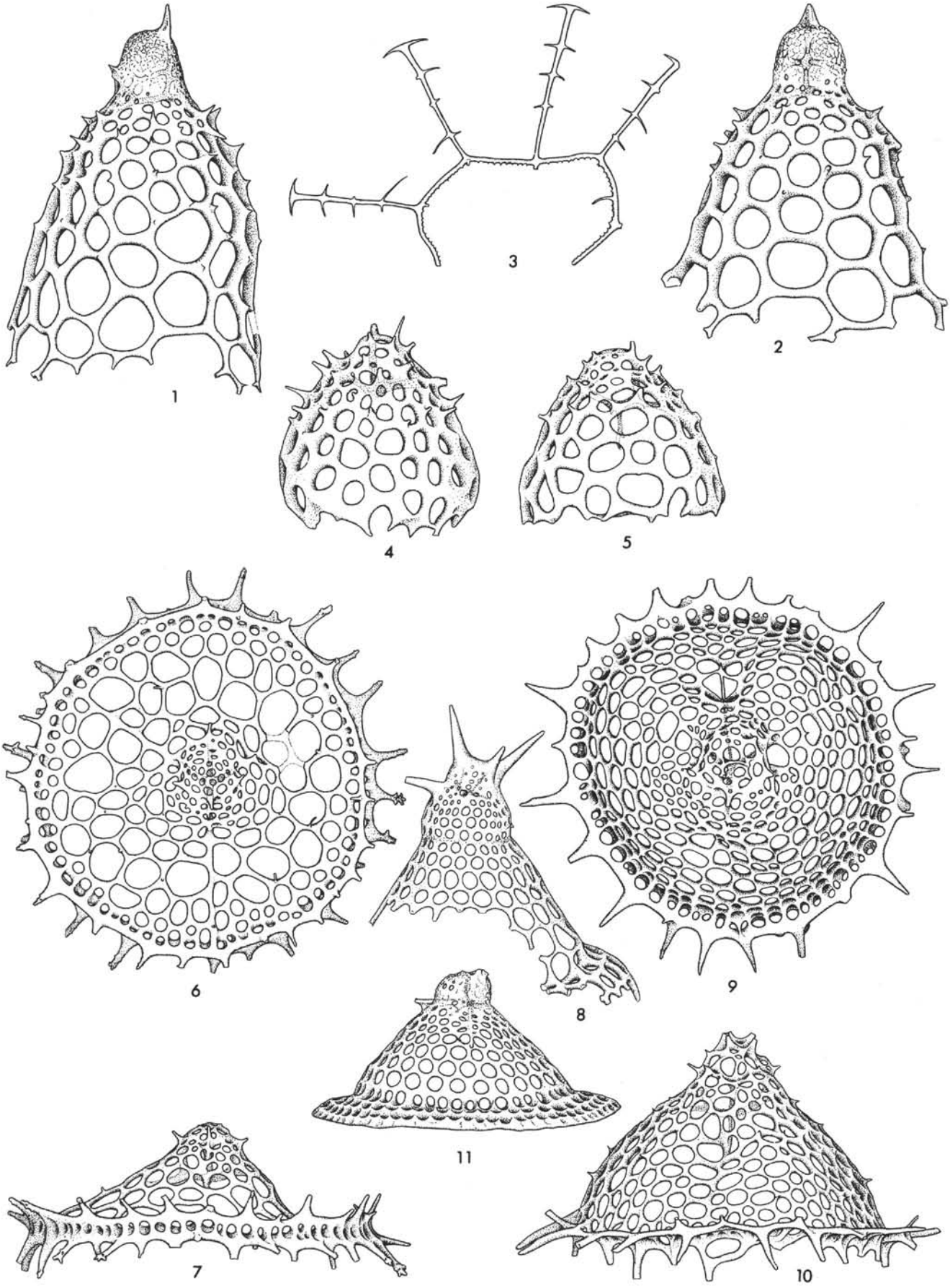


PLATE 24

Quaternary Radiolaria

Figures 1, 3, 6. *Carpocanistrum* spp. 128-10-3, 5-8 cm, X325.

Figure 2. *Carpocanistrum* (?) *odysseus* (Haeckel). 128-10-3, 5-8 cm, X325.

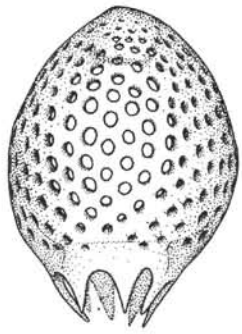
Figures 4, 5. *Amphiplecta cylindrocephala* n. sp. 128-3-5, 20-25 cm, X325.
4. Paratype, in dorsal view.
5. Holotype, in dorsal view.

Figure 7. *Clathrocycloma davisiana* (Ehrenberg). 128-3-6, 80 cm, X325.

Figures 8, 9. *Lampromitra erosa* Cleve, the same specimen, in apical and lateral view. 128-3-5, 20-25 cm, X325.

Figures 10, 11. *Lithocampe heptacola* Haeckel.
10. 128-11 CC, X325.
11. 128-3-6, 80 cm, X325.

PLATE 24



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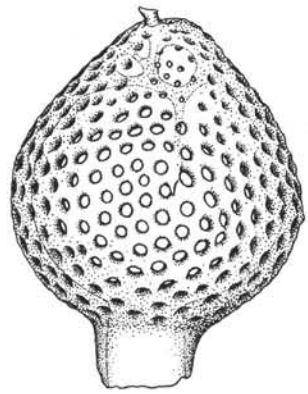

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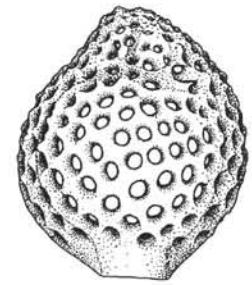

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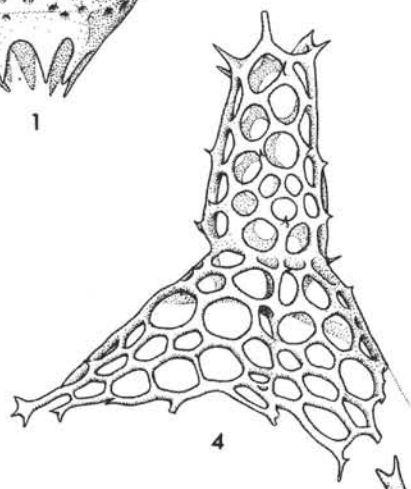

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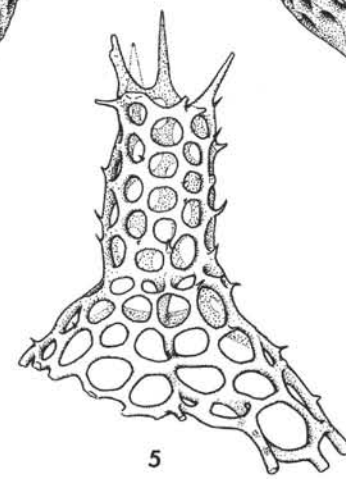

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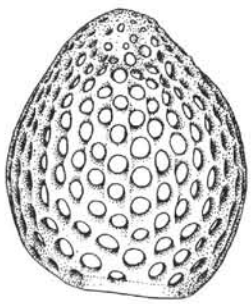

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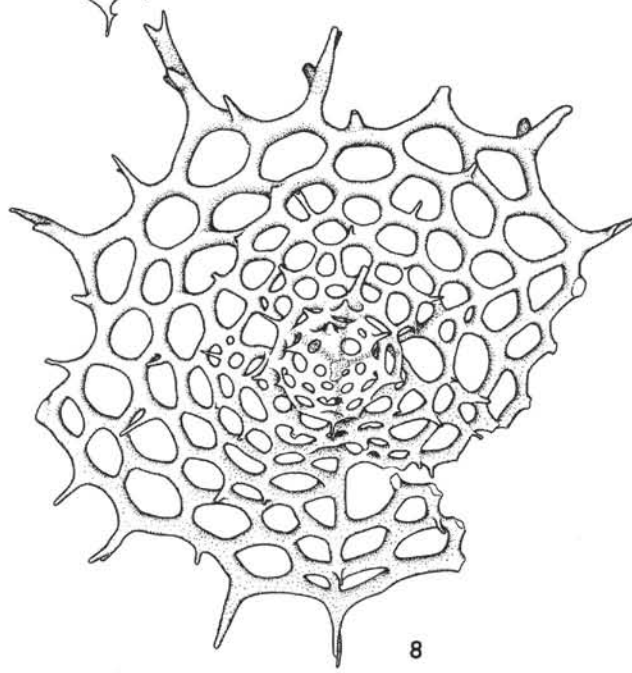

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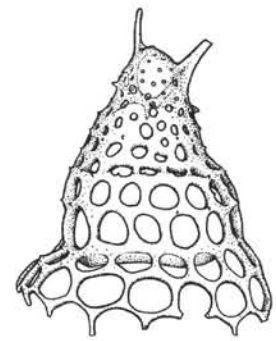

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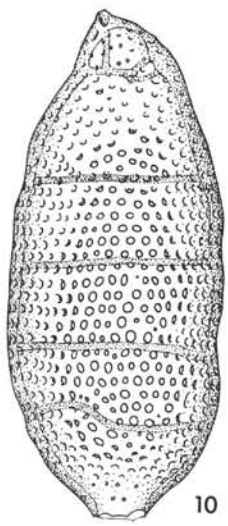

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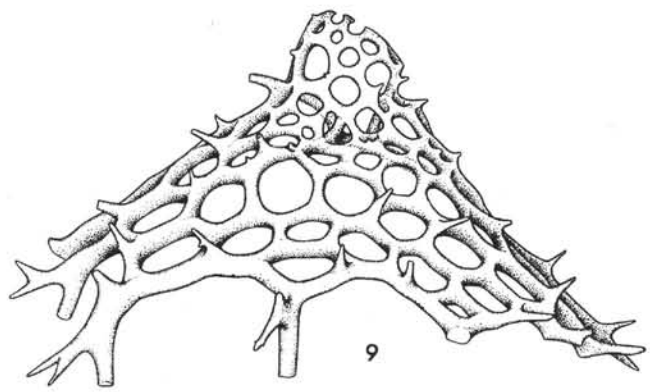

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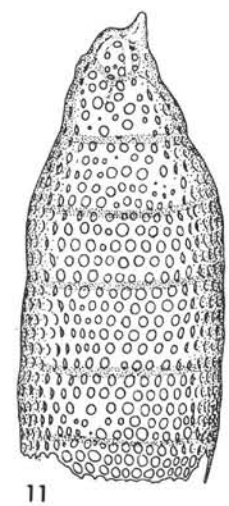

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PLATE 25

Quaternary Radiolaria

Figure 1. *Theoconus carinatus* (Haeckel). 128-2 above 0 section, X325.

Figure 2. *Lipmanella irregularis* (Cleve). 128-3-5, 20-25 cm, X325.

Figures 3-5. *Lipmanella tribranchiata* n. sp.
3. Holotype, 129B-3 CC, X325.
4. Paratype, 128-3-5, 41-44cm, X325.
5. The same, optical section through cephalis. X430.

Figures 6, 7. *Lithomelissa* (?) *ehrenbergii* Bütschli. 128-3-5, 5-8 cm, X325.
6. Specimen in lateral view.
7. Other specimen, in dorsal view.

Figure 8. *Pterocanium* sp. 128-3-5, 20-25 cm, X325.

Figure 9. *Pterocanium charybdeum* (Müller). 128-2 above 0 section, X325.

Figures 10, 11. *Arachnocorys* cf. *circumtexta* Haeckel, the same specimen in lateral and basal view. 128-3-5, 20-25 cm, X325.

PLATE 25

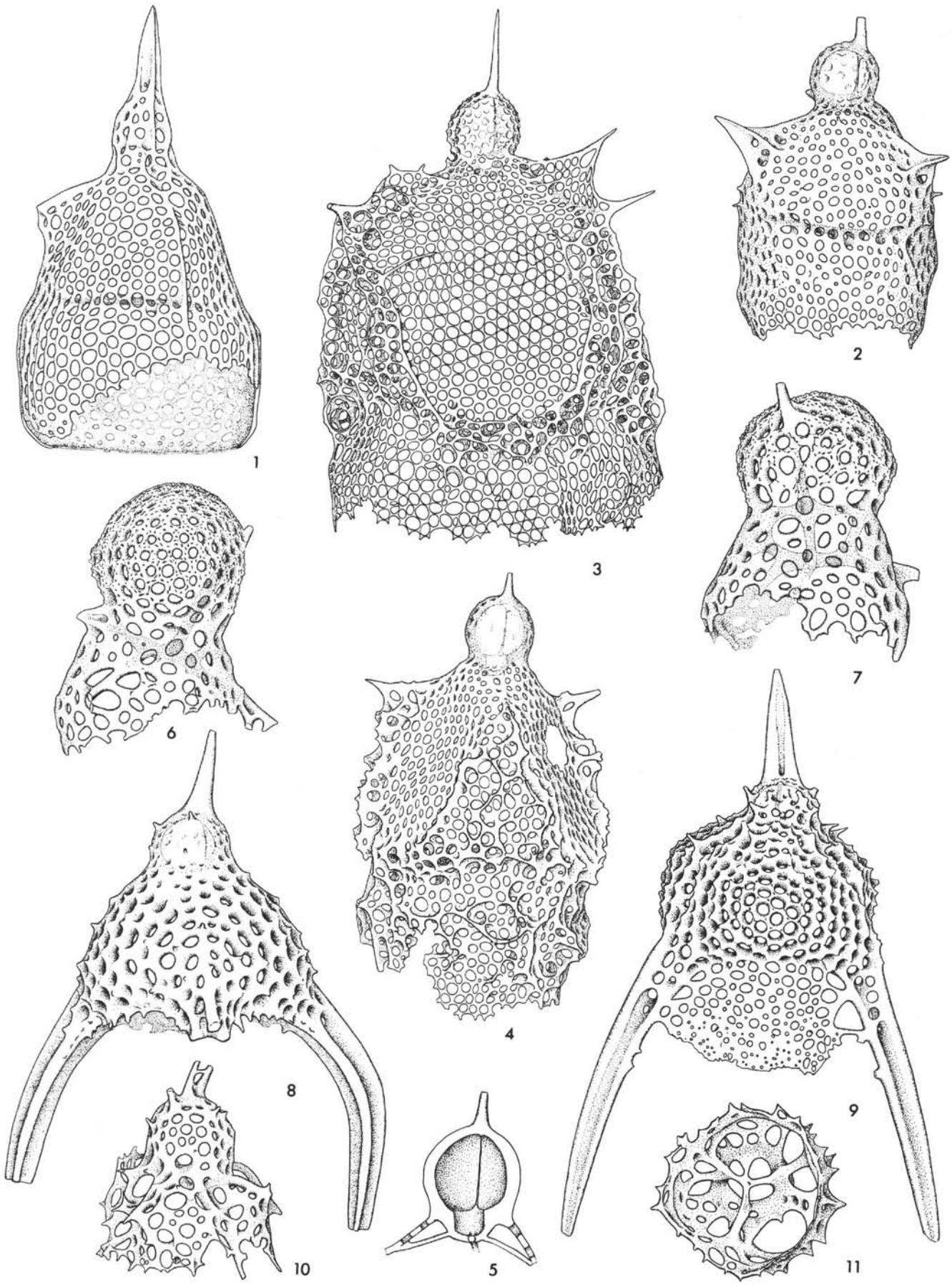


PLATE 26

Quaternary Radiolaria

Figure 1. *Theoconus* aff. *gamphonycha* (Joergensen). 121-3-4, 134-137 cm, X325.

Figures 2, 4, 5. *Theocorythium* ex gr. *amicae* (Haeckel). 128-11 CC, X325.

Figure 3. *Theocorythium vetulum* Nigrini. 128-11 CC, X325.

Figure 6. *Theoconus carinatus* (Haeckel). 128-2 above 0 section, X325.

Figures 7, 8. *Lamprocyclas aegles* (Ehrenberg). 121-3-4, 134-137 cm, X325.

PLATE 26

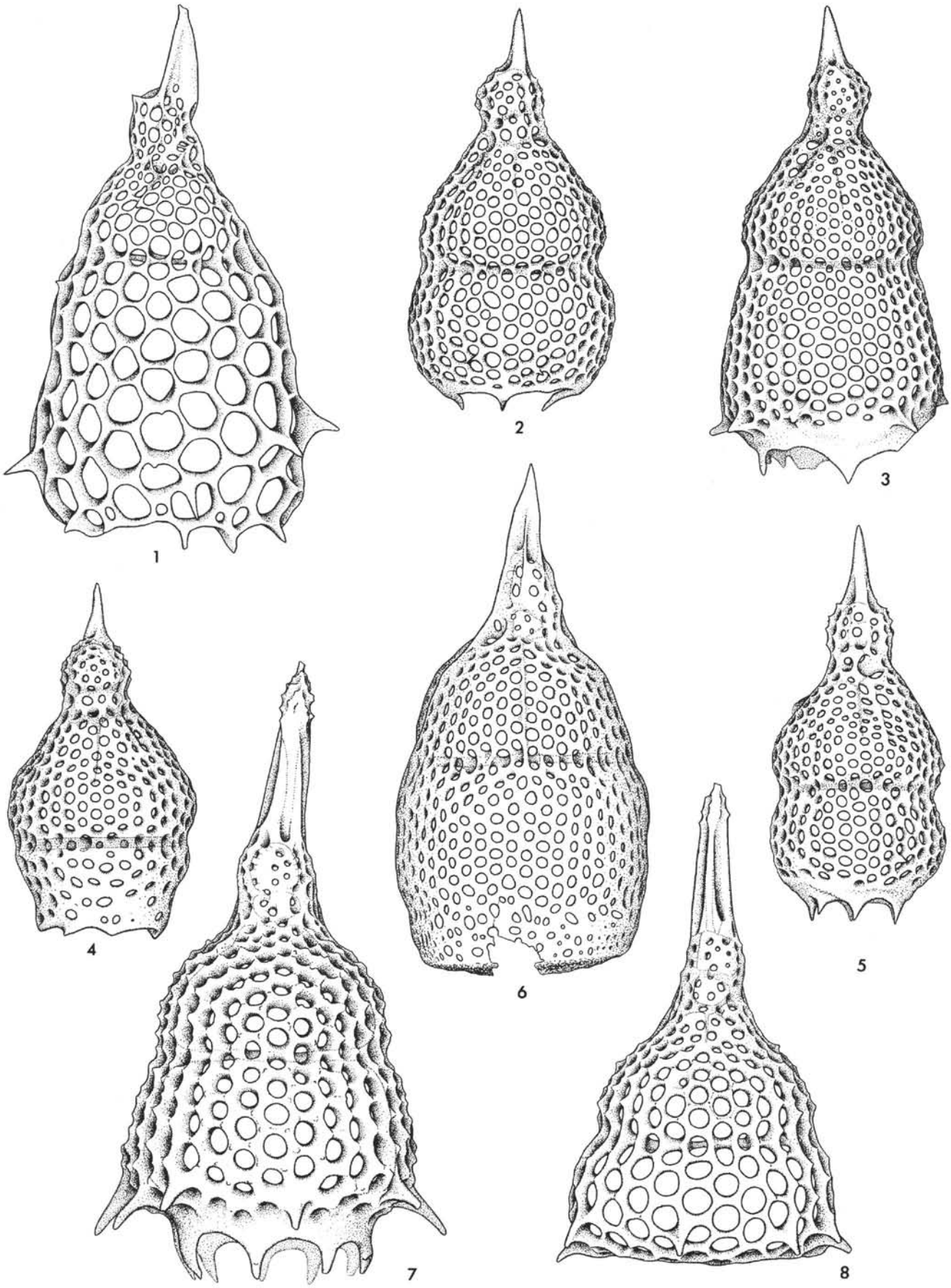


PLATE 27

Quaternary Radiolaria

Figures 1, 2. *Eucyrtidium* spp.
1. 128-10-3, 5-8 cm, X325.
2. 128-3-5, 20-25 cm, X325.

Figure 3. *Lithopera (Lithopera) bacca* Ehrenberg. 128-11 CC, X325.

Figure 4. ?Aulacanthid, gen. and sp. indet. 127-14-5, 20-21 cm X650.

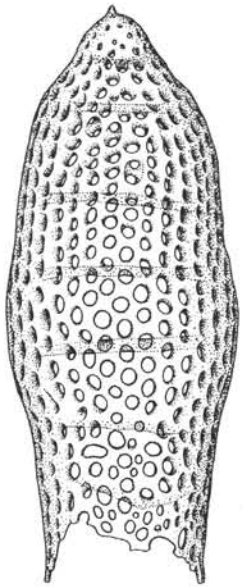
Figures 5, 6. *Ceratospyris* (?) spp. 128-3-5, 20-25 cm, X325.

Figures 7-10. *Zygocircus productus* (Hertwig). X325.
7. 128-3-5, 20-25 cm.
8, 10. 128-10-3, 5-8 cm.
9. 128-11 CC.

Figure 11. *Stichopterygium anomalum* (Haeckel). 128-3-5, 20-25 cm, X325.

Figure 12. *Certaospyris muelleri* Stöhr. 128-3-5, 20-25 cm, X325.

PLATE 27



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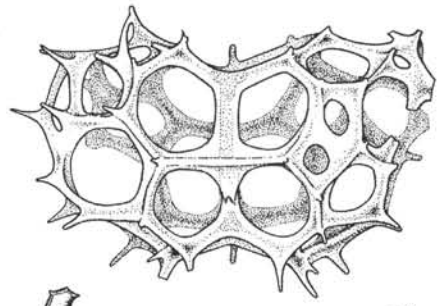

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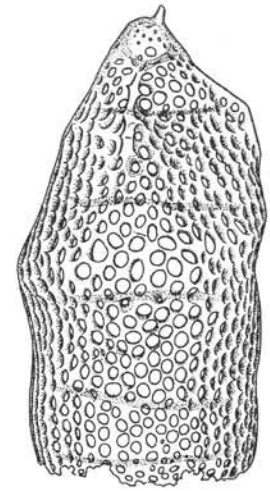

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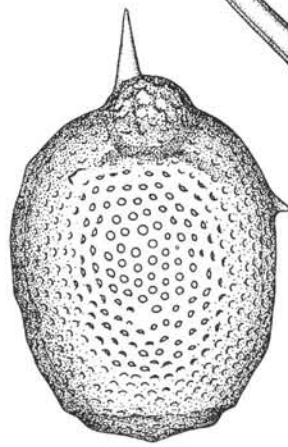

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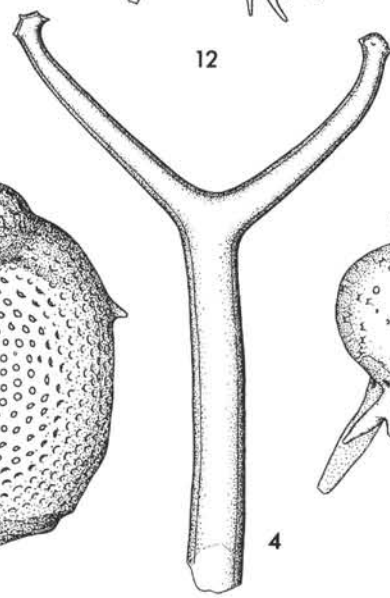

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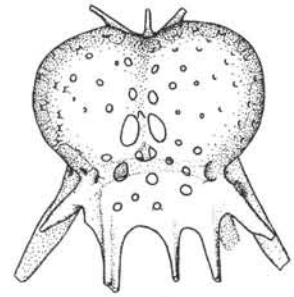

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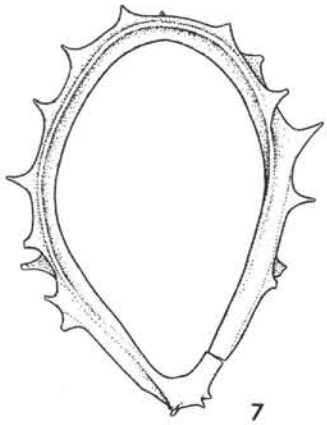

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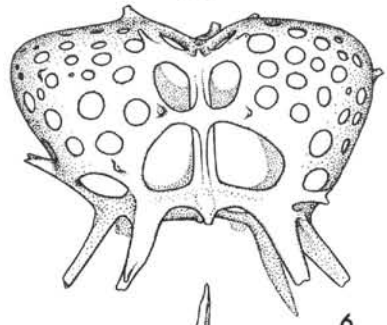

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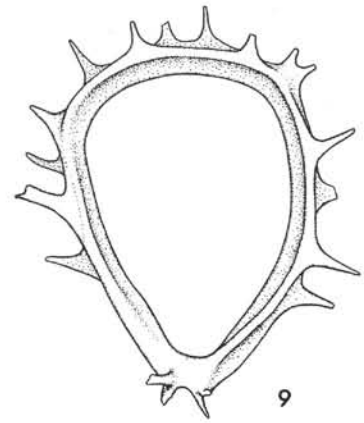

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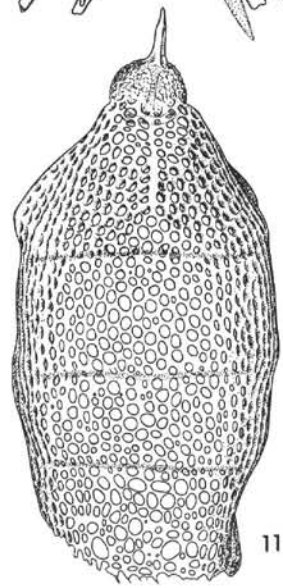

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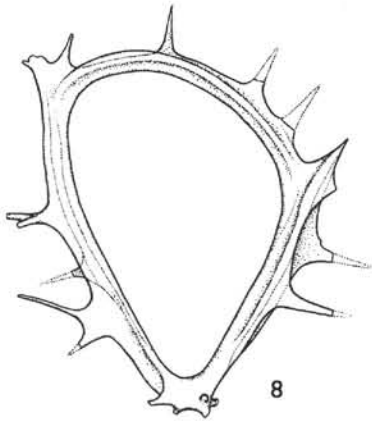

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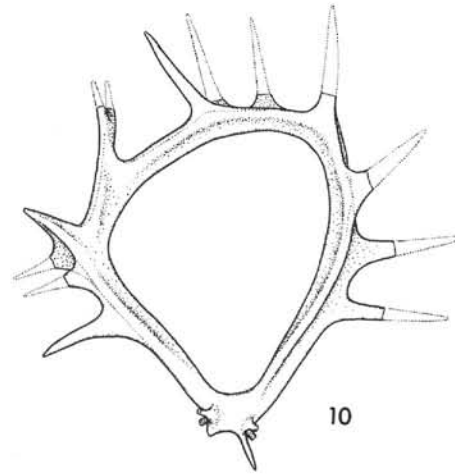

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PLATE 28

Quaternary Radiolaria

Figures 1, 2. *Acanthodesmia vinculata* (Müller). 129B-3 CC. X325.

Figures 3-7. *Lithocircus* (?) sp. 129B-3 CC, X325.
3. Basal view.
4. The same, apical view.
5. The same, lateral view.
6. Other specimen, lateral view.
7. The same, basal view.

Figure 8. *Nephrospyris renilla* Haeckel. 128-3-5, 20-25 cm, X145.

Figure 9. *Tholospyris acuminata* (Hertwig), dorsal view. 128-3-5, 20-25 cm, X325.

Figure 10. *Ceratospyris* (?) sp. 128-3-5, 20-25 cm, X325.

Figure 11. ?*Ceratospyris hyperborea* Joergensen. 127-14-5, 133-135 cm, X325.

PLATE 28