18. PLEISTOCENE PTEROPODS – LEG 15, SITE 147, DEEP SEA DRILLING PROJECT

Peter Jung, Naturhistorisches Museum, Basel, Switzerland

ABSTRACT

The cores from Site 147 yielded fourteen pteropod species, all of which are still living in Recent waters. The complete fauna occurs only near the top (Core 2) of the section. Below Core 2 there is a general decrease in abundance and species diversity. The available material is considered insufficient for a climatic interpretation. Notes on the Recent distribution of the species involved are given.

INTRODUCTION

The location of Site 147 in the Cariaco Trench is shown by Rögl and Bolli (this volume, Figure 1). The hole reached a depth of 162 meters penetrating nothing but Holocene and Pleistocene sediments. The cores obtained from this hole were sampled at irregular intervals (see Table 1) and some levels proved to be rich in pteropods. Almost one hundred samples from all parts of the section have been examined, the majority of which contained pteropods. Although the pteropods are usually well preserved, they are mostly represented by juvenile shells or fragments, and complete specimens are rare. The volume of the samples taken was on the order of only 10 cm^3, which partly explains why the number of specimens of a given species in a single sample is usually low.

VERTICAL DISTRIBUTION AND ABUNDANCE OF SPECIES

In the samples studied a total of fourteen pteropod species have been identified. All of them are described forms still living in Recent waters. They are listed below and illustrated on the accompanying plates.

Limacinidae:

Limacina inflata (d'Orbigny). Plate 1, Figures 5-8.
Limacina bulimoides (d'Orbigny). Plate 1, Figure 4.
Limacina lesueuri (d'Orbigny). Plate 1, Figures 1-3.
Limacina trochiformis (d'Orbigny). Plate 2, Figures 1-2.

Cavoliniidae:

Clio pyramidata Linné Plate 2, Figures 3-8.
Creseis acicula (Rang). Plate 2, Figure 9.
Creseis virgula conica Eschscholtz. Plate 2, Figure 11.
Creseis virgula constricta Chen and Bé. Plate 2, Figure 10.
Styliola subula (Quoy and Gaimard). Plate 3, Figures 1-5.
Hyalocylis striata (Rang). Plate 3, Figures 6-7.
Diacria trispinosa (Blainville) forma *major* (Boas). Plate 4, Figures 3-5.
Cavolinia longirostris (Blainville). Plate 4, Figures 1-2; Plate 5, Figures 1-3.
Cavolinia inflexa (Lesueur). Plate 5, Figures 4-5.

Peraclididae:

Peraclis reticulata (d'Orbigny)? Plate 5, Figures 6-8.

The vertical distribution and the abundance of these species is shown in Table 1. It is noteworthy that the complete fauna occurs only near the top of Core 2, and that the peak of abundance and species diversity in all the cores is reached in Sections 2 and 3 of Core 2. From this peak down in the section to about the middle of Core 6, where the first samples without pteropods occur, there is a general decrease in abundance and species diversity. Below Core 6 the different species occur only sporadically. None of the samples from Cores 13, 14, and 17 yielded pteropods.

Limacina inflata and *Creseis virgula constricta* are usually best represented. After the peak in Sections 2 and 3 of Core 2, both show a sudden decrease in Section 4. A similar situation is seen between the base of Core 9 and the top of Core 10, where none of the other pteropods occur. *Creseis acicula* is well represented from Cores 2 to 6, but has not been found again below the top of Core 10. Although it is rare, *Clio pyramidata* occurs in many samples of Cores 2 to 12, but is lacking entirely below. On the other hand, *Styliola subula* is scarce or absent in most samples, especially in Cores 2 to 12, but is fairly common in the upper portion of Core 15. The occurrence of *Limacina bulimoides, L. trochiformis, Peraclis reticulata,* and *Creseis virgula conica* is restricted to the upper part of Core 2.

In recent years Pleistocene pteropods from deep-sea cores have been used to determine climatic changes through time and to correlate them with data obtained from foraminifera and other sources (Chen, 1968; Herman, 1971). In the case of Site 147 the writer hesitates to give a climatic interpretation mainly because the available samples are small (the number of pteropods is too small to be representative) but also because all the material was obtained from a single hole. Material from other holes of the same general area might confirm the abundance curve of Table 1 or a cumulative abundance curve of pteropods and thus facilitate an interpretation as to climatic changes.

NOTES ON THE ATLANTIC DISTRIBUTION OF SOME RECENT SPECIES

Pteropods have been subdivided into several distributional, largely temperature-dependent groups. Tesch (1946) recognized five such groups, Chen (1964), three, and Chen and Bé (1964), four. Arctic and subarctic groups are

TABLE 1

Occurrence and Abundance of Pteropod Species from Cores of *Glomar Challenger*, Leg 15, Site 147.

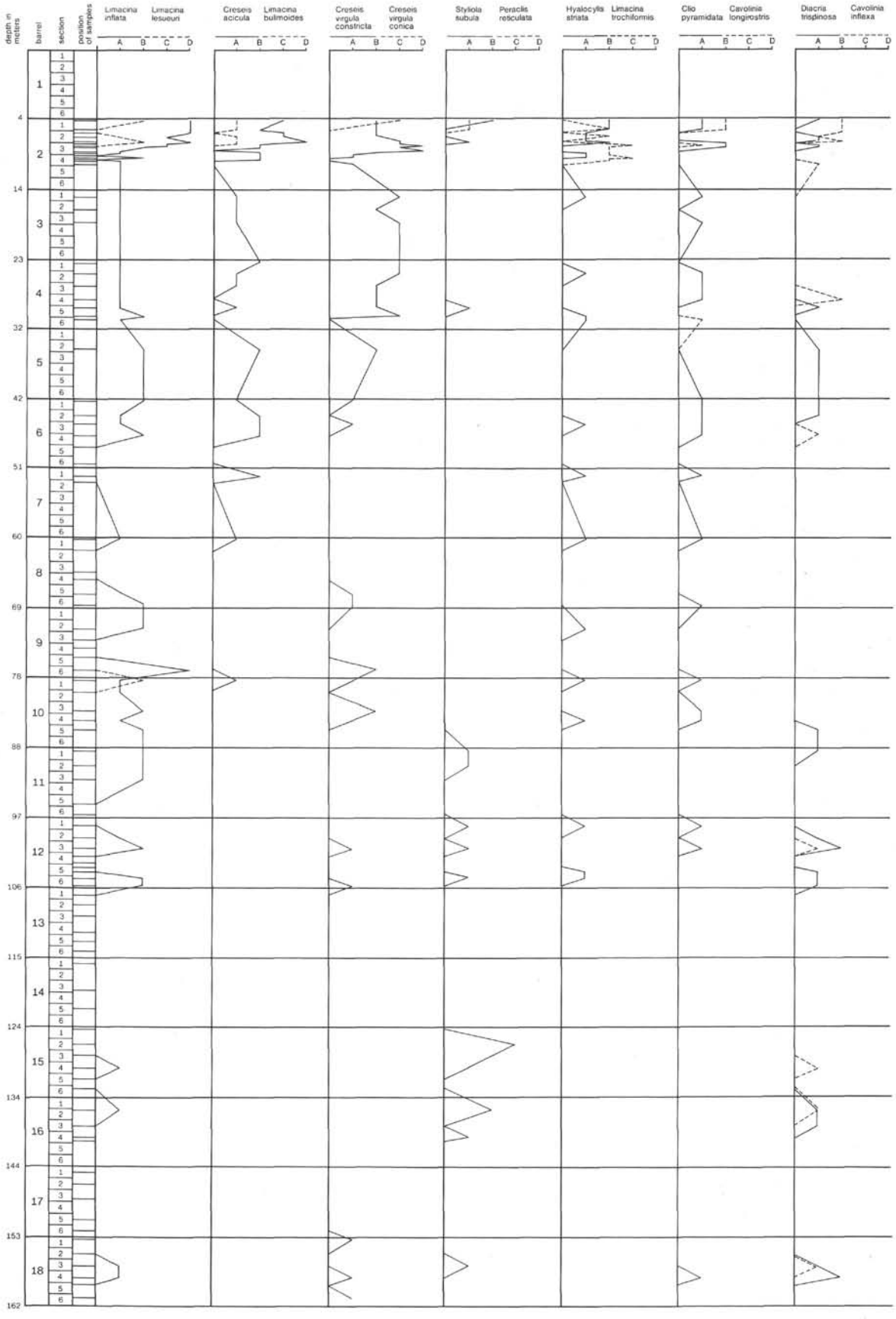

Table I Occurrence and abundance of pteropod species from cores of Glomar Challenger Leg 15, Station 147. A (rare): 5 specimens. B (uncommon): 6-20 specimens. C (common): 21-50 specimens. D (abundant): 50 specimens.

[a]A (rare): <5 specimens. B (uncommon): 6-20 specimens. C (common): 21-50 specimens. D (abundant): >50 specimens.

characterized by *Limacina helicina* and *L. retroversa* respectively. For occurrences in the North Atlantic Chen and Bé (1964) indicated a surface water temperature range of 3.2°C to 4.2°C for *L. helicina*, and 2.6°C to 18.7°C (with an optimum from 8°C to 10°C) for *L. retroversa*. Both of these species are absent in the material from Site 147.

In addition to these two groups Tesch (1946) recognized three more groups. The first group is composed of species which essentially stick to equatorial waters (*Euclio balantium, Diacria quadridentata, Cavolinia longirostris, C. uncinata*). The second group is characterized by such species as *Creseis acicula, Cuvierina columnella*, and *Cavolinia inflexa*, which spread beyond the limits of the first group and inhabit all warmer seas. The third group includes *Styliola subula* and *Cavolinia gibbosa* and is rather subtropical, but lives in tropical waters as well.

On the other hand Chen and Bé (1964) distinguished two groups besides the arctic and subarctic groups. Their Category III (subtropical, cold-tolerant) includes *Limacina bulimoides, L. inflata, L. lesueuri, Clio pyramidata, Creseis virgula constricta, Styliola subula,* and *Diacria trispinosa* and has a surface water temperature range from 14.2°C to 27.7°C with an optimum of 18°C to 22°C. Their Category IV (subtropical warm-tolerant) includes *Limacina trochiformis, Creseis acicula, C. virgula conica, Hyalocylis striata, Cavolinia inflexa,* and *C. longirostris*, and has a surface water temperature range from 16.8°C to 27.9°C with an optimum of 24°C to 27°C.

NOTES ON SITE 147 SPECIES

These largely temperature-dependent and to a lesser degree salinity-dependent groups cannot be recognized clearly in the material from Site 147. The assemblages from different levels mostly represent mixtures of Chen and Bé's Categories III and IV. As shown by Chen and Bé, the distribution of the living populations in the North Atlantic is largely controlled by seasonal influences, which may in part account for the mixtures found in the sediments of Site 147.

As far as the distribution of single species is concerned some summarized data for species occurring at Site 147 are given below. The following information has been taken from Tesch (1908, 1913, 1946), Menzies (1958), Chen and Bé (1964), and van der Spoel (1962, 1967):

Limacina trochiformis: This species has a discontinuous distribution. It is essentially subtropical and is not found in equatorial regions. Temperature range: 13.8°C to 27.9°C. Salinity range: 35.5°/oo to 36.8°/oo. Vertical migration (Florida Current): mean day level at 165 meters; mean night level at 99 meters.

Limacina inflata: Tropical and subtropical. Temperature range: 14°C to 28°C. Salinity range: 35.5°/oo to 36.7°/oo. Vertical migration: mean day level at 236 meters; mean night level at 232 meters (Florida Current); mean day level below 300 meters; mean night level at 76 meters (Bermuda area).

Limacina lesueuri has a discontinuous distribution. Essentially subtropical; not found in equatorial regions. Temperature range: about 13.8°C to 27°C. Vertical migration: mean day level at 103 meters; mean night level at 85 meters (Florida Current).

Limacina bulimoides: in warmer waters, from 40°N to 30°S. Temperature range (Florida Current): 13.8°C to 27.8°C. Salinity range (Florida Current): 35.5°/oo to 36.7°/oo. Vertical migration (Florida Current): mean day level at 90 meters; mean night level at 80 meters.

Clio pyramidata: This species occurs all over the Atlantic, from about 65°N to 70°S. Its greatest abundance is met in depths of 200 to 400 meters. Temperature range: 7.0°C to 27.8°C. Salinity range: 36.1°/oo to 36.5°/oo. Van der Spoel (1962, 1967, 1969) published detailed studies of *Clio pyramidata* and its different formae. In the 1962 paper (p. 194, 196) he showed the distributional patterns of the various formae, which are hardly overlapping. The forma *pyramidata* ranges from 45°N to 65°N. The specimens from Site 147 may represent the forma *pyramidata*, although only juvenile shells are usually present.

Creseis acicula: This is mainly a warm water form reaching from 50°N to 40°S, but it is most abundant between 10°N and 20°N, and between 0° and 10°S. *C. acicula* is essentially a surface form. Below a depth of 200 meters it rapidly decreases in number. Temperature range: 10°C to 27.9°C. Salinity range: 35.5°/oo to 36.7°/oo.

Creseis virgula conica: Tropical and subtropical. Temperature range: 15°C to 27.4°C. Salinity range: about 36.2°/oo to 36.4°/oo. Vertical migration: Mean day level at 206 meters; mean night level at 98 meters.

Styliola subula lives from 50°N to 40°S, but is less abundant in equatorial regions. Temperature range: 13.8°C to 27.8°C. Most abundant in depths of 50 to 100 meters.

Hyalocylis striata lives from 40°N to 40°S. Temperature range: 17.5°C to 27.8°C. Salinity around 36.2°/oo. It is most abundant near the surface (at night) and in depths of 200 to 400 meters (during the day).

Diacria trispinosa: Typical warm water form ranging from 50°N to 35°S. The forma *major* has not been recorded north of 30°N. The species is most abundant in depths of 300 to 400 meters.

Cavolinia longirostris: This species prefers low latitudes. It ranges from 50°N to 50°S, but is most abundant from 30°N to 10°S. Temperature range (Florida Current): 17.4°C to 27.8°C. Salinity range: 36.2°/oo to 36.8°/oo.

Cavolinia inflexa lives from 55°N to 45°S. Temperature range: 16°C to 28°C. Salinity range: 35.5°/oo to 36.6°/oo.

Peraclis reticulata: As shown by Tesch (1946, p. 69-70), the different species of the genus *Peraclis* have a bathypelagic tendency, which, however, is least pronounced in *P. reticulata*. It occurs in tropical and subtropical waters and is most abundant at a depth of about 200 meters. It is usually not found above a depth of 100 meters.

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PLATE 1

Figures 1-3 *Limacina lesueuri* (d'Orbigny). 50 X. Core 2, Section 1, top.
1: Front view.
2: Apical view.
3: Basal view.

Figure 4 *Limacina bulimoides* (d'Orbigny). 50 X. Core 2, Section 1, 140-142 cm. Front view.

Figures 5-8 *Limacina inflata* (d'Orbigny). 5-7. 75 X. Core 2, Section 1, 140-142 cm.
5: Apical view.
6: Front view.
7: Umbilical view.
8: 200 X. Core 2, Section 1, top. Front view.

PLATE 1

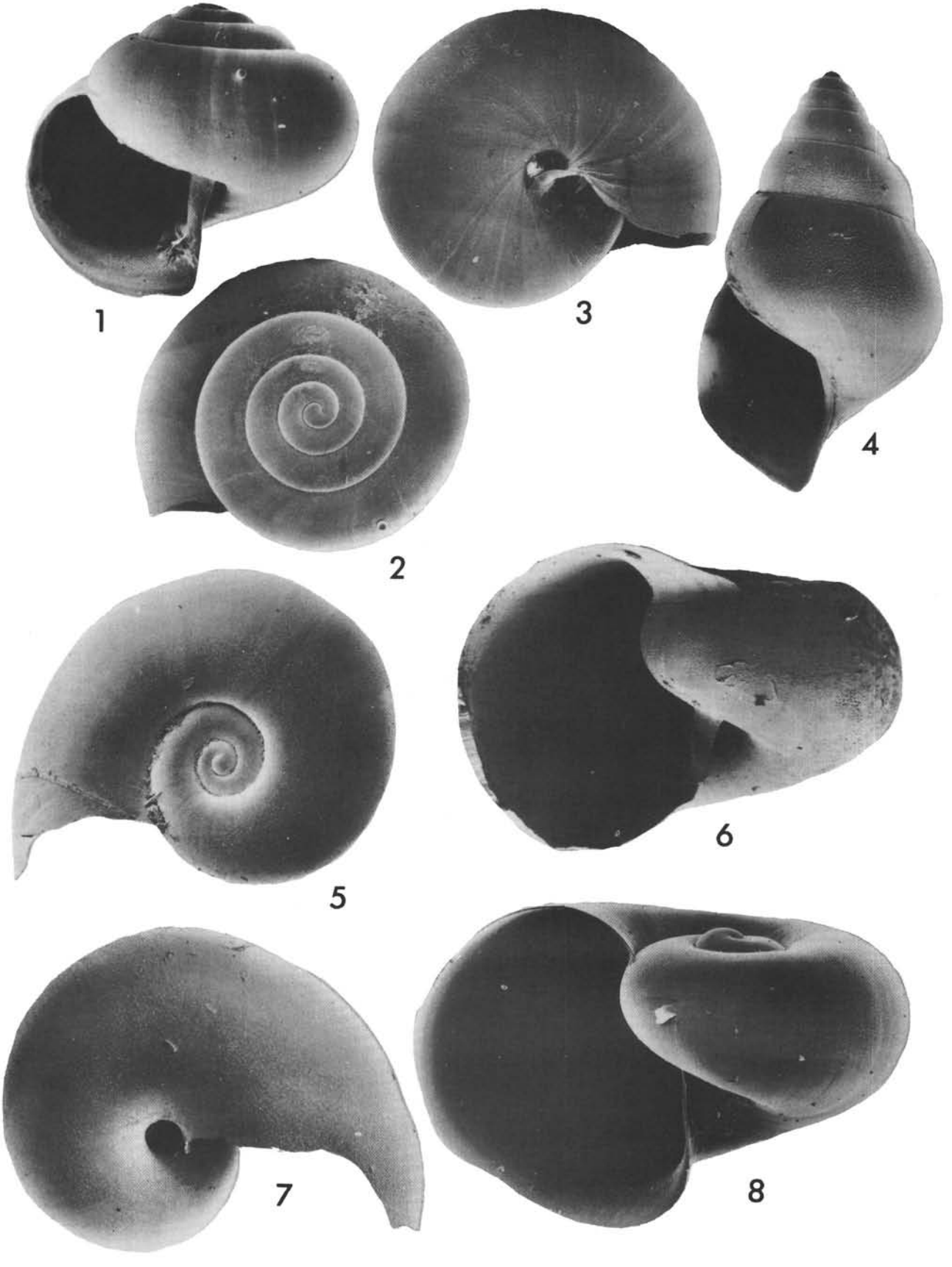


PLATE 2

Figures 1-2 *Limacina trochiformis* (d'Orbigny). 50 X. Core 2, Section 2, 74-76 cm.
1: Front view.
2: Rear.

Figures 3-8 *Clio pyramidata* Linné. All from Core 2, Section 1, top.
3: 30 X.
4: 26 X.
5: 18 X.
6: 20 X.
7-8: 200 X.

Figure 9 *Creseis acicula* (Rang). 20 X. Core 2, Section 2, 20-22 cm.

Figure 10 *Creseis virgula constricta* Chen and Bé. 20 X. Core 2, Section 1, top.

Figure 11 *Creseis virgula conica* Eschscholtz. 20 X. Core 2, Section 1, top.

PLATE 2

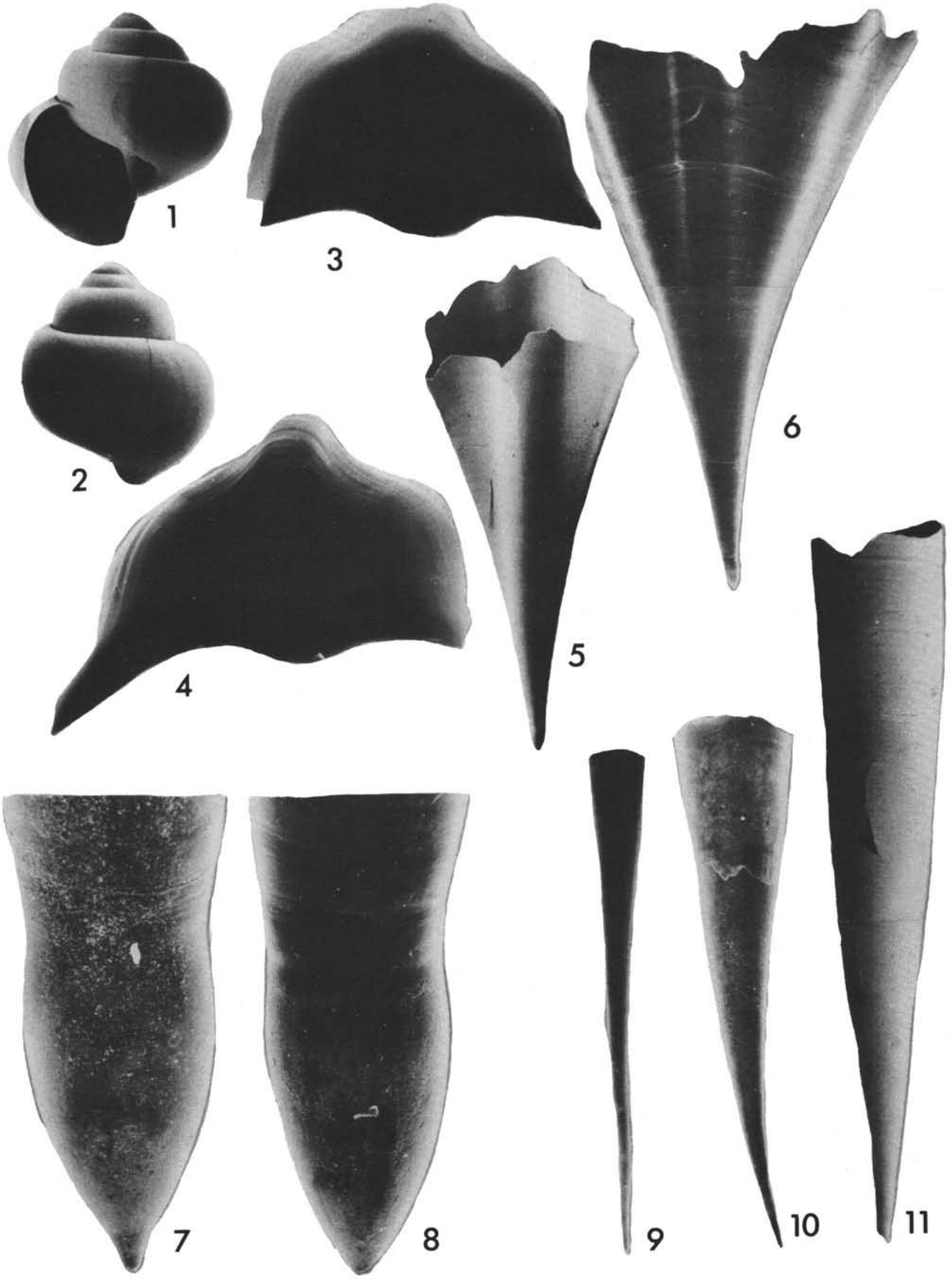
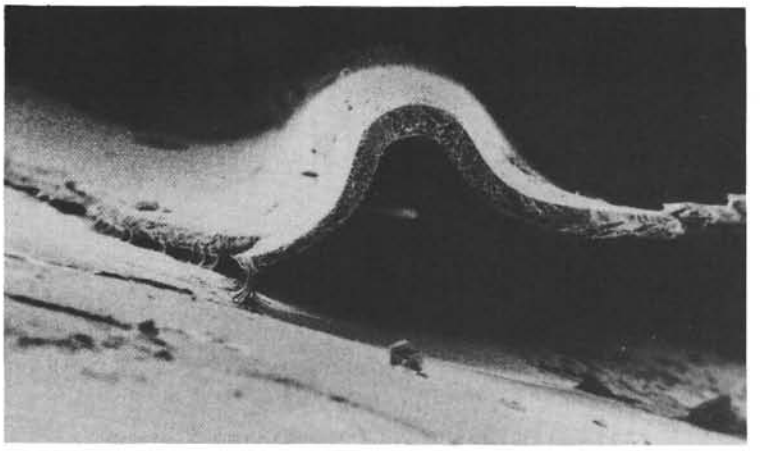


PLATE 3

Figures 1-5 *Styliola subula* (Quoy and Gaimard). All from Core 2, Section 1, top.
1: Detail of apertural view. 300 X.
2: Embryonic part of shell. 300 X.
3, 4: 24 X.
5: Apertural view. 84 X.

Figures 6-7 *Hyalocylis striata* (Rang). Core 2, Section 1, 140-142 cm.
6: 34 X.
7: 20 X.

PLATE 3



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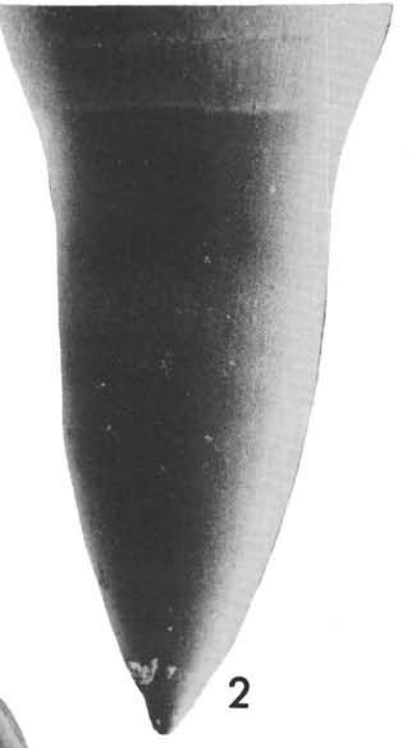

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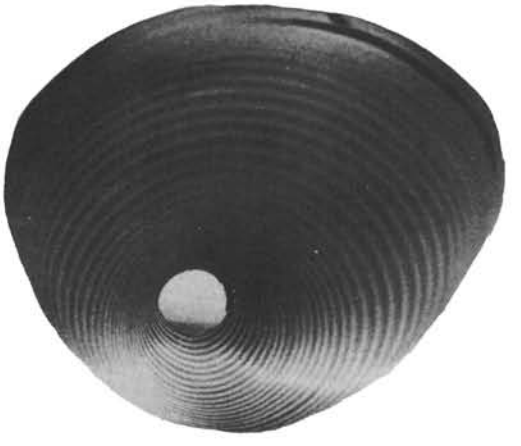

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PLATE 4

Figures 1-2 *Cavolinia longirostris* (Blainville). Core 2, Section 1, top.
1: 20 X.
2: 16 X.

Figures 3-5 *Diacria trispinosa* (Blainville) forma *major* (Boas). Core 2, Section 1, top.
3,4: 20 X.
5: Embryonic part of shell. 200 X.

PLATE 4

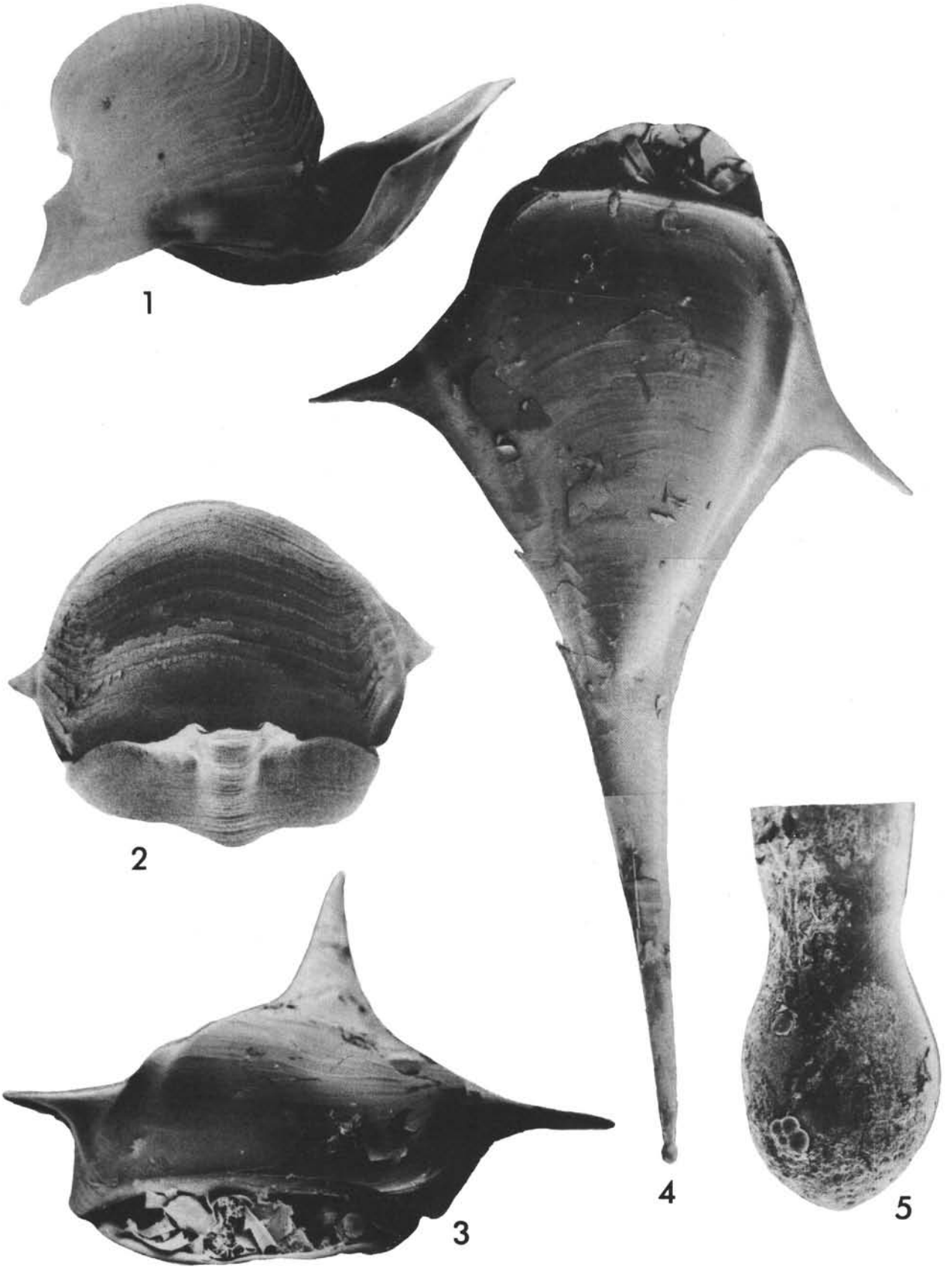

PLATE 5

Figures 1-3 *Cavolinia longirostris* (Blainville). All from Core 2, Section 1, top.
1: 12 X.
2: 16 X.
3: 12 X.

Figures 4-5 *Cavolinia inflexa* (Lesueur). Core 2, Section 1, top.
4: 24 X.
5: 29 X.

Figures 6-8 *Peraclis reticulata* (d'Orbigny) ?All from Core 2, Section 1, top.
6: 50 X.
7: Detail of sculpture. 500 X.
8: Apical view. 80 X.

PLATE 5