Marine Lower Pliocene Ostracoda of southern Spain with notes on the Recent fauna

JOSEF F. ARANKI

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More than 100 species of Lower Pliocene ostracods from southern Spain are described. These associations are compared with the fauna currently living in the same area. Although, most of the Pliocene forms have living representatives in the Mediterranean, the number of forms in common with the present-day near-shore Spanish fauna is not great (13 %). This difference is ascribed to ecological causes – the Pliocene environment recorded in the sequence of isolated hills along the coast of the Province of Málaga was marked by conditions leading to carbonate precipitation. The carbonate sediments (marls to limestones) are rich in microfossils and there are also a few species of pelecypods (the "*Chlamys* association") which, however, may be locally numerous. The sediments contain much unsorted detrital material from the country rock. Notwithstanding the ecological repercussions doubtless arising from the Messinian salinity episode, the Pliocene associations of southern Spain display continuity with the ostracod faunas of the Mediterranean Miocene although, perhaps, somewhat reduced in species diversity. *Aurila convexa*, which makes up 57 % of the Almayate Pliocene ostracod samples, is very rare in the Recent material.

Two species range from Eocene to Recent, five from Oligocene to Recent, 42 from Miocene to Recent and 71 from Pliocene to Recent. The early Pliocene dating yielded by nannoplankton and planktonic foraminifers for the limestone occurrences is supported by the ostracod data.

The Pliocene material has been extensively predated upon by muricid and naticid gastropods. There does not seem to be any relationship between the texture (ornament) of the shell-surface and the intensity of predation. Data on the growth-stages of several species are presented.

The analysis of available bathymetric data supports the view that the habitat of the Pliocene associations was shallow, near-shore. The study sheds new light on the depth-distributions of several species, as well as increasing the known stratigraphical ranges of many forms. New data have also been obtained for the nature of the substrates lived on by many species considered; it seems that a wider range of bottom sediments are acceptable than has been noted previously, at least for the Mediterranean region.

Josef F. Aranki, Department of Historical Geology and Palaeontology, Uppsala University, Box 558, S-751 22 Uppsala, Sweden, 30th March, 1987.

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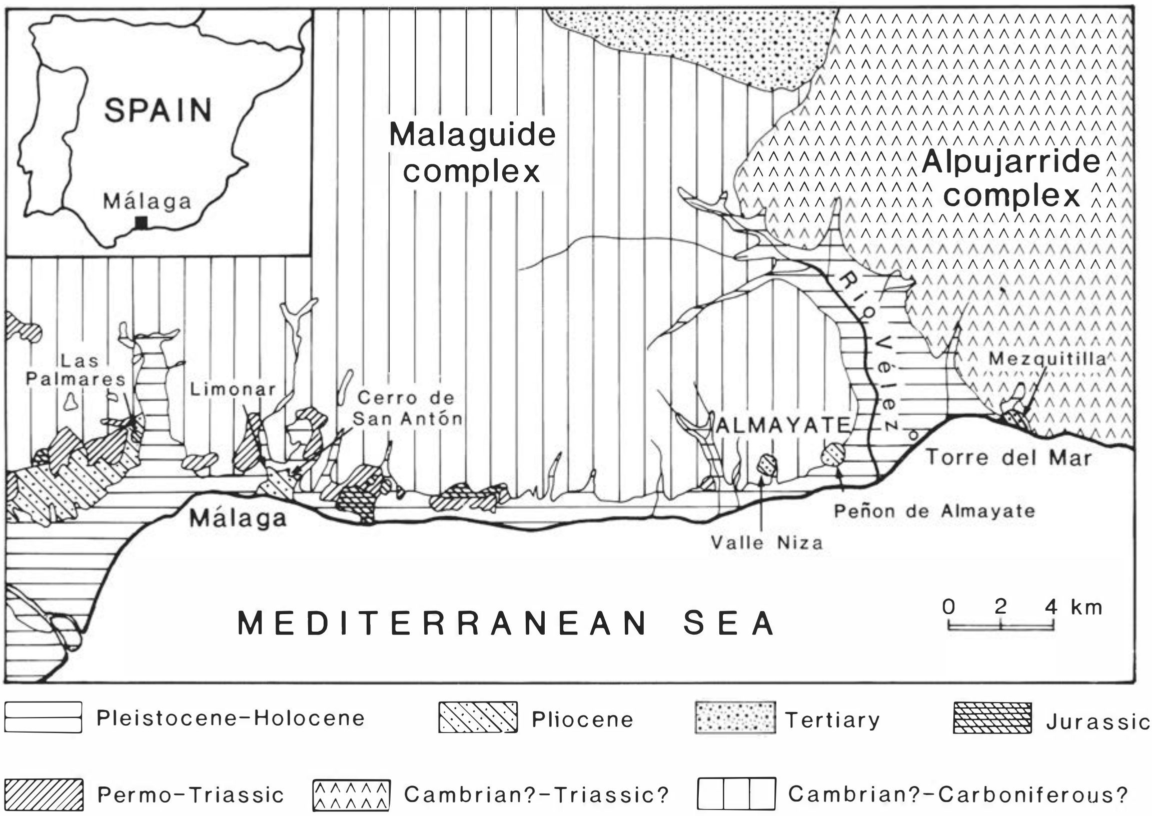


Fig. 1. Sketch map showing the location of the Pliocene localities, and the surrounding area. The offshore sediment today consists of material clearly derived from the Malaguide complex and, to a lesser extent, from the Alpujarrides. Modified after "Mapa Nacional" sheet Granada-Málaga 83.

Introduction

The ostracods described in this monograph were obtained from samples from the Peñon de Almayate, 29.5 km east of Málaga, Valle Niza, 2 km west of Almayate (and 27 km from Málaga), Mezquitilla, 40 km east of Málaga, and from the three hills located within the confines of the city of Málaga, Cerro de San Antón, Limonar, and las Palmares (Fig. 1). A further location of interest is Rio Guadalminar, near Estepona (Hotel Atalaya: San Pedro de Alcantara), (Fig. 2).

Also, Recent near-shore ostracods from Torrenueva, Torre del Mar, Las Cuches, Estepona, Tarifa, Rio Jaca near Tarifa, and Los Barrios (Fig. 19) were included for taxonomic comparison with the Pliocene associations.

The fossil and living material was collected by Professor R.A. Reyment and Mrs. E.R. Reyment, Department of Historical Geology and Palaeontology, Uppsala University, Sweden, at intervals between 1981 and 1986, and in 1981 in connection with student fieldwork in southern Spain. The living ostracods were collected in June of 1984 and July of 1985.

The aim of this investigation has been to study the Neogene ostracod associations in the western Mediterranean region, and to compare these, as far as possible, with the living near-shore ostracod fauna from the same region in order to chart eventual changes in the faunal composition of the area. In all, the present work treats 122 species form southern Spain.

The plan of this work is as follows: The lists of fossils from the localities are first presented and annotated, with particular emphasis placed on the long stratigraphical ranges displayed by many of these species. The material contains abundant evidence of the effects of predation by naticid and muricid gastropods; this topic is treated in a separate chapter. The main part of the monograph comprises the taxonomic description of the material.

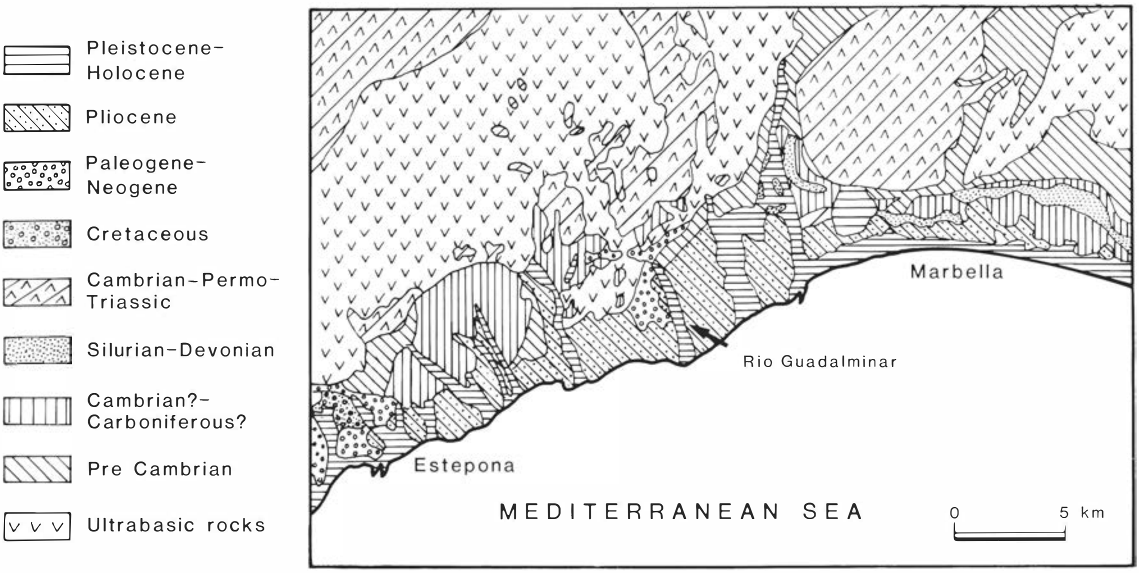


Fig. 2. Sketch map showing the location of Rio Guadalminar, and the geology of the surrounding area. Modified after "Mapa Nacional" sheet Algeciras 87.

The presentation of the taxonomic information is primarily based on the present material, supplemented by comparative data from the literature, including the Recent ecology. The stratigraphical information available on the species is appended to each of the descriptions. Available data on geographical and palaeogeographical distributions are summarized. Finally, a comparative analysis of the Spanish Pliocene ostracods in relation to the eastern Mediterranean is given.

The monograph contains 23 plates. Plates 1–15 with white background, are the fossil Pliocene ostracods; plates 16–23 with dark background, are the Recent species.

Rather remarkably, the present monograph constitutes the first description of Neogene ostracods from southern Spain, which is noteworthy because of the richness of the Pliocene occurrences. Most of these localities have been studied with respect to their content of planktonic foraminifers and, to a lesser extent, molluscs.

Material and methods

The method of hard-rock maceration of Kirchner (1958) was used for disaggregating the fossil samples. Ethanol, methanol, 12 % acetic acid, hydrogen peroxide (H_2O_2), and distilled water were used to clean the ostracods. Ultrasonic treatment was used only in some cases, because of the risk of damage to the ostracods. The Recent ostracods were stored on sampling in one litre of water and sediment containing 10 ml formalin, and 10 gr of hexamethylentetramine ($C_6H_{12}N_4$). They were cleaned with distilled water and methanol and studied in cavity slides immersed in glycerine. To open the valves containing soft parts, sharpened feathers were used, occasionally with the additional aid of a needle inserted in the end to minimize vibration.

All adults an juvenile carapaces and isolated valves were picked out from the main sample. Whole carapaces were counted as two valves. The total number of valves examined is more than 30 000. From the Peñon de Almayate alone, over 16 000 valves were counted. The specimens were mounted on aluminium stubs and gold-plated for observation with the scanning electron microscope. The specimens were photographed by means of a MINI-SEM (Akahi Co.) at magnifications varying between 100 and 2 000 times. The film used was Kodak Plus X Pan 120.

Acknowledgements

I wish to express my sincere gratitude to my supervisor Professor R.A. Reyment for introducing me to the subject, and his enormous generosity in guidance, and constructive criticism, and to Mrs. E.R. Reyment, who kindly made the material available and carried out the extensive SEM-photography. Thanks are due to the technical staff of the Department of Historical Geology and Palaeontology, Uppsala, for help with the preparation of this monograph. Special thanks go to Professor José-Maria González-Donoso, Málaga, and his research students, for advice on and material from localities in and around the city of Málaga. Thanks are due to Drs.: J. Backman, B. Malmgren, E. Savazzi, J. Schöbel, U. Sturesson, and to G. Coles, for help and advice in various ways, and to Drs.: R. Whatley, P. Bengtson and S. Bengtson for valuable advice and critical comments on an early draft of the manuscript.

Geological setting

The Peñon de Almayate (*peñon* is Spanish for cliff) is located in the southernmost part of the Betic Cordilleras complex foldbelt, which extends from Cape Nao in south east Spain to Gibraltar in the south west, a distance of 600 km. The coast of the province of Málaga to the east of Málaga, is ruggedly outlined by a succession of cliffs (*peñones*). Most of these consist of sea-eroded bluffs and headlands of the metamorphic Malaguides which have been gradually uplifted throughout historic time and during the Pleistocene. In a few places the isolated carbonate accumulations occur at Almayate, the cliffs can be seen in sections to overlie eroded rocks of the Malaguides.

The Betic zone consists of folded and faulted Mesozoic and Tertiary sediments (Mosely *et al.*, 1981). A great variety of nappes occur in the hinterland, ranging from the metamorphites of the Nevado-Filabride Complex, and the Alpujarrides, to the non-metamorphic Carboniferous and Mesozoic rocks of the Betic of Málaga Nappe (Mosely *et al.*, 1981).

The Peñon de Almayate is a microfossil-rich Neogene bioclastic sequence. The Almayate deposit is a detrital limestone, containing abundant shell material and fragments from the Malaguide country rock; these fragments display little evidence of water abrasion in the upper reaches of the formation, as opposed to the condition of the same material occurring today along the shore, and it may be concluded that the sedimentational episode was rapid. A few species of pelecypods represent most of the macrofauna (Fig. 3), the "*Chlamys*-association" Scaphopods, brachiopods, bryozoans, echinoids, fish teeth, clionid sponge borings and barnacles are also present, (Fig. 3–6). The observed microfauna consists of ostracods, and benthonic and planktonic foraminifers. Dr. Björn Malmgren, University of Uppsala, has kindly determined the most common planktonic foraminifers at Almayate: *Globigerinoides sacculifer, Globigerinoides ruber* and *Orbulina universa.* He estimated that the planktonic foraminifers make up less than 10 % of the total foraminiferal content.

The coccolith content of the sediment points to a Pliocene age. The nannoplankton in the present sediment show, by the presence of *Sphenolithus abies* and *Dictyococcites productus,* that the sequence belongs to the Lower Pliocene, varying in age between approximately 3.3 and 5.2 Ma. The nannofossil-analyses were kindly made by Dr. Jan Backman (Stockholm, Cambridge).

All fossils are recrystallized, presumably due to the limy matrix of the rocks. Therefore, this study was mainly based on the outer characters of the shells. Pliocene microfossils have been described from the coastal Pliocene of Andalusia by González-Donoso & de Porta (1977) in a work based largely on the planktonic foraminifers. The present work is the first description of Lower Pliocene ostracods from the southern Spanish region.

The Pliocene was marked by a transgression in the Mediterranean realm (Carbonnel & Ballesio, 1982, p. 57). Isolated Pliocene outcrops are found along part of the coast of Málaga Province; they may be very fossiliferous, and some have been given a Late Pliocene age (González-Donoso & de Porta, 1977). (It is interesting to note that naticid predation is evident in the pelecypods shells figured by González-Donoso & de Porta (1977, pl. 3); however, no ostracods were recorded by these authors). There do not seem to be strong reasons to doubt that the calcareous deposits of the ostracod-rich sequences accumulated close to the shore in a special environment (perhaps similar to the present-day Anse de Kernic of Brittany, France), with bodies of water partially trapped along a rugged rocky coast, perhaps even locally forming a skerry landscape.

The height above sea-level of the Peñon de Almayate ranges from about 15 m to 40 m. The nearby deposit at Valle Niza has about the same areal extent, but is less thick. The deposits between Málaga and Torre del Mar occur at varying elevations. The highest of these is the Cerro de San Antón which attains around 100 m. Clearly, the post Pliocene uplift has been unevenly manifested over the distance of 30 km involved, presumably as the result of differential tectonic movements. At Cerro de San Antón and Las Palmares, near the suburb of El Palo of Málaga, the Pliocene lime-deposits are in contact with Triassic red-beds (Fig. 1).

The occurrence in the Rio Guadalminar can be dated as belonging to the planktonic foraminiferal Zone MP1-2 (zone of *Globorotalia margaritae)*. A planktonic foraminiferal dating of the Rio Guadalminar occurrence (consisting of yellow sands) has been given by González-Donoso & de Porta (1977, p. 32) as PM1-6, the lower part of the Upper Pliocene. The relatively abundant macrofauna, consisting mainly of various pelecypods, has been interpreted as indicating a moderately deep environment (González-Donoso & de Porta, 1977).

Up to the present, detailed geological maps of the Neogene of the eastern zone of Málaga and Granada are lacking, although work being undertaken at the University of Málaga is expected to rectify this situation.

Short geological orientation

Both the Mediterranean and the Black Sea are remnants of the ancient (hypothetical) equatorial ocean, the Tethys, that separated Africa from Europe and connected the Atlantic with the Indian Ocean.

Some 90 million years ago, the northward movement of the African plate had advanced to a point at which it began to close the Tethys. The continuing collision with Asia severed the eastern connection with the Indian Ocean, and at the same time, pressing against Europe, gave rise to orogenic activity. The result of this mountain-building was to divide the Tethys into two inland seas. One was the ancestral Mediterranean, which occupied the same basin as it does today; the other sea, to the north and east, has been called the Paratethys (Hsü, 1978).

About six million years ago, the continued northerly movement of the African plate accelerated mountain-building on the Iberian Peninsula and in the northwest corner of Africa, creating an isthmus that sealed off the Mediterranean. This transformation seemingly had a catastrophic effect on the marine fauna (Whatley & Maybury, 1981).

Over the next thousand years or so (Hsü, 1978), much of the enormous volume of the Mediterranean, some four million cubic kilometres of water, evaporated away and salts and other residues were deposited in the desiccated basin. The Deep Sea Drilling Project (DSDP) in the western Mediterranean has shown that thick layers of saline environmental sediments (carbonates, sulphates, and salt), were deposited by the evaporation of brines during Late Miocene time in some areas of the eastern an western Mediterranean Sea (Hsü *et al.,* 1973; Hsü, 1978).

This has given rise to a theory that the salt deposits derive from a period of marked eustatic fall in sea-level during which the Mediterranean became isolated from the world oceanic system by the Gibraltar threshold. The Mediterranean was then transformed into a series of lagoons ("lago mare"), which either dried up, alternatively gradually became desalinified (Benson, 1976). A little more than five million years ago, the Atlantic broke through at Gibraltar and the basin again became a sea, thus marking the boundary between the Miocene and the Pliocene (Hsü, 1978). The stratigraphical evidence suggests that the filling of the Mediterranean was not a catastrophic event (Hsü *et al.,* 1973).

The evidence available indicates that the diversity and density of ostracods were increasing during the Tortonian. A significant decrease coincides with the Messinian "salinity crisis". The Pliocene and Early Pleistocene fauna is, once again, characterized by high diversity and density (Sissingh, 1976). The southern Spanish ostracod associations seem to belong to this phase.

Late Miocene Faunal Crisis

The events of the Late Miocene (Messinian) in the Mediterranean are considered to have led to a significant reduction of the fauna (Ruggieri, 1967). If this is meant to imply a decrease in diversity, then a case could possibly be made for the purported Pliocene recolonizaton of the western Mediterranean. A desiccated Mediterranean realm would have had profound effects on marine life. New forms might have evolved to adapt to the harsh new conditions. Finally, the Pliocene Mediterranean fauna should represent a return of the "refugees", accompanied by immigrants from the Atlantic (Hsü *et al.,* 1973).

Communication with the Indian Ocean, which had previously existed across Syria, had already ceased in Lower Miocene times. From the Vienna Basin eastwards to the Caspian Sea and beyond, the "Paratethys", was in intermittent communication with the Mediterranean, across the Balkan Peninsula and Turkey. This sea was populated by a distinctive fauna, the *Sarmatic fauna,* which occurs sporadically in the Peloponnese region and in eastern Sicily (Ruggieri, 1962; Hsü *et al.,* 1973; Stambolidis, 1985).

Glacial events during the Late Miocene are estimated to have lowered the sea-level by ca 40 to 60 m and contributed to the isolation of the Mediterranean Basin during the late Messinian. Interglacial conditions prevailed at 5.2 Ma and between 5.0 and 4.1 Ma in the early Pliocene. The Deep Sea Drilling Project (DSDP) sites from the South Atlantic and southwest Pacific oceans show that the beginning of the Pliocene was marked by changes in many climatic indicators at all sites, suggesting a prolonged interval of warm, interglacial conditions between 5.0 and 4.1 Ma during the earliest Pliocene (Hodell and Kennett, 1986).

A strong correspondence is suggested between the general trends in latest Miocene/earliest Pliocene oxygen isotopic records and the deposition of the Messinian evaporites in the Mediterranean (Hodell *et al.,* 1986). Waxing and waning of Late Miocene ice sheets caused glacio-eustatic sea level oscillations that controlled the flux of marine waters into the Mediterranean during the Messinian. Hence, the Messinian "crisis" can hardly be characterized as being a single catastrophic event, but rather one of an oscillatory nature, which contradicts the opinion of Benson (1972). The Pliocene was ushered in by a prolonged interval of warm, interglacial conditons that lasted between ca 5.0 an 4.1 Ma. The Miocene/Pliocene boundary coincided with climatic warming, decreased global ice-volume, marine transgression, reflooding of the Mediterranean, and termination of evaporite deposition (Hsü, *et al.,* 1973; Hodell and Kennett, 1986).

The Mediterranean Pliocene fauna was thus, originally, the product of a reintroduction of the Atlantic fauna from the region facing the Gibraltar straits, probably the true asylum for the Indo-Pacific relicts during the salinity crisis of the Upper Miocene (Ruggieri, 1967). Perés (1967, not seen) who considered the Mediterranean as a subprovince of the North Atlantic province, suggested that the greater part of the benthonic fauna originates from the North Atlantic and from endemic elements.

The discovery of psychrospheric ostracods in Pliocene and earlier deposits of the Mediterranean promotes the thought that the gradual restriction and final extinction of this fauna in the Mediterranean during Tertiary times was accompanied by the closing of the Atlantic gateway (Benson & Sylvester-Bradley, 1971). Benson (1972) showed that only shallower psychrospheric assemblages of ostracods are represented in the Pliocene fossil record in the Mediterranean. Therefore, he suggested that at least two sills existed in the Mediterranean during the Pliocene, one at the entrance (the Iberian portal), which must have been considerably wider and deeper during the Pliocene than the Strait of Gibraltar is at present, and a second west of the Ionian Basin, the sill of the Sicilian-African marginal platform (now forming the Sicilian Straits) which was deeper than at present but not as deep as the sill of the Iberian Portal.

Benson (1976) suggested that the "Iberian Portal", which can now be shown to have existed in Andalusia, Spain, allowed the deep, lower cool-water masses of the Atlantic (the lower layer, the world-ocean "psychrosphere") and its fauna to invade some of the deeper basins of Tethys (the oceanic phase) in the Paleogene to persist through Serravallian time at least. During the Tortonian, the Iberian Portal became shallower and eventually closed.

The psychrospheric ostracod faunas of the Atlantic can be traced in strata of Miocene age (Serravallian and Tortonian) from western Andalusia into the bottom sediments of the Balearic Basin (Benson, 1976). Benson (1973) also suggested that some ostracods (e.g. *Costa* and *Oblitacythereis*), from depths of at least 500 m survived the salinity crisis, and he believes that they can serve as depth-survival indicators. He concluded that no animals with a range greater than 50 m would could have been able to survive the Messinian event.

Description of localities

A general characteristic of this part of the coast of Spain is the continual uplift it is experiencing. This is manifested, for example, in the need, in the past, to construct new coastal defence systems in order to keep pace with the advancing coastline, as at Torre del Mar.

Peñon de Almayate

The Pliocene rock of Almayate has been quarried since Phoenician times as a source of building material and Almayate was founded by the Moors on the site of a fortified Phoenician trading station. The name in Arabic is "Almiyah" which in colloquial form becomes "Almayyat" and means "The Waters". Even today, there is local remembrance of "water" around the peñon.

Table 1. Grid references for the Lower Pliocene localities.

Localities	Latitude	Longitude
Mezquitilla	36° 45′ 04″	4° 02′ 07″
Peñon de Almayate	36° 43′ 10″	4° 07′ 07″
Valle Niza	36° 43′ 07″	4° 09′ 05″
Cerro de San Antón	36° 43′ 05″	4° 21′ 07″
Limonar	36° 43′ 08″	4° 22′ 05″
Las Palmares	36° 44′ 06″	4° 25′ 08″
Rio Guadalminar	36° 28′ 12″	5° 01′ 02″

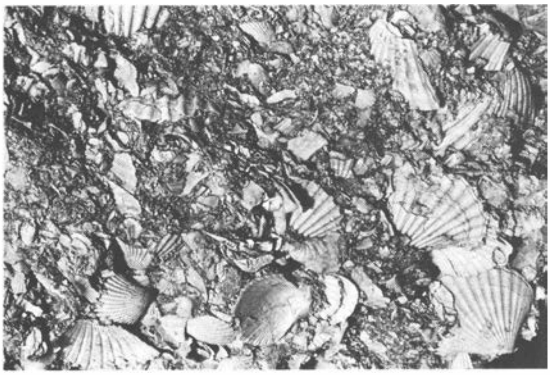


Fig. 3. Coquina of pectinids. Almayate (the "Chlamys association").

Fig. 4. Pectinid shells, Almayate; note the gastropod drill-hole in one specimen.

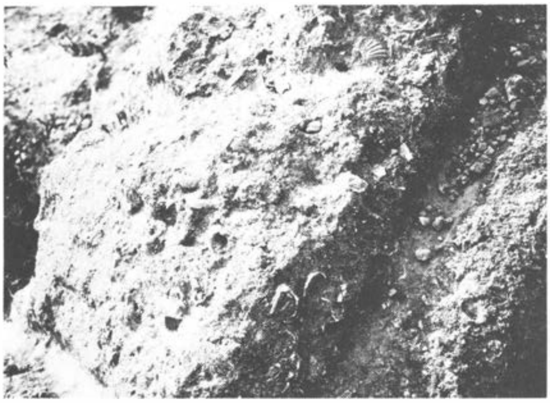


Fig. 5. Nature of the rock forming the Peñon de Almayate. Shells and clastic fragments lie embedded in soft limestone.

Fig. 6. Texture of the rock of the Peñon de Almayate.

Six samples were collected at this locality. Each sample, comprising about one kg, was obtained from a 10 cm thick section of the sediment. The intervals between the horizons are variable and are indicated in Fig. 10. Sample AL1 and AL2 were taken from abandoned quarries, and sample AL4 came from a quarry in active use (Figs. 7A, B–9). The Peñon de Almayate is the most diversified locality in the present study. Therefore, special attention was paid to palaeoecological and geochemical properties of this section.

A total of 77 ostracod species were identified from the six samples. Complete carapaces and left and right valves were counted in each sample (see Table 2). This information is necessary for analyzing gastropod predation on the ostracod associations. It is obvious that the probability of finding the exact left and right valve for each moult-stage and valve in every sample is small. As the right valve is always slightly different in shape from the left valve, it might possibly have a tendency to have been transported by currents in a slightly different manner (Reyment, 1960; Breman, 1980). As an example, it can be mentioned that, where there are many instars (e.g. in *Cytherelloidea beckmanni* and *Quadracythere (T.) prava*), the ratio between left and right valves is significantly different (see Table 2), which may be explained by the fact that the juveniles are lighter and more easily transported by winnowing bottom currents.

Counting the left and right valves (LV and RV) for all species in each sample shows that the total number of each is almost equal, as shown in Fig. 11. The percentage of carapaces is different in each sample. Carapaces are more common in samples AL1 to AL4. The opposite condition pertains in samples AL5 and AL6. This effect has nothing to do with the volume of the samples, and there has to be another explanation for it. (N.B. the time period between AL1 and AL6 is approximately 1.9 Ma). Nonetheless, considering the material as a whole, as summarized in Table 2, and in spite of the margin of error arising from dealing with different moult stages and the effect of erosion, transported specimens etc., one can assume that environmental conditions were relatively stable during the time of sedimentation of the Almayate sequence, and that the majority of the fossils are autochthonous.

These assumptions were further confirmed by the chemical analysis of the six samples. The Early Pliocene en-

Table 2. Alphabetically ordered list of species showing the total number of collected carapaces, and left and right valves in each sample at the Peñon de Almayate.

LV = Left valve RV = Right valve CX = Carapaces

Species	Number of valves	SAMPLE AL1			AL2			AL3			AL4			AL5			AL6		
		LV	RV	CX	LV	RV	CX	LV	RV	CX	LV	RV	CX	LV	RV	CX	LV	RV	CX
Acanthocythereis hystrix	68							12	10	5				8	5	4	3	6	3
Aurila cimbaeformis	1563	6	10	58	40	36	230	82	39	154	3	3	75	38	38	45	37	41	33
Aurila convexa	7939	56	58	289	194	180	787	674	654	892	37	33	329	209	214	104	251	253	162
Bosquetina carinella	130							38	35	2				7	12	1	13	11	4
Bradleya ? pliocenica ? [1]	2													2					
B. (Buntonia) sublatissima dertonensis	2																		1
Bythocypris bosquetiana	54				1	1	2	7	4	18								1	
Bythocythere turgida	12				1	2								1	2		3	3	
Callistocythere flavidofusca	30						2			6				3		2		1	3
Callistocythere littoralis	79			4			7	3	9	11				3	2	8			1
Callistocythere lobiancoi	36							1	3	8				1		4	2	1	2
Callistocythere pallida	295					4	15	10	12	73				4	9	25	5	5	10
Callistocythere rastrifera	28							4		5					2	6			
Carinocythereis antiquata	17													4	6	3		1	
Carinocythereis carinata	133						1	38	28	6				19	23	3	1	2	1
Caudites calceolatus	7							1		3									
Costa batei	170	1		3	4	7	6	16	28	15			2	15	10	10	6	5	3
Costa aff. *batei*	2									1									
Costa edwardsii	1																	1	
Costa punctatissima	85				1	2		12	6	10				13	20	5		1	
Costa reymenti	77			2	1		8	11	13	7				2	4	1	3	1	3
Cytherelloidea beckmanni	211				5	5	14	35	26	37	2		5	10	3	3		3	2
Cytheropteron rotundatum	4							2		1									
Cytheropteron sp.	3							2	1										
Echinocythereis scabra	305	1		1	1	2	2	51	60	33				25	23	11	20	16	6
Echinocythereis sp.	4							4											
Eucytherura complexa	1																1		
Flexus triebeli	89							10	3	29			1	2	3	4	1		1
Graptocythere hscripta	37				2		6	1	5	4							1	4	2
Henryhowella asperrima	8									2				1	3				
Hermanites haidingeri	42						1	7	7	2				7	2	1	4	3	2
Heterocythereis albomaculata	9				1		4												
Hiltermannicythere emaciata	1																	1	
Hiltermannicythere quadridentata	69							11	12	8				11	15	2			
Hiltermannicythere retifastigata	57			1	1		1	11	7	13				1		1	2	1	1
Hiltermannicythere turbida	1							1											
Lixouria aquila	5							5											
Loxoconcha agilis	66			2		[illegible]	3	6	7	9				4	8	5		?	
Loxoconcha obliquata	391			1			12	30	34	96			9	5	9	22	5	4	12
Loxoconcha rhomboidea	591			2	5	4	17	81	79	173				4	7	5	2	3	6
Loxoconcha tumida	600	1		5	2	5	25	42	45	127	1	1	3	35	36	44	5	3	8
Loxoconcha variesculpta	2							1	1										
Loxoconcha versicolor	2													1	1				
Macrocypris succinea	14							1	1	1				2		4			
Microcytherura angulosa	2									1									
Monoceratina mediterranea	12							4	2					4			1	1	
Mutilus elegantulus	319			1	7	8	23	54	62	21				27	33	1	6	8	11
Neonesidea corpulenta	34				1	2	3	3	5	2				2	1	2	3	1	1
Neonesidea formosa	261	2	1	5				41	53	13				50	46	16			
Neonesidea frequens	78				13	10	16	4	1	2				6	4	2			
Neonesidea longevaginata	17													3	11			3	
Neonesidea mediterranea	145							29	28	15				15	3	1	15	17	3
Pachycaudites ungeri	24				2	1	2		2	3				2			2	1	2
Paracypris aff. *polita*	136				2		2	12	9	8				24	29	14	3	5	2
Paracytheridea depressa	38				5	5		5	1					9	7		4	2	
Pontocypris acuminata	8						1			3									
Protocytheretta obtusa	38			2		1	5						7		1	2			2
Pseudocythere caudata	1		1																
Pseudocytherura calcarata	1	1																	
Pterygocythereis siveteri	8				1	1				1					2	1			
Quadracythere (Tenedocythere) prava	160	1		2		2		28	51	11				23	29				
Quadracythere (Tenedocythere) salebrosa	243				16	11	60	8	11	5				8	14	3	14	13	6
Ruggieria tetraptera	198					1	6	25	33	38			1	3	10	7	7	9	3
Semicytherura acuticostata	1	1																	
Semicytherura alifera	2														2				
Semicytherura inversa	3													2			1		
Semicytherura sp. 1.	6							6											
Semicytherura sp. 2.	2							1									1		
Urocythereis favosa	45	2	2		1	1	4	18	12		1								
Urocythereis labyrinthica	44				3	5	4	7	7	2					6		1	1	1
Urocythereis margaritifera	2								2										
Xestoleberis communis	1056	4	6	19	15	21	52	110	101	174				62	57	44	31	27	22
Xestoleberis dispar	115							13	11	18				25	18	4		2	1
Xestoleberis fuscomaculata	56					1		14	8	11						3	1		2
Xestoleberis margaritea	269			1			5	24	22	85				14	9	6			3
Xestoleberis reymenti	19				1			2	3	5				1			1	1	
Xestoleberis ventricosa	109	1		1	1	1		19	16	29					4		1		3

[1] After the cliché of this table had been made, work on Australian Miocene ostracods has convinced me that this species is not a *Bradleya*.

A.

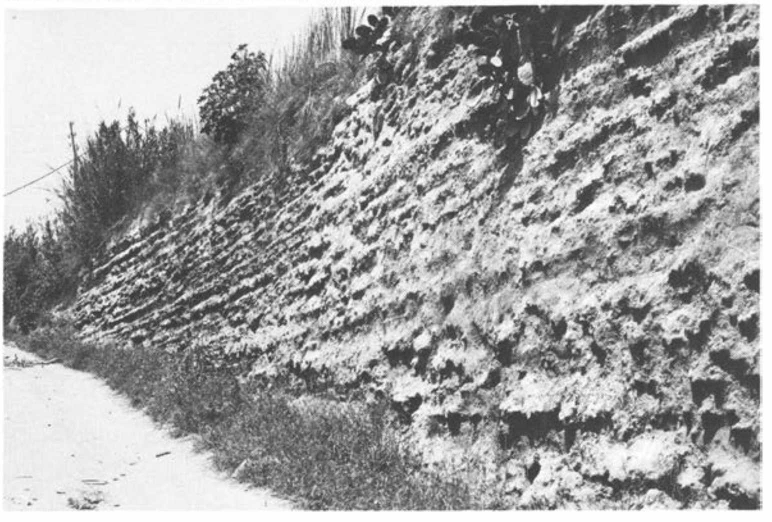

B.


Fig. 7. A, view of Almayate displaying tilted coarse bedding, truncated upwards and B, coarse tilted sediments in the lower part of the sequence.

vironment was restricted in nature, presumably protected behind bars, and marked by a high content of calcium carbonate, possibly similar to the Anse de Kernic of northwestern France (cf. Tietze *et al.*, 1979). This would explain the relatively few species in comparison with the situation pertaining in more open environmental conditions. The modern environment of the area is quite different. It is open to the sea, often perturbed by storms and strong longshore currents. The sedimentational regime today is one of sand and silty sand. The fluctuation in the content of $CaCO_3$ is the most noteworthy feature of the table; from a high value of about 85 % in the lowest part of the sampled sequence, there is a sharp fall to less than 50 %, due to a marked increase in the content of detritus. The contents of $CaCO_3$, $MgCO_3$, and $SrCO_3$ indicate sedimentation in an environment of shallow-water origin (Table 3), which accords well with the Almayate abundancy of the genus *Aurila,* which represent almost 57 % of the ostracod fauna at this locality. In this connection one

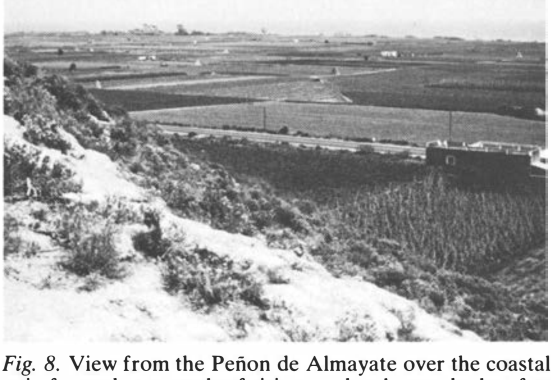


Fig. 8. View from the Peñon de Almayate over the coastal strip formed as a result of rising sea-level over the last few thousand years (as indicated by archaeological evidence).

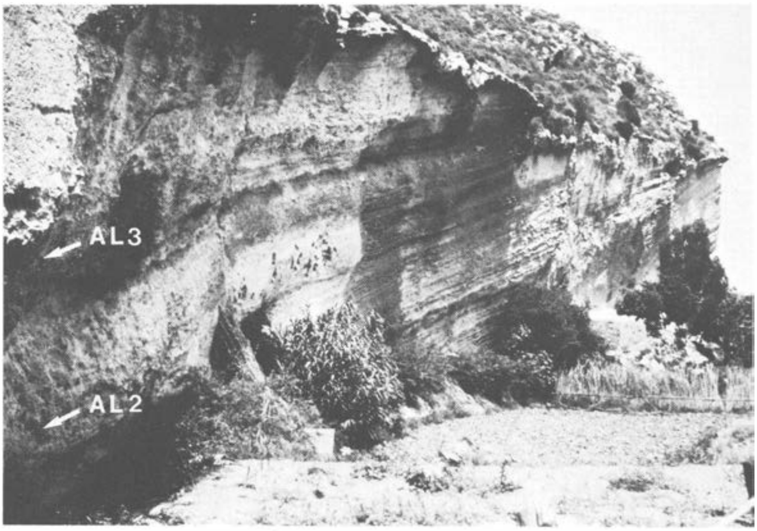


Fig. 9. Sites AL2 and AL3 at the Peñon de Almayate.

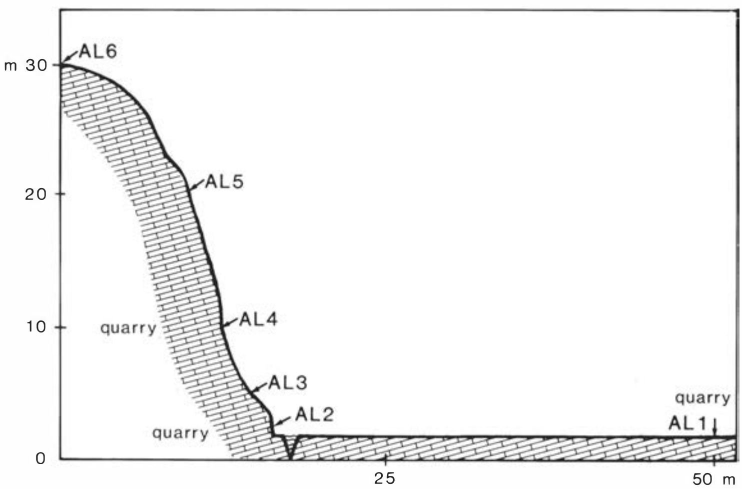


Fig. 10. Schematic representation of the Peñon de Almayate showing the sampling sites.

Table 3. The means and standard deviations for the contents of $CaCO_3$, $MgCO_3$ and $SrCO_3$ in the six samples collected at the Peñon de Almayate. N=10.

		AL1	AL2	AL3	AL4	AL5	AL6
%$CaCO_3$	x̄	84.65	46.47	59.05	62.35	59.00	64.70
	s	7.79	1.10	3.30	1.37	2.42	1.85
%$MgCO_3$	x̄	0.58	1.12	0.92	0.68	0.87	0.87
	s	0.03	0.06	0.08	0.04	0.09	0.04
%$SrCO_3$	x̄	0.01	0.03	0.02	0.02	0.03	0.03
	s	0.001	0.001	0.001	0.001	0.001	0.002
Coarse terrestrial material		1.16	11.91	36.23	18.76	21.29	20.07
Remainder (colloidal fraction)		13.60	40.47	3.78	18.19	18.81	14.33

x̄ denotes the mean and s the standard deviation.

can note that *Aurila* is a good indicator of shallow, near-shore conditions.

Heterocythereis albomaculata, Loxoconcha rhomboidea, L. turbida, Urocythereis favosa and *U. margaritifera* are still living today off Tore del Mar (cf. Tables 2 and 11).

Mezquitilla

The properties of this small outcrop are almost identical with those of the Peñon de Almayate with respect to the density and diversity of species. Sixty-eight species have been identified from the three samples taken from this sequence (see Fig. 13 and Table 4).

The following eight species found at Mezquitilla are still living in the same region, at Torre del Mar: *Cytherella vulgata, Hemicytherideis elongata, Hemicytherideis turbida, Heterocythereis albomaculata, Hiltermannicythere sphaerulolinaeta, Loxoconcha rhomboidea, Propontocy-*

pris pirifera, and *Urocythereis favosa.* It is interesting to note that *Cytherella vulgata,* which occurs abundantly at Mezquitilla, is absent at the Peñon de Almayate.

The Mezquitilla occurrence is marked by the occurrence of large, well preserved pectinid pelecypods (cf. Fig. 12). These are frequently oriented at a sharp angle to the horizontal, indicating mobility of the calcareous sediment prior to cementation. Small, well-rounded pebbles occur and in general, the appearance of the Malaguide inclusions differs markedly from the angular and poorly sorted fragments at Almayate. Well preserved barnacles also occur.

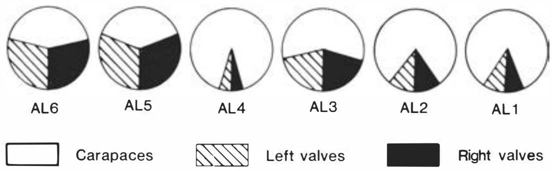


Fig. 11. Pie-diagrams showing the proportions of ostracod carapaces and left and right valves in the samples from the Peñon de Almayate.

Valle Niza

This locality is some 6 km west of the Peñon de Almayate. Twenty six species were identified from the two samples taken from this locality (see Fig. 14 and Table 5). Most of the ostracod fauna at this locality are also present at the Peñon de Almayate and Mezquitilla.

Propontocypris pirifera, Semicytherura cribriformis, and *Urocythereis favosa* are still living today off Torre del Mar. Many of the ostracod species occurring at this locality seem to be forms that would have required deeper environmental conditions than the site off Torre del Mar today. Presumably, a specialized study, based on the distributions of living species in the Mediterranean, could yield useful results with respect to estimating the depth of sedimentation of the calcareous cliffs of the Málaga coastline.

Other localities

The following three Pliocene localities at Cerro de San Antón (2), Limonar and Las Palmares (see Tables 7–9)

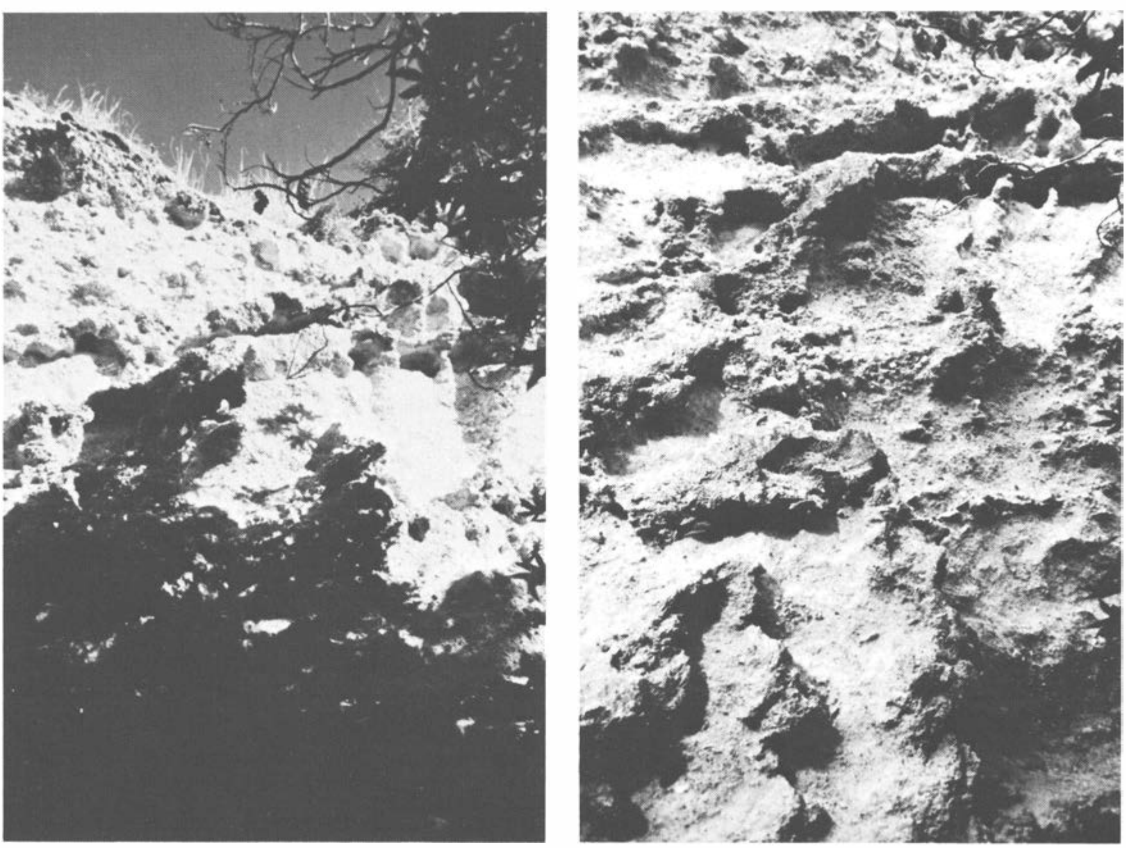


Fig. 12. Two views of the outcrop at Mezquitilla.

Table 4. The ostracods collected at Mezquitilla.

MEZQUITILLA	SAMPLE LOCATION (height above base of section)		
SPECIES	(4 m) UPPER	(2 m) MIDDLE	(1 m) LOWER
Acanthocythereis ascoli		X	
Acanthocythereis hystrix	X	X	X
Aurila cimbaeformis	X	X	X
Aurila convexa	X	X	X
Bassleriles berchoni	X		
Bosquetina carinella	X	X	X
Bythocypris bosquetiana	X		X
Bythocythere turgida			X
Callistocythere littoralis	X	X	
Callistocythere lobiancoi	X	X	
Callistocythere pallida	X		
Callistocythere rastrifera	X		
Carinocythereis antiquata	X	X	
Carinocythereis carinata	X	X	
Caudites calceolatus	X		
Cistacythereis pokornyi	X		
Costa batei	X	X	X
Costa punctatissima	X		
Costa reymenti	X		
Cytherella vulgata		X	X
Cytherelloidea beckmanni	X	X	X
Cytheretta adriatica	X	X	X
Echinocythereis scabra	X	X	
Echinocythereis sp.	X		
Flexus triebeli	X	X	X
Graptocythere hscripta	X	X	X
Hemicytherideis elongata	X	X	X
Hemicytherideis turbida	X	X	X
Hermanites haidingeri		X	X
Heterocythereis albomaculata		X	X
Hiltermannicythere quadridentata		X	X
Hiltermannicythere retifastigata	X		X
Hiltermannicythere sphaerulolineata		X	
Hiltermannicythere turbida	X		
Lixouria aquila	X		
Loxoconcha agilis	X		
Loxoconcha obliquata	X	X	
Loxoconcha rhomboidea	X	X	
Loxoconcha tumida	X	X	
Loxoconcha versicolor			X
Macrocypris succinea		X	
Mutilus elegantulus	X	X	X
Neonesidea corpulenta	X	X	X
Neonesidea formosa	X		
Neonesidea frequens	X	X	X
Neonesidea longevaginata	X	X	X
Neonesidea mediterranea	X		X
Pachycaudites ungeri	X		X
Paracypris aff. *polita*	X	X	
Paracytheridea depressa	X		
Pontocypris acuminata	X	X	
Propontocypris pirifera	X		
Protocytheretta obtusa	X	X	X
Pseudocytherura calcarata	X		X
Pterygocythereis siveteri	X		
Quadracythere (T.) prava	X		
Quadracythere (T.) salebrosa	X	X	X
Ruggieria tetraptera	X	X	X
Semicytherura acuticostata		X	
Semicytherura inversa		X	
Urocythereis favosa	X	X	X
Urocythereis labyrinthica		X	X
Xestoleberis communis	X	X	X
Xestoleberis dispar	X	X	X
Xestoleberis fuscomaculata	X	X	X
Xestoleberis margaritea	X	X	
Xestoleberis reymenti	X	X	
Xestoleberis ventricosa	X		

Table 5. The ostracods collected at Valle Niza.

	SAMPLE LOCATION (height above base of section)	
SPECIES	(2.5 M) UPPER	(1.5 M) LOWER
Acanthocythereis hystrix		X
Aurila cimbaeformis	X	X
Aurila convexa	X	X
Buntonia (Rectobuntonia) subulata		X
Callistocythere littoralis		X
Carinocythereis carinata		X
Costa batei		X
Costa reymenti		X
Echinocythereis scabra		X
Flexus triebeli		X
Graptocythere hscripta	X	
Hiltermannicythere retifastigata		X
Loxoconcha obliquata		X
Loxoconcha tumida	X	X
Mutilus elegantulus	X	X
Neonesidea corpulenta		X
Neonesidea longevaginata		X
Paracytheridea depressa		X
Pontocypris acuminata	X	X
Propontocypris intermedia		X
Propontocypris pirifera		X
Quadracythere (Tenedocythere) salebrosa		X
Ruggieria tetraptera		X
Semicytherura cribriformis		X
Urocythereis favosa	X	X
Xestoleberis communis	X	X

within the city limits of Málaga, were collected in 1982–1983 and were kindly made available for study by Professor J.M. González-Donoso, University of Málaga, Spain. The general aspects of these localities are illustrated in Figs. 15–18.

Further material was obtained in June 1985 from Las Palmares by Professor Richard Reyment. Cerro de San Antón (1) was sampled in June 1984 (Table 6).

The ostracods collected at the Rio Guadalminar sample are listed in Table 10. *Cytherella vulgata, Hiltermannicythere sphaerulolineata* and *Urocythereis margaritifera* are still living off Torre del Mar (cf. Table 11).

Fig. 13. The locality at Mezquitilla.
Height above base of section. (Lower = 1 m; middle = 2 m; upper = 4 m.)

Fig. 14. The locality at Valle Niza. The samples studied here were obtained from the exposure at the foot of the deserted village of Valle Niza.

Height above base of section. (Lower = 1.5 m; upper = 2.5 m.)

Fig. 15. View of the Cerro de San Antón. Here, non-marine Triassic is overlain by Pliocene.

Fig. 16. View of Limonar.

Fig. 17. Detrital calcareous sediment showing unsorted material from the underlying formations at Las Palmares.

Fig. 18. Section at Las Palmares.

Table 6. The ostracods collected at Cerro de San Antón (1).

SPECIES	SAMPLE LOCATION (height above base of section) (1 m) UPPER	(2 m) MIDDLE	(3 m) LOWER
Acanthocythereis hystrix	X		
Aurila cimbaeformis	X	X	
Aurila convexa	X	X	X
Callistocythere pallida		X	
Carinocythereis carinata	X	X	
Costa batei	X	X	X
Costa punctatissima	X		
Cytherella vulgata	X		
Cytherelloidea beckmanni	X	X	
Cytheretta adriatica		X	
Cytheromorpha sp.	X		
Echinocythereis scabra	X	X	X
Flexus triebeli	X	X	
Graptocythere hscripta	X	X	
Hemicytherideis elongata	X		
Hermanites haidingeri		X	X
Heterocythereis albomaculata	X		X
Hiltermannicythere retifastigata	X		
Hiltermannicythere turbida	X	X	
Loxoconcha concentrica	X	X	
Loxoconcha rhomboidea	X	X	
Loxoconcha tumida	X	X	X
Microcytherura angulosa	X		
Mutilus elegantulus	X	X	
Neonesidea corpulenta	X	X	
Occultocythereis dohrni		X	
Pachycaudites ungeri	X	X	
Paracytheridea depressa		X	
Pontocypris acuminata		X	
Pontocypris mytiloides	X	X	
Pterygocythereis jonesii	X		
Quadracythere (Tenedocythere) salebrosa	X		
Ruggieria tetraptera	X	X	
Urocythereis favosa	X	X	X
Urocythereis labyrinthica	X	X	
Xestoleberis communis	X	X	
Xestoleberis dispar		X	

Table 8. The following ostracods were collected from Limonar a suburb of Málaga. The preliminary extraction of these fossils was carried out by students of the University of Málaga.

SPECIES	SAMPLE 1	2	3	4	5	6
Acanthocythereis hystrix	X			X		X
Aurila cimbaeformis					X	
Aurila convexa	X		X	X	X	X
Callistocythere flavidofusca	X	X				
Costa batei		X				
Cytherelloidea beckmanni	X					
Cytheridea neapolitana	X		X			
Flexus triebeli	X	X				
Hemicytherideis elongata	X				X	X
Hiltermannicythere retifastigata		X	X		X	
Hiltermannicythere turbida			X			
Loxoconcha tumida					X	
Loxoconcha turbida			X			
Paracytheridea calcarata						X
Pterygocythereis siveteri	X					
Ruggieria tetraptera				X		X
Urocythereis favosa						X
Urocythereis labyrinthica			X		X	

Table 9. Ostracods collected from the outcrops around the north side of the hill at Las Palmares, city of Málaga.

SPECIES
Acanthocythereis hystrix
Aurila cimbaeformis
Aurila convexa
Bythocythere turgida
Carinocythereis carinata
Caudites calceolatus
Flexus triebeli
Heterocythereis albomaculata
Hiltermannicythere retifastigata
Loxoconcha rhomboidea
Mutilus elegantulus
Paracytheridea depressa
Ruggieria tetraptera
Urocythereis favosa

Table 7. Cerro de San Antón (2).

SPECIES	SAMPLE 1	2	3	4	5	6	7	8	9	10	11
Aurila convexa	X	X	X					X			
Costa batei								X			
Costa punctatissima								X			
Cytherelloidea beckmanni							X				
Cytheridea neapolitana										X	
Cytheromorpha sp.				X							
Echinocythereis scabra	X							X			
Graptocythere hscripta			X								
Hemicytherideis elongata						X					
Hermanites haidingeri							X	X			
Hiltermannicythere turbida											X
Hirschmannia sp.									X		
Loxoconcha concentrica					X						X
Pseudocytherura calcarata										X	
Pterygocythereis jonesii										X	
Urocythereis favosa			X		X						

(The preliminary extraction of these fossils was carried out by students of the University of Málaga.)

Table 10. The following fossil ostracods were collected from the west side of the Rio Guadalminar (see Fig. 2).

SPECIES
Aurila cimbaeformis
Aurila convexa
Bosquetina carinella
Bythocypris lucida
Costa punctatissima
Cytherella vulgata
Flexus triebeli
Hiltermannicythere rugosa
Hiltermannicythere sphaerulolineata
Hiltermannicythere stellata
Loxoconcha tumida
Macrocypris succinea
Neonesidea formosa
Neonesidea longevaginata
Neonesidea mediterranea
Pontocypris acuminata
Ruggieria tetraptera
Ruggieria tetraptera angustata
Urocythereis margaritifera
Xestoleberis communis

Table 11. Species collected at Torre del Mar.

	SAMPLE Water-depth in metres					
SPECIES	4	5	8	10	12	20
Asterope cf. *marie*			X			
Cytherella abyssorum					X	
Cytherella vulgata		X				
Eucypris virens ?					X	
Hemicytherideis elongata		X		X	X	
Hemicytherideis turbida		X		X	X	
Heterocythereis albomaculata		X		X	X	
Hiltermannicythere sphaerulolineata					X	
Leptocythere fabaeformis					X	
Leptocythere aff. *lagunae*				X		
Leptocythere levis					X	
Leptocythere rara					X	
Loculicytheretta pavonia		X			X	
Loxoconcha elliptica		X			X	
Loxoconcha rhomboidea		X			X	
Loxoconcha turbida					X	
Microcythere inflexa	X	X	X		X	
Microcythere levis	X	X	X		X	
Microcythere obliqua	X	X	X		X	
Neocytherideis fasciata					X	
Paradoxostoma simile					X	
Propontocypris pirifera					X	
Pseudosammocythere similis					X	
Sahnicythere retroflexa				X	X	X
Semicytherura costata					X	
Semicytherura cribriformis					X	
Semicytherura incongruens			X		X	
Semicytherura sulcata			X	X	X	
Semicytherura sp. 3				X	X	
Urocythereis favosa					X	
Urocythereis margaritifera					X	

Living near-shore ostracods (Provinces of Málaga, Granada and Cádiz)

Present-day near-shore ostracods from Torrenueva (Granada), Torre del Mar, Las Cuches, Estepona (Málaga), Tarifa, Rio Jaca near Tarifa, and Los Barrios (Cádiz) were studied for comparative ecological reasons. Thirty-four species were identified from the near-shore environment, thirteen of which are also present in the material from the Lower Pliocene localities studied herein. These are:

Cytherella vulgata, Neonesidea mediterranea, Hemicytherideis elongata, Hemicytherideis turbida, Hiltermannicythere sphaerulolineata, Heterocythereis albomaculata, Aurila convexa, Urocythereis favosa, Urocythereis margaritifera, Loxoconcha rhomboidea, Loxoconcha turbida, Semicytherura cribriformis and *Propontocypris pirifera.*

The genus *Aurila* is abundant in the Almayate sequence and also at the other Pliocene localities and represents almost 57 % of the ostracod fauna with respect to number of individuals; it is rare in the near-shore ostracod associations of southern Spain today. It was not found in the collection of Recent ostracods from Torre del Mar.

A location, outside the Mediterranean region on the Atlantic coast of France at Roscoff, was studied in November, 1985, for comparison with the Mediterranean fauna. This investigation showed that *Aurila convexa* is abundant at Dune de Rater, Pierre Noir and Primel. This observation is highly interesting for the evolution of the Early Pliocene of the western Mediterranean, inasmuch as the intertidal environment of the Roscoff area is dominated by a carbonate regime (Tietze *et al.*, 1979).

TORRENUEVA: There is a single sample from Torrenueva which was taken from in a backwater partly open to the sea. A few specimens of *Hemicytherideis elongata* and *H. turbida* were present in the sample. These species occur in the Pliocene of Mezquitilla.

TORRE DEL MAR: Seven samples were taken from this locality in June 1984 and July 1985 at different depths from 1.5 m to 20 m (with numerous foraminifers, gastropods, bivalves and brittle stars). No ostracods were found in the 1.5 m zone, which yielded mainly foraminifers and bivalves.

Semicytherura sulcata was abundant in the 12 m zone sample collected in June 1984, but was rare in the July 1985 sample; on the contrary, species of the genus *Microcythere* was more abundant in July 1985. This can probably be explained as being the outcome of seasonal factors operating on the distribution of the different species. Also, during certain times of the year, this part of the coast is ravaged by heavy storms which cause upchurning of deeper sediments in the 20–30 m zone, combined with wind-induced longshore drift. Substained powerful winds from the Atlantic may operate parallel to the coast. At other times, strong winds blow for days at a time (Levante). Obviously, such climatological conditions influence the distribution of dead shells.

LAS CUCHES: Five km west of Marbella. Three samples were taken from this locality: one from a small lagoon, with frequent influx of sea-water, and two from a sandy bottom, poorly sorted. Ostracods are rare at this locality, but a few valves of *Loxoconcha elliptica* were found in the lagoon sample.

ESTEPONA: Three samples were taken from this locality, one from a brackish water lagoon (not in direct contact with sea), and two from strand-swash, one of which yielded a few valves of *Callistocythere diffusa* and *Loxoconcha elliptica* in sample ESO2.

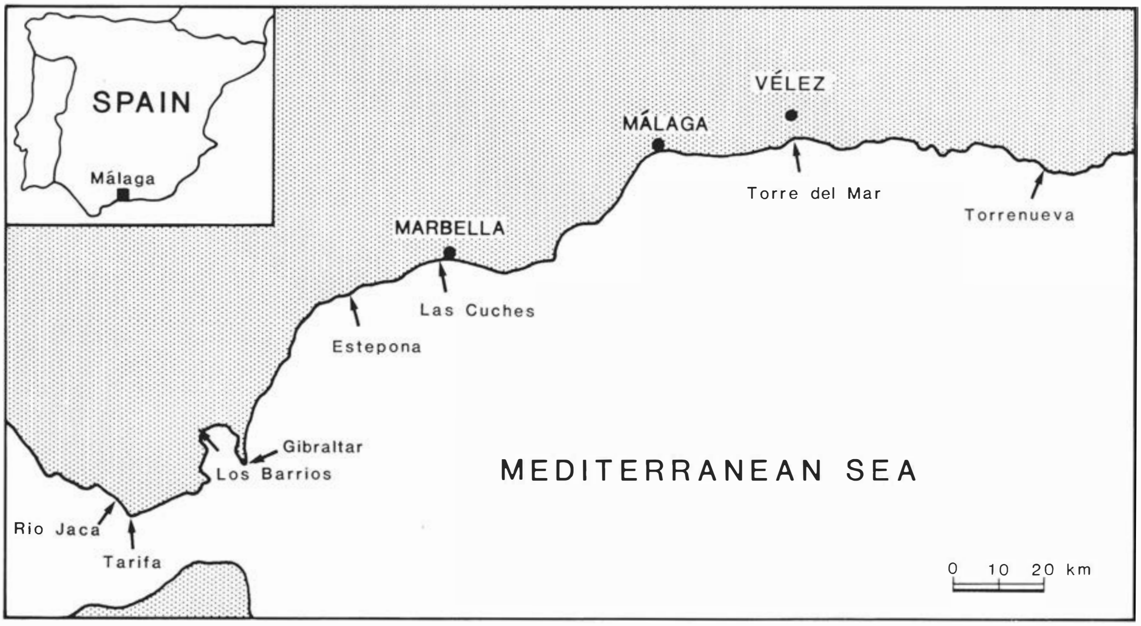


Fig. 19. Map showing the near-shore localities from which living ostracods were obtained for comparative studies.

TARIFA: West of the town and west of the Rio Jara. Two samples: one from the swash-zone and one taken from a depth of 1 m offshore. The swashed material (with numerous foraminifers including *Elphidium* sp., *Quinqueloculina* sp., *Gyroidina* sp., predaceous gastropods and echinoid spines) yielded *Aurila convexa.* The offshore sample yielded *Heterocythereis albomaculata* and *Neonesidea mediterranea.*

RIO JARA (TARIFA): Three samples were taken from this locality, near where the watercourse enters the sea. They contain mainly foraminifers, gastropods, bryozoan fragments and bivalves; ostracods are rare: Only *Neonesidea mediterranea* and *Heterocythereis albomaculata* were present in one of the samples.

LOS BARRIOS: A lagoon, adjacent to Hotel Guadacorte, about 1 km from the beach, and fed by water from

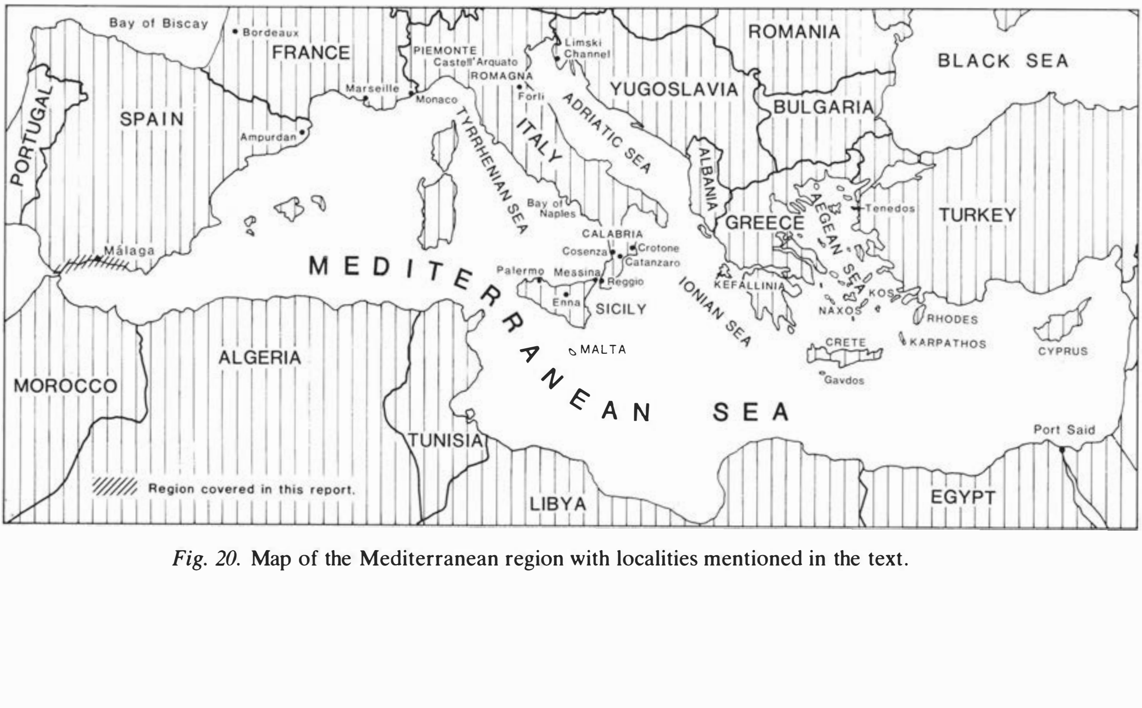


Fig. 20. Map of the Mediterranean region with localities mentioned in the text.

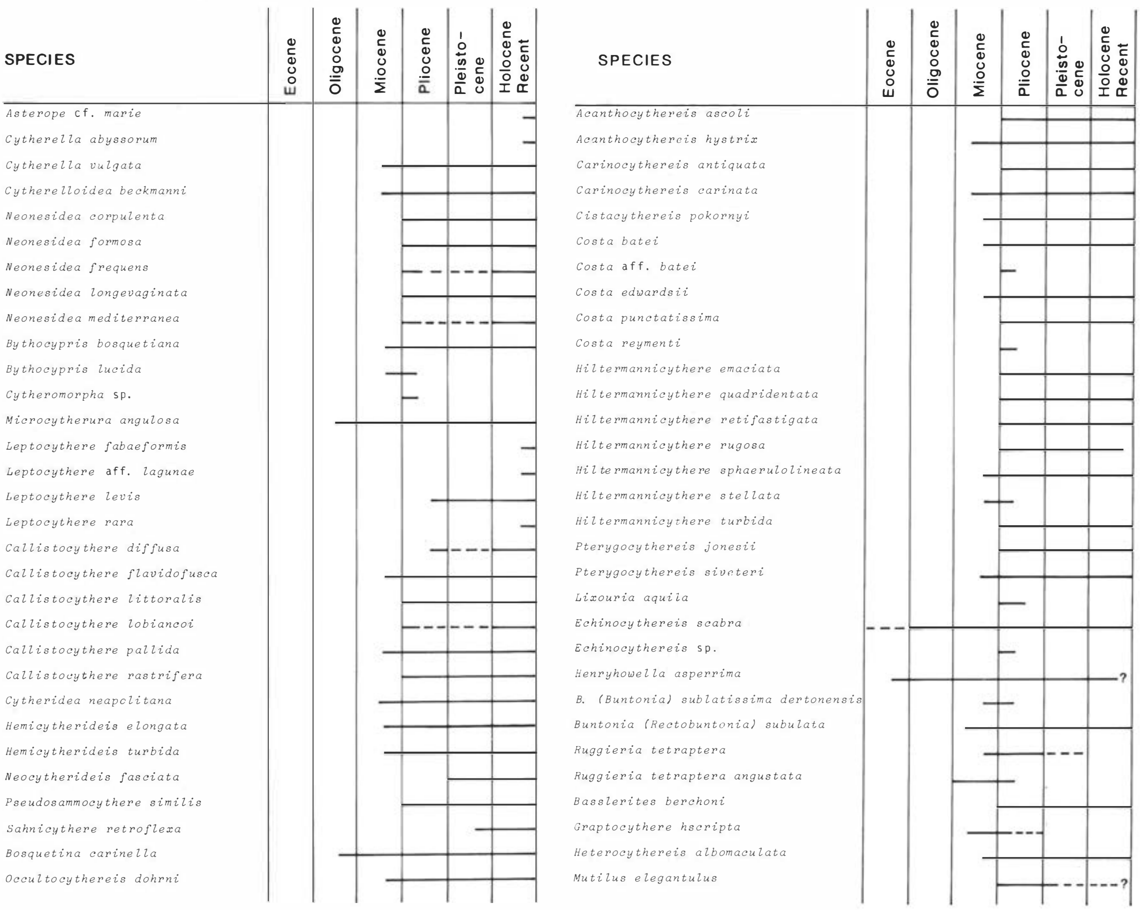
a culvert was sampled. The sediment smells strongly of hydrogen sulphide and dead minnows were seen floating in the lake. Small living gastropods occur in the bottom sediment. *Elphidium* sp. occurs in the sediment, as well as living ostracods. There are also bivalves. This locality is, as regards ostracods, exclusively colonized by *Loxoconcha elliptica,* which occurs in exceptional numbers (several hundred were obtained in a litre of water and sediment). The connection between the brackish "lagoon" and the sea is not clear. Possibly the lagoon has been in fairly recent contact with the open sea (as evidenced by the occurrence of foraminifers). The environment is a rather remarkable one, with stagnant bottom sediments. Previous reports of landlocked lagoons with *Loxoconcha* have been summarized by Bodergat (1983).

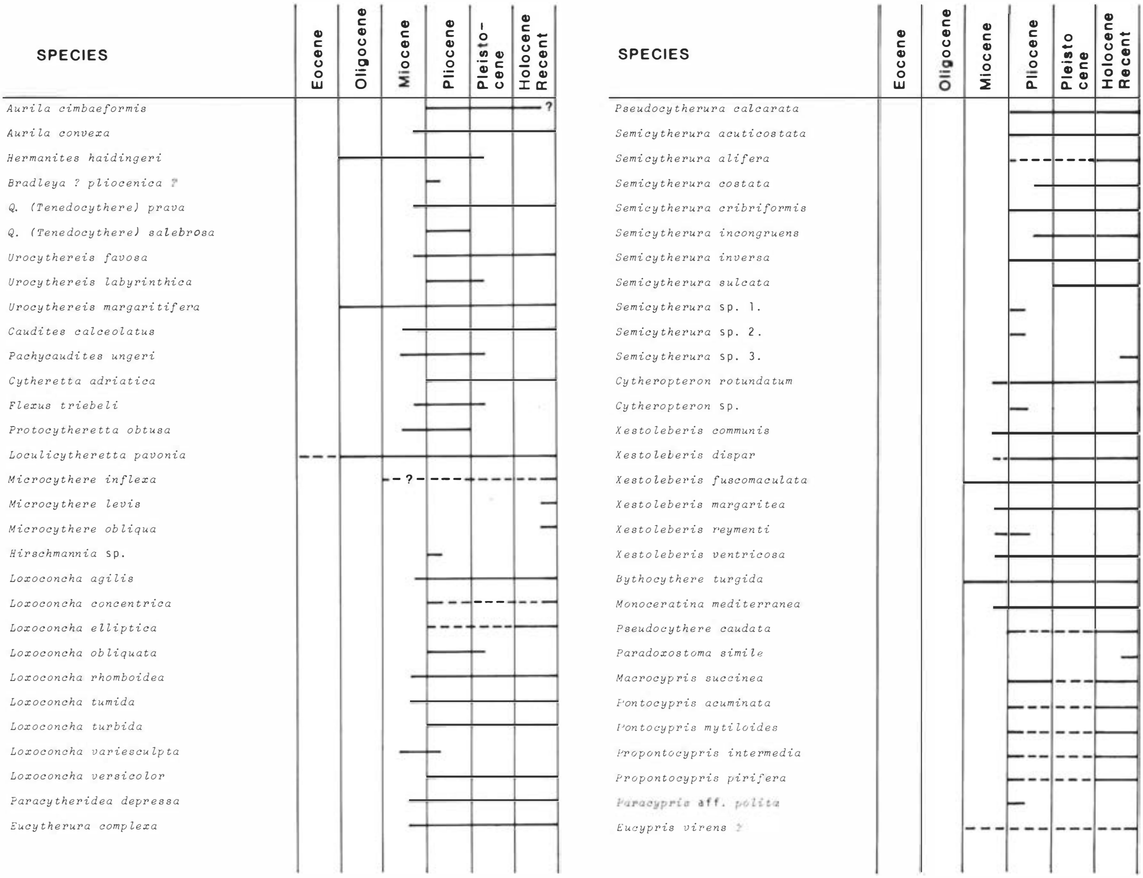
An observation of special significance is that a few drilled shells of *Loxoconcha elliptica* were found in the present material. Inasmuch as there are no drilling gastropods at in the lagoon at Los Barrios today the drilled shells derive from the time of normal salinity, during which there was a connection with the ocean.

Stratigraphical ranges and distributions

The stratigraphical ranges and distributions of the ostracod faunas studied herein are mainly based on the information given by various authors cited in the synonymy lists for each species in the taxonomical section, and on my own observations. To avoid confusion, I have omitted species on which satisfactory data are not available. In some cases, I have commented on the level of reliability of a particular work. The present study shows that Neogene ostracods can have a long time-range in the Mediterranean region, a sobering thought for biostratigraphers dealing with older strata. Thus, seven species range over almost 40 Ma., a long period, stratigraphically speaking, for the span of a species. Of the 122 species identified in the samples from

Table 12. The stratigraphical ranges of the species considered in this study.





N.B. Dashed lines indicate uncertain distributional information.

southern Spain, 101 were collected from Lower Pliocene localities, and 34 species from the present day near-shore localities. Thirteen species of the near-shore locations are also present in the samples from the Lower Pliocene localities.

Among the Early Pliocene ostracods, I found that two species (see Table 12) range from Eocene to Recent, five species range from Oligocene to Recent, and one species from Oligocene to Pleistocene. In addition, 52 species are known from the Miocene, and 42 of them range from Miocene to the present. Seventy-one species range from the Pliocene to the present, five species range form Pliocene to Holocene.

Thus, seventy-one species of the 101 collected at the Pliocene localities are still living in the Mediterranean Sea; furthermore, seven species are probably still living there, but this has not yet been fully confirmed as specimens with soft parts have not yet been obtained. This study shows then that almost 80 % of the Pliocene ostracod species collected in southern Spain are still living in the Mediterranean today. Thirty-nine species are reported outside the Mediterranean as Recent, sub-Recent and fossil; 28 of them are living in the Atlantic Ocean (British coastal waters, North Sea, Cabo Verde etc.), some have a broader geographical distribution and have been found off the coast of Florida, Australia and Japan.

The choice of terminology used here i.e. Recent, sub-Recent, and Holocene is as follows: I have referred all the living forms to Recent. Those which are probably living, as they have been found together with living individuals are referred to as being sub-Recent, and those which have been collected from bottom sediment and have only been described on the basis of shell characters, are referred to as Holocene.

Biostratigraphical notes

Palaeogene species

Seven species in the present study have a long stratigraphical range: *Henryhowella asperrima* has been recorded from the Upper Eocene to Upper Pliocene of Central America (Ruggieri, 1962, p. 20). In NW Germany, the species is known from the Lower Oligocene to the Lower Miocene (Uffenorde, 1981). In the Mediterranean region, it is known from the Upper Miocene to Holocene.

Loculicytheretta pavonia has the longest range in the Mediterranean, it has been living in the Mediterranean since the Eocene (N. Africa), as noted in Oertli (1973). I did not find species at the Lower Pliocene localities but it is living at present off Torre del Mar.

Echinocythereis scabra has been recorded from the Eocene of Belgium by Keij (1957) (see Van Morkhoven, 1963, p. 171). In the Mediterranean, this species is known from Miocene to Holocene, and it is probably still living in the Mediterranean (Brady, 1866).

Microcytherura angulosa, about which Ruggieri (1952, p. 87) recalled that Lienenklaus (1894) had probably found it in the Upper Oligocene and Miocene of Germany, is in the Mediterrranean region known from the Lower Pliocene to Recent.

Bosquetina carinella, has been found by Méhes, (1941) in the Upper Oligocene of Budapest (Ruggieri, 1962, p. 46). In the Mediterranean, it is known from the Miocene to Recent.

Hermanites haidingeri has been reported from the Oligocene and Miocene of France and Austria (Reuss, 1850; Bosquet, 1852). In the Mediterranean, the species is known from the Miocene to Pleistocene.

Urocythereis margaritifera has been reported from the Oligocene of Hungary. In the Mediterranean it is known from the Lower Pliocene. I found it in the fossil material of the Peñon de Almayate sequence and Rio Guadalminar. It is living at present off Torre del Mar.

Early Miocene species

Ruggieria tetraptera angustata is known in the Lower Miocene and Pliocene of Sicily. It is present in the Pliocene of Rio Guadalminar.

Xestotoleberis fuscomaculata has been living in the Mediterranean since the Miocene. It occurs in the Lower Pliocene at Almayate and Mezquitilla.

Bythocythere turgida is known in the Lower Miocene of France (Bordeaux), and from the Recent of the Mediterranean (Bonaduce *et al.,* 1975). I found the species in the Lower Pliocene of Almayate, Mezquitilla and Las Palmares. *B. turgida* is living off the Atlantic coast of Europe.

Middle Miocene species

Cytheridea neapolitana is known from the Middle Miocene of the Vienna Basin (Ruggieri, 1967) and has thus been living in the Mediterranean since the Middle Miocene. In Spain it occurs in the Pliocene.

Carinocythereis carinata has been living in the Mediterranean since the Middle Miocene. In Spain it occurs in the Pliocene at Almayate, Mezquitilla, Valle Niza, Cerro de San Antón and Las Palmares.

Acanthocythereis hystrix has also been living in the Mediterranean since the Middle Miocene, and it has been reported from the Vindobian of Czechoslovakia and Austria (Reuss, 1850; Triebel, 1941) quoted from Ruggieri (1953, p. 65). In Spain it occurs in the Pliocene at Almayate, Mezquitilla, Valle Niza, Cerro de San Antón, Las Palmares and Limonar.

Buntonia (Rectobuntonia) subulata is known from the Middle Miocene to Recent in the Mediterranean region. In Spain it occurs in the Pliocene at Valle Niza.

Graptocythere hscripta, Reuss (1850) recorded the species from the Middle Miocene of the Vienna Basin. The species is known in the Mediterranean from the Middle Miocene to Pliocene. In Spain it occurs in the Lower Pliocene at Almayate, Mezquitilla, Valle Niza and Cerro de San Antón.

Caudites calceolatus has been recorded from the Middle and Upper Miocene of Ampurdan, Spain (Carbonnel, 1982) and in the Tortonian (Upper Miocene) to Upper Pliocene of Crete and Gavdos (Sissingh, 1972) and in the Pliocene of the Aegean Islands (Uliczny, 1969). It occurs in the Upper Pliocene of Italy and Algeria. I found this species in the Lower Pliocene of Almayate, Mezquitilla and Las Palmares. It occurs in the Lower Pleistocene of Rhodes (Sissingh, 1972). *C. calceolatus* occurs today in the Mediterranean Sea.

Pachycaudites ungeri was described from the Middle Miocene of the Vienna Basin (Reuss, 1850). The species is known in the Mediterranean from the Tortonian of Italy (Benestare) Ruggieri (1962, p. 43) to Lower Pleistocene of Crete. I found the species in the Lower Pliocene of Almayate, Mezquitilla and Cerro de San Antón.

Protocytheretta obtusa was described from the Middle Miocene of Sicily (Benestare) Ruggieri (1962). I found it in the Lower Pliocene of Almayate and Mezquitilla. Sissingh (1972) found this species in the Upper Pliocene of Greece (Karpathos, Crete).

Loxoconcha variesculpta was originally described from the Middle Miocene of Sicily (Enna) Ruggieri (1962). Sissingh (1972) found the species in the Upper Miocene of Crete. In Spain it occurs in the Lower Pliocene of the Peñon de Almayate.

Microcytherura inflexa, which occurs today off Torre del Mar, is living in the Bay of Naples and the Adriatic Sea (Müller, 1894; Uffenorde, 1972; Bonaduce *et al.,* 1975). Van den Bold (1946, p. 26) reported this species from the Miocene of Central America, a claim seemingly requiring further documentation. In the Mediterranean *M. inflexa* is known only from the Recent, as far as has come to my knowledge.

Late Miocene species

Cytherella vulgata is known form the Upper Miocene to Recent in the Mediterranean. Ruggieri (1962) described this species from Sicily (Enna) from the Upper Tortonian. It occurs in the Miocene of Algeria and Crete (Sissingh, 1972a, 1972b). The species occurs in the Pliocene and Pleistocene of Italy and Greece (Ruggieri, 1962; Sissingh (1972a). I found *C. vulgata* in the Lower Pliocene of Mezquitilla and it is living at present off Torre del Mar.

Cytherelloidea beckmanni has been recorded from the Upper Miocene, Pliocene and Pleistocene of Greece (Sissingh, 1972). It occurs in the Lower Pliocene of Almayate, Mezquitilla, Cerro de San Antón and Limonar. This species is living in the Aegean Sea.

Bythocypris bosquetiana is known in the Mediterranean from the Upper Miocene and Pliocene of Crete (Sissingh, 1972) and from the Recent of the Bay of Naples (Müller, 1894). I found it in the Lower Pliocene of Almayate and Mezquitilla. It is living in the Atlantic (Brady, 1866; Sars, 1928).

Bythocypris lucida has been recorded from the Upper Miocene of Crete (Sissingh, 1972) and the Lower Pliocene of Italy, Crete and Spain (Ampurdan) Carbonnel (1982). I found this species in the Pliocene of Rio Guadalminar.

Hiltermannicythere sphaerulolineata was originally described from the Pliocene of Suffolk Crag, England (Jones, 1856). Carbonnel (1969) reported the species from the Upper Miocene of the Rhône Basin, France. This form occurs in the Pliocene of Rhodes and Crete and in the Pleistocene of Rhodes; I found it in the Lower Pliocene of Mezquitilla and Rio Guadalminar. It is living at present off Torre del Mar.

Hiltermannicythere stellata, which is known from the Upper Miocene of Italy, is present in the Pliocene of Rio Guadalminar.

Buntonia sublatissima dertonensis is known in the Upper Miocene of Italy and Greece; it occurs in the Lower Pliocene of Almayate.

Callistocythere flavidofusca, which was originally described from the Upper Miocene of Italy Ruggieri (1950), has been recorded from the Pliocene of Greece (Sissingh, 1972; Mostafawi, 1981). I found this species in the Lower Pliocene of Almayate and Limonar. It is living in the Adriatic Sea (Bonaduce *et al.,* 1975).

Callistocythere pallida has been recorded from the Upper Miocene to Pleistocene of Greece (Sissingh, 1972). I found it in the Lower Pliocene of Almayate, Mezquitilla, and Cerro de San Antón. It is living in the Mediterranean.

Hemicytherideis elongata and *H. turbida* have the same stratigraphical range in the Mediterranean namely, Late Miocene to Recent. I found *H. elongata* in the Lower Pliocene of Mezquitilla, Cerro de San Antón and Limonar, and *H. turbida* at Mezquitilla. These two species are living at present off Torre del Mar and Torrenueva. *H. elongata* occurs in the Altantic and has been reported from the West Coast of Florida (Neil *et al.,* 1964).

Occultocythereis dohrni occurs in the Upper Miocene of Gavdos and Crete and in the Lower Pleistocene of Rhodes (Sissingh, 1972). It is present in the Pliocene of Italy (Ruggieri, 1962). I found this species in the Lower Pliocene of Mezquitilla and Cerro de San Antón. *O. dohrni* is living in the Mediterranean (Müller, 1894).

Costa edwardsii (Roemer) was redescribed by Ruggieri, 1961 from the Sicilian (Lower Quaternary) of Cosenza (see Map Fig. 20). It occurs in the Lower

Miocene of Greece (Gavdos) and in the Pliocene of Crete (Sissingh, 1972) and Turkey (Doruk, 1973). I found the species in the Lower Pliocene of Almayate. It is common in the E Mediterranean (Doruk, 1973).

Costa batei is known from the Upper Miocene of Turkey to Recent in the Mediterranean (Doruk, 1973). It is present in the Lower Pliocene sediments of Almayate, Mezquitilla, Cerro de San Antón and Valle Niza.

Pterygocythereis siveteri inhabits the Mediterranean today (Müller, 1894). It is known from the Upper Miocene of Gavdos and Crete, Greece (Sissingh, 1972). In the present collection it occurs in the Lower Pliocene sequences of Almayate, Mezquitilla and Limonar. *P. siveteri* is living in the Atlantic off Madeira, in the North Sea, and in the Bay of Biscay (Athersuch, 1978).

Cistacythereis pokornyi was originally described from the Tortonian of Italy Ruggieri (1962). It occurs in the Pliocene of Italy (Ruggieri, 1962), Greece (Uliczny, 1969; Sissingh, 1972), and Cyprus (Doruk, 1981). I found it in the Lower Pliocene of Mezquitilla. Stambolidis (1985) found the species in sub-Recent material from the Evros-Delta, Greece.

Ruggieria tetraptera is known in the Mediterranean region to range from Late Miocene to Early Pleistocene. The species is present in all the fossil material of Early Pliocene age in the current study.

Heterocythereis albomaculata is living today in the Mediterranean and also off the Atlantic coast of Europe. Sissingh (1973) found it in the Calabrian of Santa Maria di Catanzaro, Italy. Sissingh (1973) expressed doubts about Moyes', (1965) determination of this species in the Upper Miocene and Pliocene strata of the Aquitaine Basin considering that reliable records of this species are from Pleistocene and younger deposits. In Spain this species occurs in the Lower Pliocene of Almayate, Mezquitilla, Cerro de San Antón and Las Palmares, and it occurs living today off Tarifa.

Aurila convexa is known in beds of Early Miocene to Recent age in the Mediterranean region. I found it in all the Lower Pliocene material investigated herein and it was collected alive off Tarifa. *A. convexa* is living off the Atlantic coast of Europe.

Quadracythere (Tenedocythere) prava was originally described from Tenedos, Turkey. It is known in the Mediterranean region from the Late Miocene to the Recent. It occurs in the Lower Pliocene of Almayate and Mezquitilla. *Q. (T.) prava* has a broad geographical distribution outside the Mediterranean.

Urocythereis favosa ranges from the Late Miocene and Pliocene of Italy (Capeder, 1900; Ruggieri, 1950) and is found in the Pliocene of Greece (Uliczny, 1969; Sissingh, 1972), France (Keij, 1957), Turkey (Doruk, 1974). It occurs in the Lower Pliocene of Almayate, Mezquitilla, Cerro de San Antón, Limonar, Las Palmares and Valle Niza. *U. favosa* was reported from the Recent of the North Aegean Sea and the west coast of Turkey (Doruk, 1974). It is living at present off Torre del Mar.

Flexus triebeli was redescribed by Ruggieri (1962) from the Upper Pliocene and Lower Pleistocene of Toscany, Italy. It occurs in the Miocene to Pleistocene of Italy (Ruggieri, 1956; 1962; Dieci & Russo, 1964) and in the assumed Late Pliocene boundary zone of Karpathos, Greece (Sissingh, 1972). In Spain it is present in the Lower Pliocene sediments investigated herein. Uffenorde (1981) found this form in the Upper Miocene of Cuxhaven, Germany.

Loxoconcha agilis, Ruggieri (1967) described this species from the Sahelian (Lower Messinian) of Casa and Gessi, Italy. It occurs in the Pliocene and Pleistocene of Turkey (Doruk, 1979). I found it in the Lower Pliocene of Almayate and Mezquitilla. It is living in the Bay of Naples, and the Aegean Sea.

Loxoconcha rhomboidea ranges from the Late Miocene to Early Pleistocene of the Aegean Islands (Sissingh, 1972). It occurs in the Lower Pliocene of Almayate, Mezquitilla, Cerro de San Antón and Las Palmares. It is living at present off Torre del Mar. This species was originally described from the Kattegat and has been reported from different regions off the west coasts of Europe and NW Africa (Elofson, 1941).

Loxoconcha tumida was described by Brady (1869) from Piraeus and Besika Bay, Greece. It has the same stratigraphical range as *L. rhomboidea* and almost the same distribution in the Mediterranean. I found it in the Lower Pliocene of Almayate, Mezquitilla, Cerro de San Antón, Limonar, Valle Niza and Rio Guadalminar. Carbonnel (1982) reported this species from the Pliocene of Ampurdan, Spain.

Paracytheridea depressa has been reported in the Mediterranean from the Lower Tortonian of Crete (Sissingh, 1972) to Recent. Carbonnel (1982) found a similar morph of this species in the Upper and Middle Pliocene of Ampurdan, Spain. In the present collection, *P. depressa* occurs at Almayate, Mezquitilla, Cerro de San Antón. Las Palmares and Valle Niza.

Eucytherura complexa, which was originally described from the Hebrides (Brady, 1866), has been recorded in the Mediterranean from the Tortonian of Romagna (Ruggieri, 1962) and the Lower and Middle Pliocene of Crete and in the Upper Pliocene and Lower Pleistocene of Rhodes (Sissingh, 1972). It is present in the Lower Pliocene of Almayate.

Cytheropteron rotundatum. Peypouquet (1971) found this species in the Lower Miocene of France and Sissingh (1972) recorded it in the Lower Pleistocene of Rhodes. I found it in the Lower Pliocene at Almayate. It is found living in the Bay of Naples (Müller, 1894).

Xestoleberis communis is recorded in the Upper Miocene of Crete and the Upper Pliocene and Lower Pleistocene of Rhodes (Sissingh, 1972). In Spain it is present in the Lower Pliocene of Almayate, Mezquitilla, Cerro de San Antón, Valle Niza and Rio Guadalminar. It lives today in the Mediterranean (Müller, 1894; Athersuch, 1976).

Xestoleberis margaritea has a broad geographical distribution outside the Mediterranean. It is living off the Gulf of Monaco, Marseille, Italy, Ionian Sea, Levant (Brady, 1966; Ruggieri, 1953; Athersuch, 1976). Sissingh (1972) found a morph of this species and placed it in the same stratigraphical range and distribution as *X. communis.* In Spain it occurs in the Lower Pliocene of the Peñon de Almayate and at Mezquitilla.

Xestoleberis reymenti, Ruggieri (1967) described this species from the Messinian (Sahelian) of Casa and Gessi, Italy. Sissingh (1972) recorded it from the Upper Tortonian (Upper Miocene) to Lower Pliocene of Crete, and from the Upper Miocene of Gavdos. Cabonnel & Ballesio (1982) recorded the species from the Middle Pliocene of SE France. In Spain it is present in the Lower Pliocene of Almayate and Mezquitilla.

Xestoleberis ventricosa is recorded from the Upper Miocene to Lower and Middle Pliocene of Crete (Sissingh, 1972). I found the species in the Lower Pliocene of Almayate and Mezquitilla. *X. ventricosa* is living off the Bay of Naples (Müller, 1894) and Cyprus (Athersuch, 1976).

Monoceratina mediterranea. Ruggieri (1953) found this species in the Upper Pliocene and the Lower Pleistocene of Rio Riorzo, Italy. Sissingh (1972) described this species from the Lower Tortonian of Crete, the Pliocene of Karpathos and Rhodes, and the Lower Pleistocene of Rhodes. In Spain it occurs in the Lower Pliocene of the Peñon de Almayate. *M. mediterranea* is living off the Bay of Naples (Minichelli *et al.*, 1976).

Early Pliocene species

Neonesidea corpulenta has been reported from the Middle Pliocene of Crete and the Upper Pliocene of Karpathos (Sissingh, 1972). It occurs in the Lower Pliocene sequences of Almayate, Mezquitilla, Valle Niza and Cerro de San Antón. *N. corpulenta* is found today off the Bay of Naples and the Adriatic Sea (Bonaduce *et al.*, 1975).

Neonesidea formosa occurs in the Upper Pliocene of Karpathos and Rhodes, and in the Lower Pleistocene of Crete and Rhodes (Sissingh, 1972). I found this species in the Lower Pliocene of Almayate and Mezquitilla. It is living in the Mediterranean Sea.

Neonesidea frequens is known in the Recent of the Mediterranean (Müller, 1894; Breman, 1976). It occurs in the Lower Pliocene of Almayate and Mezquitilla.

Neonesidea longevaginata was described from the Recent off the Bay of Naples (Müller, 1894). Sissingh (1972) recorded it from the Upper Pliocene and Lower Pleistocene of Rhodes. The species is present in the Lower Pliocene of Almayate, Mezquitilla, Valle Niza and Rio Guadalminar.

Neonesidea mediterranea is living off the Bay of Naples (Müller, 1894), Aegean Sea (Barbeito-Gonzales, 1971), Adriatic Sea (Bonaduce *et al.*,1975) and at present off Tarifa. I found this species in the Lower Pliocene of Almayate, Mezquitilla and Rio Guadalminar.

Callistocythere littoralis was redescribed and provided with a neotype by Athersuch (1980). It has been reported from the Pleistocene of Italy (Ruggieri, 1952) and from the Upper Pliocene of Kos, Greece (Mostafawi, 1981). It occurs in the Lower Pliocene of Almayate, Mezquitilla and Valle Niza. *C. littoralis* is living in the Mediterranean and off the Atlantic coast of Europe.

Callistocythere lobiancoi occurs today in the Bay of Naples (Müller, 1894), Aegean Sea (Barbeito-Gonzalez, 1971), Limski Channel (Uffenorde, 1972), Adriatic Sea (Masoli 1968; Bonaduce *et al.*, 1975; Breman, 1976). This species occurs in the Lower Pliocene of the Peñon de Almayate and at Mezquitilla.

Callistocythere rastrifera was described by Ruggieri (1953) from the Quaternary of Calabria, southern Italy. Sissingh (1972) recorded it in the Upper Pliocene of Karpathos and Rhodes, and in the Lower Pliocene and Lower Pleistocene of Rhodes. Mostafawi (1981) reported it from Kos, Greece in the Upper Pliocene. In Spain it is present in the Lower Pliocene of Almayate and Mezquitilla. *C. rastrifera* is living in the Mediterranean, Yassini (1979) reported it in the Bay of Bou-Ismael, Algeria. Breman (1976) found it in the bottom sediments of the Adriatic Sea.

Pseudosammocythere similis is a living form in the Mediterranean Sea [Bay of Naples (Müller, 1894), Adriatic Sea (Barbeito-Gonzalez, 1971; Bonaduce *et al.*, 1975; Breman, 1976), Torre del Mar (herein)]. Sissingh (1972) reported this species from the Lower Pliocene of Crete, and from the Upper Pliocene and Lower Pleistocene of Rhodes.

Acanthocythereis ascoli is living in the Bay of Naples (Müller, 1894; Puri, 1963). Ruggieri (1953) found it in the Quaternary of Italy, near Crotone. The species is present in the Lower Pliocene of Mezquitilla.

Carinocythereis antiquata occurs today in the Bay of Naples (Müller, 1894), Adriatic Sea (Bonaduce *et al.*, 1975; Breman, 1976), and in the Limski Channel (Uffenorde, 1972). It was recorded from the Pliocene and Pleistocene of Rhodes (Sissingh, 1972). In Spain it occurs in the Lower Pliocene of Almayate and Mezquitilla.

Hiltermannicythere emaciata inhabits British waters. Ruggieri (1953, p. 140) recorded this species in calcareous organic tuff in Palermo, Sicily. Uliczny (1969) found it in the Pliocene of Kefallinia, Greece. It is present in the Lower Pliocene of Almayate.

Hiltermannicythere quadridentata is known in British waters (Brady, 1868). In the Mediterranean it has been reported from the Pliocene of Kefallinia, Greece (Uliczny, 1969). Sissingh (1972) found it in the Lower Pliocene of Crete and in the Upper Pliocene of Karpathos. It occurs in the Lower Pliocene of Almayate.

Hiltermannicythere retifastigata was originally described from Suffolk Crag, England. It is living in the Mediterranean Sea (Müller, 1894). Sissingh (1972) recorded this species in the Lower and Middle Pliocene and in the Pleistocene of Crete, in the Upper Pliocene of Karpathos and in the Upper Pliocene and Lower Pleistocene of Rhodes. I found it in the Lower Pliocene of Almayate, Valle Niza, Mezquitilla, Cerro de San Antón, Limonar and Las Palmares.

Hiltermannicythere rugosa was originally described from deposits exposed near Naples, Italy. Uliczny (1969) recorded it in the Pliocene of Kefallinia. Sissingh (1972) found it in the Lower Pliocene of Crete. Bassiouni (1979) reported it from the Upper Pliocene of Turkey. It is present in the Pliocene of Rio Guadalminar, Spain.

Hiltermannicythere turbida is living today in the Mediterranean Sea (Müller, 1894; Uffenorde, 1972; Bonaduce *et al.*, 1975; Breman, 1976) and off the Atlantic "Bay of Biscay". Uliczny (1969) recorded it in the Pliocene of Kefallinia, Greece. This species occurs in the Lower Pliocene of Almayate, Mezquitilla and Limonar.

Pterygocythereis jonesii is known in the Recent and Holocene off the Atlantic coasts of northern Europe (Baird, 1850; Brady, 1868; Sars, 1928; Elofson, 1941). It is living in the Mediterranean Sea (Athersuch, 1978). Sissingh (1972) recorded it in the Pliocene of Rhodes, Karpathos and Crete, and in the Pleistocene of Rhodes. It is known in the Pliocene and Pleistocene of Italy (Ruggieri, 1950), Algeria (cf. Mostafawi, 1981). In Spain it occurs in the Lower Pliocene of Cerro de San Antón.

Lixouria aquila, Ruggieri (1972) described this species from the Middle Pliocene of Piancenza, Italy. I found it in the Lower Pliocene of Almayate and Mezquitilla.

Basslerites berchoni was originally described from British waters (Brady, 1869). It lives also in the Mediterranean; Bay of Naples (Müller, 1894), Aegean Sea (Barbeito-Gonzalez, 1971; Uffenorde, 1972), Port Said, Egypt (Yassini, 1969). Ruggieri (1973) recorded this species in the Pleistocene of Calabria, Italy. Sissingh (1972) found it in the Lower Pleistocene of Rhodes. Mostafawi (1981) reported it in the Upper Pliocene of Kos, Greece. This species occurs in the Pliocene southeastern France (Carbonnel, 1982). In Spain it is present in the Lower Pliocene of Mezquitilla.

Mutilus elegantulus was redescribed by Ruggieri & Sylvester-Bradley (1975) from the Middle Pliocene of the River Modione, Sicily. Sissingh (1972) found the species in the Upper Pliocene and Middle Pliocene of Crete, Upper Pliocene of Karpathos and Upper Pliocene and Lower Pleistocene of Rhodes. Carbonnel (1982) found it in the Upper Pliocene of Ampurdan, Spain. This species occurs in the Lower Pliocene of Almayate, Mezquitilla, Valle Niza, Cerro de San Antón and Las Palmares.

Aurila cimbaeformis is known in the Mediterranean from the Middle Pliocene of Greece (Uliczny, 1969) to Holocene? Recent (Bonaduce *et al.*, 1975). In Spain, I obtained it from all the Lower Pliocene sequences studied.

Quadracythere (Tenedocythere) salebrosa was originally described from the Pliocene of Kefallinia, Greece (Uliczny, 1969). It occurs in the Pliocene of Algeria (Yassini, 1979). Carbonnel (1982) found it in the Middle and Upper Pliocene of Ampurdan, Spain. It is present in the Lower Pliocene of Almayate, Mezquitilla, Valle Niza and Cerro de San Antón.

Urocythereis labyrinthica. Uliczny (1969) described this species from the Pliocene of Kefallinia, Greece. Sissingh (1972) recorded it in the Lower Pliocene and Lower Pleistocene of the South Aegean Islands. Doruk (1974) found it in the Lower Pleistocene of Italy. In Spain it occurs in the Lower Pliocene of Almayate, Mezquitilla, Cerro de San Antón and Limonar.

Cytheretta adriatica was redescribed by Ruggieri (1952) from the Milazzian of Imola, Italy. Sissingh (1972) recorded the species in the Lower Pliocene and the Pleistocene of Crete, and in the Upper Pliocene of Karpathos, Greece. In Spain, I found it in the Lower Pliocene of Mezquitilla and Cerro de San Antón. *C. adriatica* inhabits the Mediterranean (Athersuch, 1976).

Loxoconcha concentrica was described from the Recent in the Adriatic Sea and was also found in the Bay of Naples. In Spain, I found a morph of this species in the Lower Pliocene of Cerro de San Antón.

Loxoconcha obliquata. Ruggieri (1963) made a neotype for this species from the Lower Pleistocene of Benestare, Italy. It occurs in the Lower Pliocene of Almayate, Mezquitilla and Valle Niza.

Loxoconcha turbida is living today off Torre del Mar (p. 18), and in the Bay of Naples (Müller, 1894), the Adriatic Sea (Bonaduce *et al.*, 1975; Breman, 1976) and Monaco. Ruggieri (1952) recorded it in the Calabrian of Italy. It occurs in the Upper Pliocene and Lower Pleistocene of Rhodes (Sissingh, 1972) and in the Pliocene of Algeria (Yassini, 1979). It is present in the Lower Pliocene deposits of Limonar.

Loxoconcha versicolor is distributed widely today in the Mediterranean Sea (Müller, 1894 Bonaduce *et al.*, 1975; Breman, 1976). Sissingh (1972) recorded it in the Upper Pliocene of Karpathos and in the Lower Pleistocene of Rhodes. I found it in the Lower Pliocene of Almayate and Mezquitilla.

Pseudocytherura calcarata occurs in the Calabrian of Italy and in the Upper and Middle Pliocene of Castell'Arquato, Italy (Ruggieri, 1952). Sissingh (1972) found it in the Lower and Middle Pliocene and the Pleistocene of Crete, in the Upper Pliocene of Karpathos, and in the Upper Pliocene and Lower Pleistocene of Rhodes. In Spain, it occurs in the Lower Pliocene of Almayate, Mezquitilla and Cerro de San Antón. *P. calcarata* is living Mediterranean species (Bonaduce *et al.*, 1975).

Semicytherura acuticostata was originally described from the North Sea (Sars, 1866); it also occurs in the Mediterranean Sea (Müller, 1894; Barbeito-Gonzalez, 1971; Bonaduce *et al.*, 1975; Breman, 1976). Ruggieri (1952) recorded the species in the Calabrian of Italy. Sissingh (1972) found it in the Lower and Middle Pliocene and the Pleistocene of Crete, and in the Upper Pliocene of Karpathos, and in the Upper Pliocene to Lower Pleistocene of Rhodes. I found it in the Lower Pliocene deposits of Almayate and Mezquitilla.

Semicytherura alifera, a living form in the Mediterranean Sea, occurs in the Lower Pliocene of Almayate.

Semicytherura cribriformis is living today off Torre del Mar and in the Bay of Naples (Müller, 1894). Ruggieri (1953) recorded this species in the Upper Pliocene and Lower Calabrian of Italy. *S. cribriformis* is present in the Lower Pliocene of Valle Niza.

Semicytherura inversa is known from the Pliocene to the present in the Mediterranean. It occurs in the Lower Pliocene of Almayate and Mezquitilla.

Xestoleberis dispar is living in the Mediterranean Sea. It has been recorded from the Pliocene of SE France (Carbonnel, 1982). In Spain, it occurs in the

Lower Pliocene of Almayate, Mezquitilla and Cerro de San Antón. Sissingh (1972, p. 150) was unable to separate the specimens attributed by him to *X. dispar* from other forms of the Miocene to Pleistocene of Greece.

Pseudocythere caudata, which lives in the Atlantic and in the Mediterranean Sea, occurs in the Lower Pliocene of Almayate.

Macrocypris succinea is living in the Bay of Naples (Müller, 1894) Sissingh (1972) found a morph of this species in the Upper Pliocene of Karpathos, Greece. Nascimento (1983) found this species in the Pliocene of Pombal, Portugal. In Spain, it occurs in the Lower Pliocene of Almayate and Mezquitilla.

Pontocypris acuminata is known from the Recent of the Mediterranean (Müller, 1894; Barbeito-Gonzalez, 1971; Breman, 1976). It occurs in the Lower Pliocene of Almayate, Mezquitilla, Valle Niza, Cerro de San Antón and Rio Guadalminar.

Pontocypris mytiloides is living in the Bay of Naples (Müller, 1894) and also off the Atlantic coast of France (De Vos, 1957). It occurs in the Pleistocene of Norway and Scotland (Sars, 1928). In Spain, I found it in the Lower Pliocene deposits of Cerro de San Antón.

Propontocypris intermedia is known from the Recent of Tenedos (Brady, 1868), the Adriatic Sea (Bonaduce *et al.*, 1975) and from the Bay of Naples (Müller, 1894). It occurs in the Lower Pliocene of Valle Niza.

Propontocypris pirifera, which occurs today off Torre del Mar (herein), in the Bay of Naples (Müller, 1894) and in the Adriatic Sea (Bonaduce *et al.*, 1975), is present in the Lower Pliocene of Mezquitilla and Valle Niza. *P. pirifera* is known from the Atlantic coast of Europe.

Ten species were found to be confined to the Lower Pliocene of southern Spain. These may all be new, but only one, *Costa reymenti,* has been erected as a new species. The others are commented upon in the systematic section. It is possible that some, or all of these species, have short stratigraphical ranges. The forms in question are:

Cytheromorpha sp., *Costa* aff. *batei, Bradleya ? pliocenica ?, Semicytherura* sp. 1, *Semicytherura* sp. 2 and *Cytheropteron* sp. at Almayate. *Echinocythereis* sp. and *Paracypris* aff. *polita* at Almayate and Mezquitilla. *Costa reymenti* sp. nov. at Almayate, Mezquitilla and Valle Niza. *Hirschmannia* sp. at Cerro de San Antón.

Recent species studied in the present monograph and which do not occur in the Lower Pliocene of the Mediterranean region, as far as I could extract from the available literature and my own observations, are the following:

Asterope cf. *marie, Cytherella abyssorum, Leptocythere fabaeformis, L.* aff. *lagunae, L. levis, L. rara, Callistocythere diffusa, Neocytherideis fasciata, Sahnicythere retroflexa, Microcythere levis, M. obliqua, Loxoconcha elliptica, Semicytherura costata, S. incongruens, S. sulcata, S.* sp., *Paradoxostoma simile* and *Eucypris virens ?*

Predation

This section gives a necessarily brief account of studies of the intensity of predation represented in the material, mainly from Almayate.

Reyment (1966) made a quantitative ecologic study of the microbenthos of the Niger Delta, in order to throw light upon some of the problems encountered in interpreting conditions found in the fossil and sub-fossil sediments. Reyment (1963 and 1966) showed that most of the predation on ostracods and pelecypods is due to naticid and muricid gastropods. The drills prefer to bore the central area of pelecypod valves and many ostracod shells. This observation is confirmed in the Spanish material studied herein in that the location of drilling sites are usually near the centre of the lateral area.

Muricid and naticid gastropods have different modes of predatory behaviour, and make drill-holes of different shape. The holes bored by muricids are usually steep-sided to almost cylindrical (Carriker, 1955; Hancock, 1959; Ziegelmeier, 1954; Reyment, 1963; Reyment, 1966). The holes drilled by naticids tend to have a greater diameter than those of muricids, they are more strongly conical, and there is often a tendency to develop countersunk walls. There is usually also a broad zone of scraping around the actual hole (Reyment, 1966). The muricids attack animals of the epifauna and occasionally even eat carrion (Ziegelmeier, 1954). Naticids inhabit the upper layer of sediment and attack principally dwellers in that environment. However, records of drilling by naticids at depths of around 2000 m, and deeper, exist (Arnold *et al.*, 1985; Whatley *et al.*, 1986, pl. 1, figs. 12 and 13).

Reyment (1963) observed that muricids and naticids only very rarely attack juvenile ostracods. This

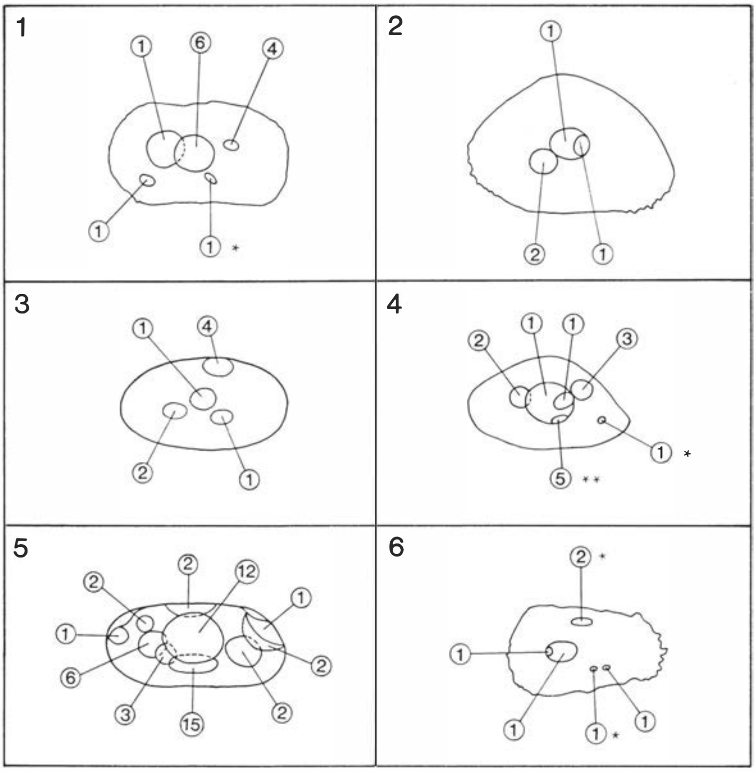


Fig. 21. Pope-diagrams showing numbers of holes at certain locations, distribution and average size of predator holes for the following species: (Here and in the succeeding Pope diagrams, the figures in which denotes the number of holes drilled at the site indicated.)

1. *Cytherelloidea beckmanni* 2. *Bairdia formosa*
3. *Cytherella vulgata* 4. *Bairdia mediterranea*
5. *Cytheretta adriatica* 6. *Hermanites haidingeri*
* Instars.
** Four juveniles.

is manifested in the following Pope-diagrams (N.B. The term "Pope-diagram" for predation maps was introduced by Carriker (1955) in honour of their originator), (cf. Fig. 21: 1, 4, 6; Fig. 22: 1, 3, 5; Fig. 24: 8). It is interesting to note that the drill-holes in juveniles in the present study are not preferentially located on the central area; in the case of *Aurila cimbaeformis,* two juveniles were drilled in the ocular region.

Further biological interpretations could perhaps be extracted from the Pope-diagrams given herein by seeking parallels between the fossils and their living representatives with respect to the location of the soft parts. This idea could not be followed up in this study owing to insufficient diagnostic living material with preserved extremities.

Thirty-nine species out of 122 in the present study show traces of drill-holes in the shells. The size of predator holes varies in dimension, and are from conical to elliptical in shape as is indicated on the Pope-diagrams. There seems to be little relation between "taxonomy" and susceptibility to attack from drilling gastropods, although some species seem to have proved uninteresting to the predators.

The number of holes was recorded in the entire samples for Almayate, and occasionally from Mezquitilla, to show the intensity of predation in the material. The predation level (percentage of bored shells) varies among the species. It is high for, e.g., *Cytherella vulgata* (15.4 %), *Bosquetina carinella* (14.6 %) and *Hermanites haidingeri* (14.3 %), and very high for *Graptocythere hscripta* (29.7 %), *Urocythereis favosa* (22.2 %), *Protocytheretta obtusa* (23.7 %) and *Lixouria aquila* where three valves out of five were drilled in almost the same region. As is apparent from Table 13, the most commonly

Table 13. Proportion of drilled to undrilled specimens per species, and proportion in the entire sample.

SPECIES	Number of drill-holes	Number of bored shells	Sample size	% bored shells
Cytherella vulgata	8	6	39	15.4*
Cytherelloidea beckmanni	13	13	211	6.2
Neonesidea formosa	4	4	261	1.5
Neonesidea frequens	2	2	78	2.6
Neonesidea mediterranea	13	11	145	7.6
Bosquetina carinella	19	19	130	14.6
Acanthocythereis hystrix	1	1	68	1.5
Carinocythereis antiquata	1	1	17	5.9
Carinocythereis carinata	1	1	133	0.8
Costa batei	25	22	170	12.9
Costa punctatissima	2	2	85	2.4
Costa reymenti	8	8	77	10.4
Hiltermannicythere retifastigata	1	1	57	1.7
Lixouria aquila	3	3	5	
Echinocythereis scabra	47	38	305	12.5
Ruggieria tetraptera	17	15	198	7.6
Graptocythere hscripta	16	11	37	29.7
Mutilus elegantulus	8	8	319	2.5
Aurila cimbaeformis	130	116	1563	7.4
Aurila convexa	361	340	7939	4.3
Hermanites haidingeri	6	6	42	14.3
Q. (Tenedocythere) prava	7	7	160	4.4
Q. (Tenedocythere) salebrosa	33	27	243	11.1
Urocythereis favosa	10	10	45	22.2
Urocythereis labyrinthica	3	3	44	6.8
Caudites calceolatus	1	1	7	14.3
Pachycaudites ungeri	2	2	24	8.3
Cytheretta adriatica	46	29	170	17.1*
Flexus triebeli	3	3	89	3.4
Protocytheretta obtusa	9	9	38	23.7
Loxoconcha agilis	5	5	66	7.6
Loxoconcha elliptica	5	5	600	0.8**
Loxoconcha obliquata	19	19	391	4.9
Loxoconcha rhomboidea	65	54	591	9.1
Loxoconcha tumida	61	50	600	8.3
Xestoleberis communis	102	92	1056	8.7
Xestoleberis dispar	7	7	115	6.1
Xestoleberis margaritea	8	8	269	3.0
Xestoleberis ventricosa	9	6	109	5.5

* Mezquitilla
** Los Barrios

drilled species are *G. hscripta, U. favosa* and *P. obtusa*. Predational intensities are higher than is usual among ostracods and approach what can be found for bivalves (cf. Reyment, 1966). However, this may be a result of sampling, as all of these species are relatively rare. In this connection, it is worth noting that multiple boreholes in bivalves have recently attracted considerable attention (Kitchell *et al.*, 1986; Reyment *et al.*, 1987); such are not common in the present collection.

A remarkable situation was found for *Loxoconcha elliptica,* which occurs abundantly in the brackish lagoon at Los Barrios, and which displays a predation frequency of 0.8 %. This can be taken as evidence of the former connection of Los Barrios with the open sea, and the occurrence of coastal uplift of fairly recent date, as drills only occur in a normal marine environment.

It will be observed that there is a clear tendency for holes of a certain size to be preferentially located in a specific region of the shell, a condition that is largely connected with the nature of the predator, muricid or naticid (Figs. 21–25).

In conclusion, it is noted that the level of predation in the present material tends to be high, which indicates that the environment inhabited by the

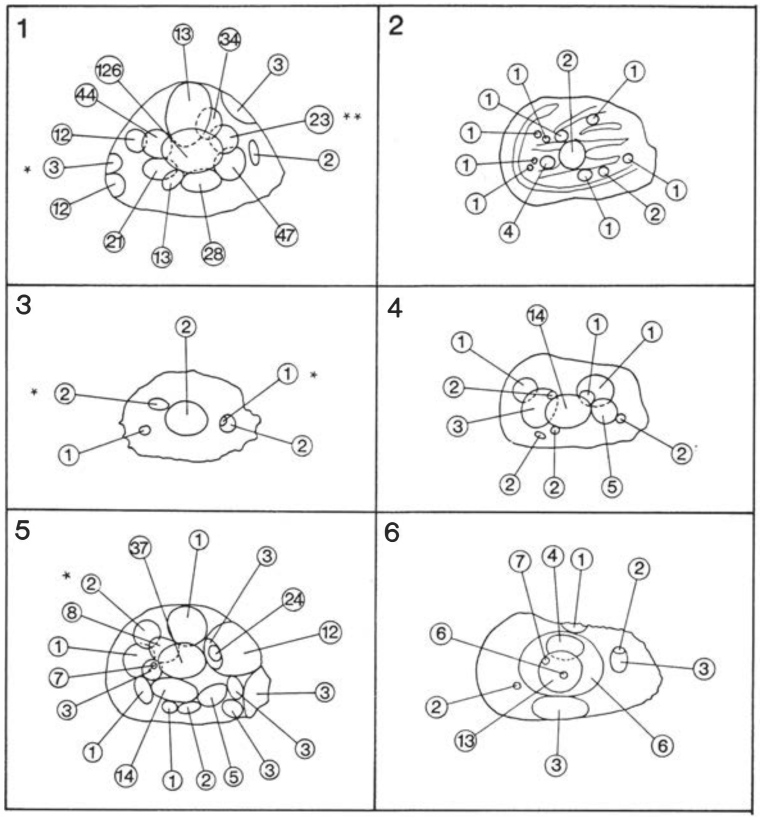


Fig. 22. Pope-diagrams showing numbers of holes at certain locations, distribution and average size of predator holes for the following species:

1. *Aurila convexa*
2. *Graptocythere hscripta*
3. *Mutilus elegantulus*
4. *Quadracythere (Tenedocythere) salebrosa*
5. *Aurila cimbaeformis*
6. *Echinocythereis scabra*

* Instars.
** Three juvenile valves.

Spanish Pliocene ostracods was near-shore, shallow-water (cf. Ziegelmeier, 1954).

Growth Stages in the material

The differences between growth stages are not always obvious in the following plots, as the fossil material described here usually lacks some instars. In several cases, this study has succeeded in illustrating the distribution of ostracod growth-stages in the samples. Growth in ostracod shell dimensions is mildly allometric and the allometric ratio varies during growth; this is manifested in several cases in the following graphs (Figs. 26–42).

The ostracod grows by ecdysis and during the relatively brief period between stages, the animal increases to about twice its former volume. The number of instars varies (e.g. Cyprididae and Cytheracea have nine instars), other have only eight (Kesling, 1961).

The figure for *Cytherelloidea beckmanni* gives a normal ontogenetic picture for cytherellids. *Neonesidea formosa* is likewise typical and shows discrete groupings into four to five growth classes. *Bythocypris bosquetiana* is less well expressed owing, no doubt, to the small sample size. The graph for *Hiltermannicythere quadridentata* suggests considerable inequality in numbers between males and females (Fig. 29). This kind of result is quite common for ostracods. *Ruggieria tetraptera* (Fig. 30) shows a

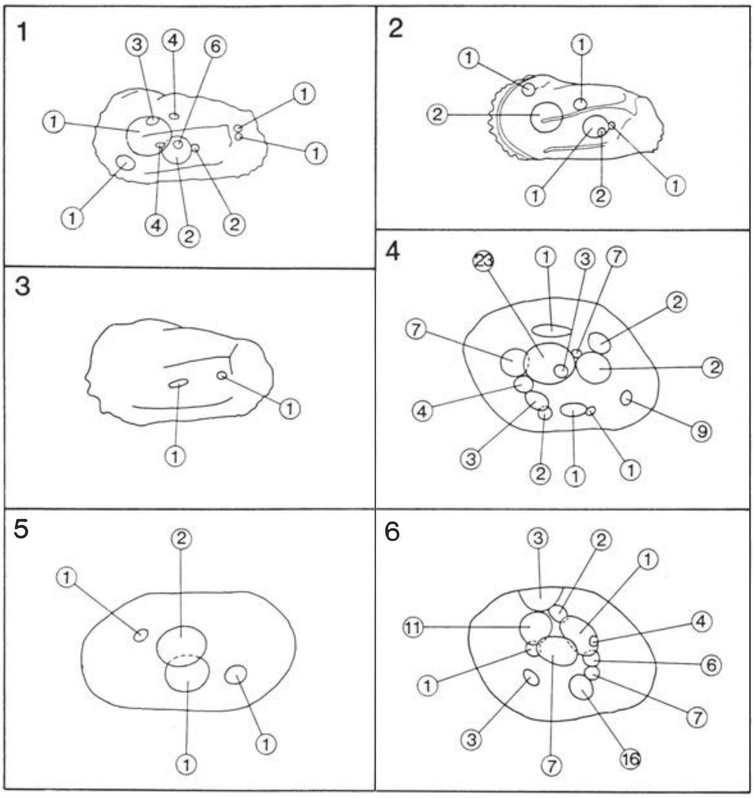


Fig. 23. Pope-diagrams showing numbers of holes at certain locations, distribution and average size of predator holes for the following species:

1. *Costa batei*
2. *Costa reymenti*
3. *Costa punctatissima*
4. *Loxoconcha rhomboidea*
5. *Loxoconcha elliptica*
6. *Loxoconcha tumida*

fuzzy distributional pattern for adults, the result of an allometric shift in length in males, whereas females follow the same direction as the larval stages. *Graptocythere hscripta* and *Mutilus elegantulus* seem to be similar to *Ruggieria tetraptera* with respect to the overlapping relationship between males and females.

In the two species of *Aurila* (Figs. 32–33), there is overlap in the distributions for the growth stages in the material. In the case of *A. convexa,* it looks as though the sample of 473 specimens comprises adults, two abundantly represented final larval stages, A-1, and A-2, as well as isolated individuals of earlier growth stages.

Xestoleberis communis (Fig. 35) presents an interesting series of growth stages, with putative males lying on the same line of size-increase as the females and larval stages. The general appearance of the plot is reminiscent of that typical for cytherellids. *Loxoconcha elliptica* (Fig. 36) displays a differentiation into several mature growth stages with males allometrically displaced to the right of the reigning direction of growth. *Bosquetina carinella* is a further case of allometric differentiation in males and females, but to a relatively slight extent. The same observation applies for *Acanthocythereis hystrix, Carinocythereis carinata, Costa batei* and, possibly, *Costa punctatissima. Costa reymenti* displays very marked sexual dimorphism, with male carapaces being displaced an exceptional distance from the linear growth line owing to strong positive allometry in the length of the carapace in relation to the final larval stage.

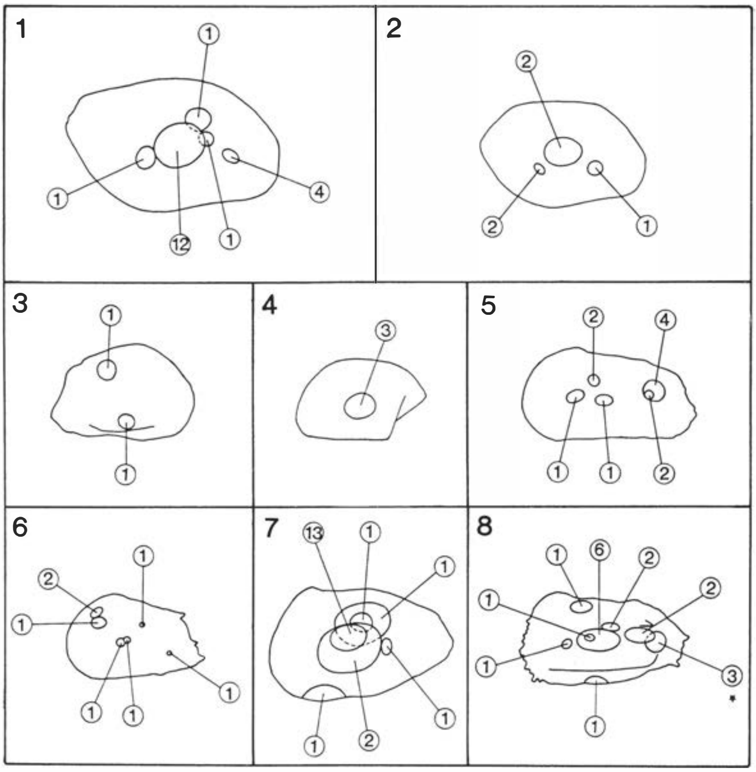


Fig. 24. Pope-diagrams showing numbers of holes at certain locations, distribution and average size of predator holes for the following species:

1. *Loxoconcha obliquata*
2. *Loxoconcha agilis*
3. *Pachycaudites ungeri*
4. *Lixouria aquila*
5. *Urocythereis favosa*
6. *Quadracythere (Tenedocythere) prava*
7. *Bosquetina carinella*
8. *Ruggieria tetraptera*

* Instars.

N.B. *Tenedocythere prava* is represented only by juveniles.

Biofacies

Most of the taxa found at the Pliocene localities of southern Spain have also been reported from other localities in the Mediterranean region, particularly around the Tyrrhenian, Adriatic, Ionian, and Aegean Seas. The Pliocene ostracods were compared with their Recent relatives from the near-shore localities studied herein, and at other localities mentioned in the text, in order to interpret the environmental conditions that existed at time of deposition, in particular with respect to the depth factor (p. 36).

Many papers dealing with Recent ostracods are based on thanatocoenoses. However, the recorded distribution for ostracods with reference to water-depth, salinity, temperature, and the preferred substratum is of great ecological value, since the depth-zonation for one and the same species may vary geographically.

The natural habitat of shallow-water, near-shore environments is characterized by the great variety of ostracods that are attached to seaweed, and can thus be passively dispersed. The distribution of organisms geographically and bathymetrically, is largely controlled by the pattern of environments. The sea-floor is divided into many areal units (biotopes), each inhabited by a particular biocoenosis whose animal and plant elements are confined, by ecological factors, within the limits of their biotopes (Weller, 1960). Shallow marine ostracod thanatocoenoses may contain both fresh- and brackish- water ostracods, which indicates that the fresh-water ostracods are of allochthonous origin and have been transported by rivers etc. to brackish and shallow marine environments.

The general picture for Almayate yielded by Table 14 can be recognized at the other localities (cf. p. 68, *Aurila convexa*).

Shallow marine

Generally shallow (no data available regarding exact depth range).

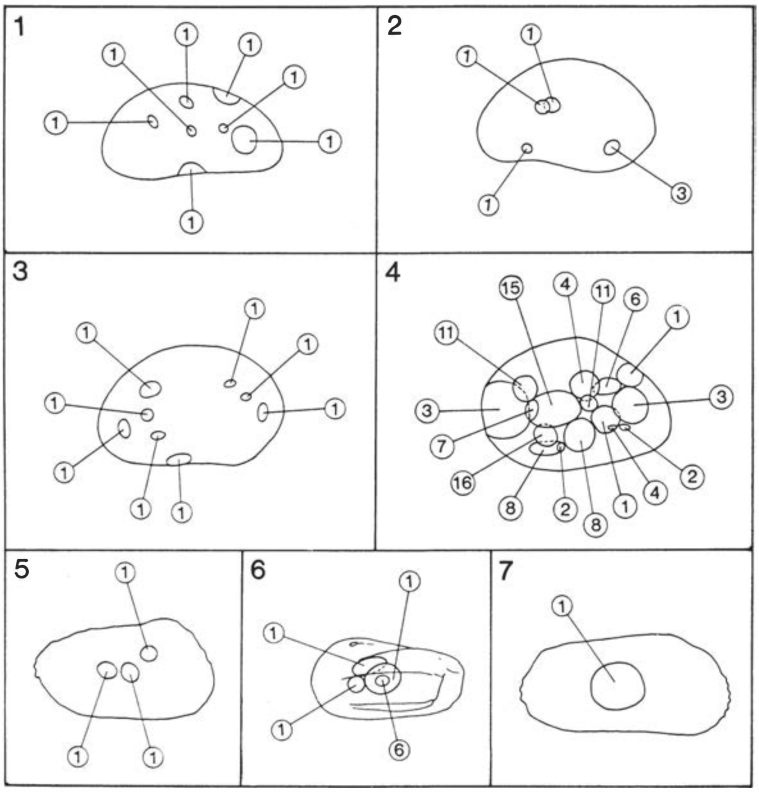


Fig. 25. Pope-diagrams showing numbers of holes at certain locations, distribution and average size of predator holes for the following species:

1. *Xestoleberis dispar*
2. *Xestoleberis ventricosa*
3. *Xestoleberis margaritea*
4. *Xestoleberis communis*
5. *Flexus triebeli*
6. *Protocytheretta obtusa*
7. *Hiltermannicythere retifastigata*

Near-shore, littoral: *Basslerites berchoni Hermanites haidingeri, Neonesidea corpulenta, Neonesidea longevaginata, Occultocythereis dohrni, Xestoleberis communis* and *Cytherelloidea beckmanni.*

Neritic and littoral: *Aurila cimbaeformis, Costa batei, Costa punctatissima* and *Neonesidea frequens. Pachycaudites ungeri* is presumed shallow marine, euryhaline species with the characteristics of littoral and infralittoral environments.

Lower infralittoral: *Bythocypris bosquetiana* and *Caudites calceolatus.*

Carbonel *et al.* (1975), in a study of the development of a Holocene lagoon in the Bay of Biscay, recognized several associations of relevance for our study:

Internal infralittoral zone: *Carinocythereis carinata, Costa edwardsii* and *Hiltermannicythere emaciata.*

Algal dwellers in normal marine salinity, following Yassini (1969): *Loxoconcha rhomboidea, Semicytherura acuticostata, Aurila convexa, Heterocythereis albomaculata, Pontocypris mytiloides, Propontocypris pirifera, "Sahnia subulata"* and *Neocytherideis fasciata.*

A "heterogenous" group occurring on algae of the euryhaline zone of the Gironde estuary: *Loxoconcha rhomboidea, L. elliptica, Callistocythere pallida, Aurila convexa, Heterocythereis albomaculata* and *Hemicytherideis elongata.*

The general impression conveyed by Table 15 is that the majority of the species listed are mainly distributed in the near-shore environment, even if the available information indicates that some of these are eurybathyal (e.g. *Bythocythere turgida*). A lesser number have, up to the present, not been recorded from shallow water (<70 m), but this could be due to an imperfect record. The picture painted by the depth-distributional data is, nonetheless, clearly one of a near-shore regime for Almayate. The fact that many of these species live today on calcareous algae, and other algae, provides a clue as to the reason why relatively deep-water species are found in near-shore de-

Table 14. Percentage occurrence and present habitat of certain species, and dominant, subgenera and genera in the Pliocene section at Almayate.

Genus, subgenus, species	habitat	percentage occurrence
Aurila convexa	Shallow marine (neritic and littoral brackish-water. Common at 50–70 m. Recorded depth 0–200 m. Salinity 26–38 ‰ Substratum: *Posidonia,* calcareous algae, sand "schill." Predation: 4.3 %	47.6 %
Aurila cimbaeformis	Predation: 7.4 %	9.4 %
Mutilus elegantulus	Predation: 2.5 %	1.9 %
Echinocythereis scabra	Linked to sediments of shallow-water origin. Predation: 12.5 %	1.9 %
Xestoleberis	Shallow marine, near-shore, phytal. Common at 50–60 m. Recorded depth 5–125 m. Salinity up to 38 ‰	9.7 %
Loxoconcha	Fresh- brackish- water and shallow marine (neritic and littoral). Common at 125–170 m. Recorded depth 0–170 m. Salinity up to 38 ‰	9.8 %
Neonesidea	Shallow marine, near-shore (neritic and littoral). Common at 70 m. Recorded depth 0–110 m. Salinity up to 38 ‰	3.2 %
Callistocythere	Shallow marine, near-shore (littoral, sublittoral to epi-neritic zones. Common at 40–70–80 m. Recorded depth 0–180 m.	2.8 %
Q. (Tenedocythere)	Shallow marine (epi-neritic). Common at 30 m. Recorded depth 10–120 m.	2.4 %
Costa	Shallow marine (neritic and littoral), lives at moderate depths 25–125 m. Substratum: calcareous algae and other algae.	2.0 %
Other		9.3 %

Predation figures not listed for genera represented by several species.

posits, namely, that they can have been transported on algal fragments.

Both bathyal and abyssal elements may be referrable to as occurring in the psychrosphere. This type of fauna is considered to be restricted to depths greater than 500 metres. Psychrospheric ostracods are usually found in waters cooler than 10°C and are said to be most typical in waters near 4°C. (Benson & Sylvester-Bradley, 1971).

Forms belonging to *Bythocypris, Neonesidea, Cytherella, Macrocypris, Cytheropteron* and *Henryhowella* occur in the deep sea fauna but also in warmer shallower waters of the outer-shelf in a large part of the Atlantic and Indian Oceans (Benson & Sylvester-Bradley, 1971).

Bosquetina is a typical genus of the comparatively warm bathyal faunas of the Mediterranean. The Recent deep Mediterranean fauna frequently contains the valves of typical shallow-water species of *Xestoleberis, Loxoconcha, Semicytherura* and *Aurila* (Benson & Sylvester-Bradley, 1971), the reason for which would seem to be posthumous transport by slumping, turbidity currents, etc.

Bosquetina carinella and *Bythocypris lucida* are among the species of ostracods which disappeared at the onset of the Messinian "salinity crisis" and reappeared in the Cretan area during the Early Pliocene. The effects of the

Table 15. Bathymetrical ranges for Spanish Early Pliocene species with living descendents. 0 denotes the zone commencing immediately below the swash-line.

Depth ranges in metres	Species
0–50	*Callistocythere lobiancoi*
0–110	*Neonesidea mediterranea*
0–120	*Acanthocythereis ascoli*
0–125	*Loxoconcha rhomboidea*
0–200	*Aurila convexa*
3–30	*Heterocythereis albomaculata*
3.5–12.5	*Cistacythereis pokornyi*
4–12	*Callistocythere pallida*
4–170	*Hiltermannicythere turbida*
4–200	*Pterygocythereis jonesii*
5	*Xestoleberis fuscomaculata*
5–120	*Cytherella vulgata*
	Hemicytherideis elongata
7–220	*Pseudocythere caudata*
10–12	*Hiltermannicythere sphaerulolineata*
	Urocythereis favosa
10–20	*Neonesidea formosa*
10–85	*Cytheretta adriatica*
10–90	*Hemicytherideis turbida*
10–135	*Callistocythere littoralis*
12	*Propontocypris pirifera*
	Semicytherura cribriformis
	Urocythereis margaritifera
12–120	*Quadracythere (Tenedocythere) prava*
12–170	*Loxoconcha turbida*
15–210	*Cytheropteron rotundatum*
15–125	*Xestoleberis dispar*
20–125	*Loxoconcha tumida*
20–170	*Loxoconcha versicolor*
20–800	*Bythocythere turgida*
25–90	*Buntonia (Rectobuntonia) subulata*
25–125	*Costa edwardsii*
40	*Callistocythere pallida*
40–180	*Callistocythere rastrifera*
40–200	*Carinocythereis carinata*
45–80	*Hiltermannicythere quadridentata*
50–1000	*Eucytherura complexa*
70	*Carinocythereis antiquata*
70–120	*Callistocythere flavidofusca*
70–165	*Semicytherura inversa*
70–170	*Loxoconcha concentrica*
70–200	*Semicytherura acuticostata*
75–120	*Microcytherura angulosa*
80–170	*Pterygocythereis siveteri*
120–170	*Bosquetina carinella*
125	*Semicytherura alifera*
125–165	*Cytheridea neapolitana*
125–170	*Acanthocythereis hystrix*
140–375	*Monoceratina mediterranea*

geographic separation of the Atlantic and Mediterranean fauna during the Messinian, may explain the sudden appearance of a large number of new species and subspecies including those arising from endemics (such as several *Aurila* representatives), *Quadracythere (Tenedocythere) prava, Q. (T.) salebrosa, Costa punctatissima, Hiltermannicythere rugosa* (Sissingh, 1976).

Discussion of the Results

The type of environment characterizing the coastal Lower Pliocene of southern Spain can possibly have developed during a phase of stasis in the tectonic history of the western Mediterranean, following on the Messinian salinity episode. These stable conditions were disrupted by the later period of crustal uplift of the coast, a phase that is still in progress, as can be deduced from the records of the history of the fortifications of southern Spain.

1. *Diversity of the Pliocene associations*

The indications yielded by the present study are that the Messinian salinity event, with the concomitant palaeogeographical upheaval in the Mediterranean, had little obvious effect on the composition of the ostracod fauna of the southern Spanish near-shore environment. The biostratigraphical analysis points to continuity with the older Miocene of the central Mediterranean. An explanation of the palaeobiogeography given by Benson (1976), Hsü (1973) and others (cf. p. 7), involving recolonization of the Mediterranean by Atlantic descendants of forms common in the Miocene Mediterranean is plausible, but cannot be substantiated by the present restricted study. It is, however, worth noting that the number of species recorded in the Pliocene calcareous sediments is less than what might be expected. Two possible reasons for this suggest themselves:

(a) Incomplete recolonization of the western Mediterranean in early Pliocene time.

(b) The relative inhospitability of the lime-rich environment to many ostracod species.

To be fair, however, we need to bear in mind that the present-day near-shore ostracod fauna is *not* remarkable for its diversity, as far as can be assessed from the limited sampling programme of the recent environment available for analysis.

A noteworthy difference between the fossil and Recent samples lies with the occurrence of *Aurila*. With respect to number of individuals it constitutes 57 % of the Almayate associations but is extremely rare in the samples of living ostracods. However, I found it to be abundant in the material from Roscoff (France, where it occurs in calcareous environment, an observation probably of significance for analyzing the Pliocene ecology of southern Spain).

The sandy environment of Torre del Mar proved itself to be inhospitable to many of the Pliocene

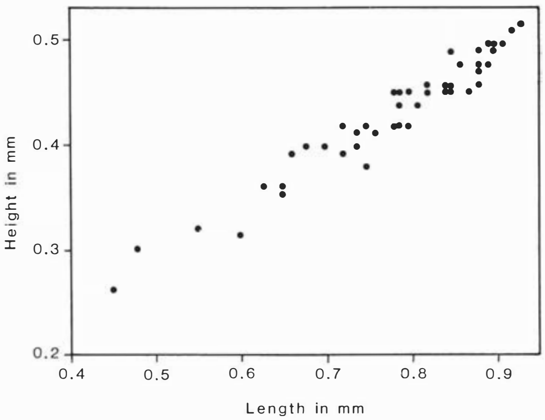


Fig. 26. Height-length plot for *Cytherelloidea beckmanni.* Normal linear relationship for cytherellid since males do not display proportional differences in dimensions.

N=55 LV

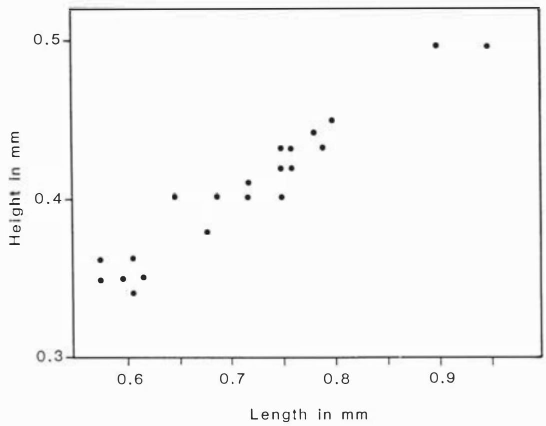


Fig. 29. Height-length plot for *Hiltermannicythere quadridentata.*

N=25 LV

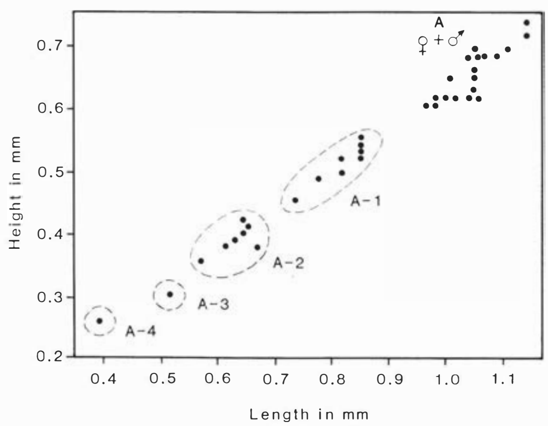


Fig. 27. Growth-stages of *Bairdia formosa* representing four to five growth stages.

N=49 LV

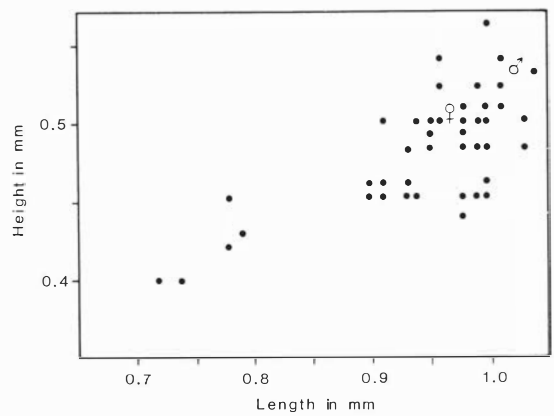


Fig. 30. Height-length plot for *Ruggieria tetraptera.*

N=52 LV

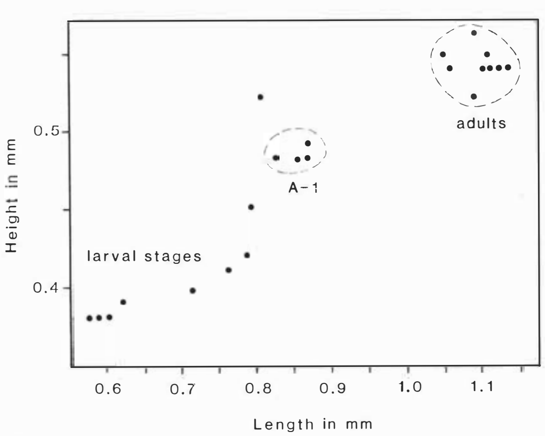


Fig. 28. Growth-stages of *Bythocypris bosquetiana* Males, females and late larval stage (undifferentiated).

N=25 LV

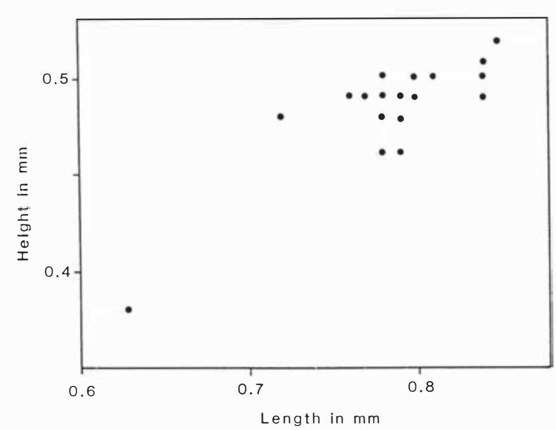


Fig. 31. Height-length plot for *Graptocythere hscripta.*

N=29 LV

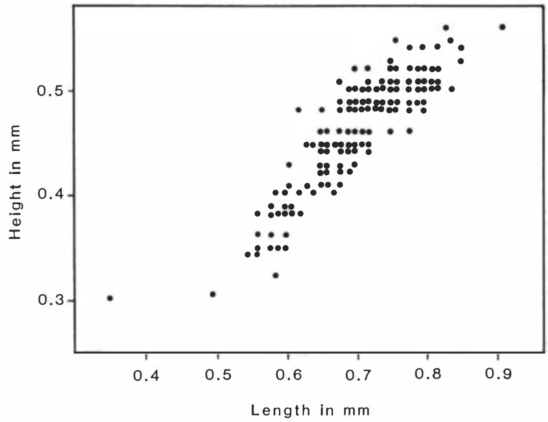


Fig. 32. Height-length plot for *Aurila convexa.* Males, females and late larval stage (undifferentiated).

N=473 LV

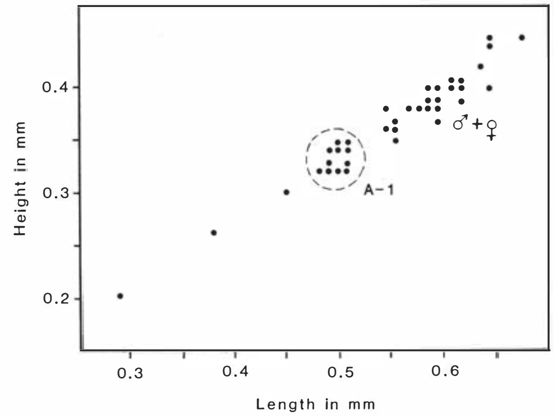


Fig. 35. Growth-stages of *Xestoleberis communis.*

N=53 LV

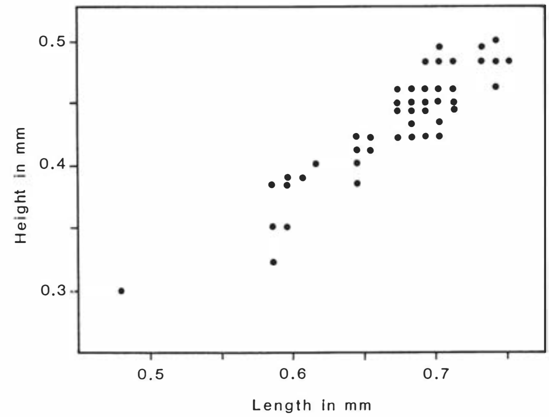


Fig. 33. Height-length plot for *Aurila cimbaeformis.*

N=190 LV

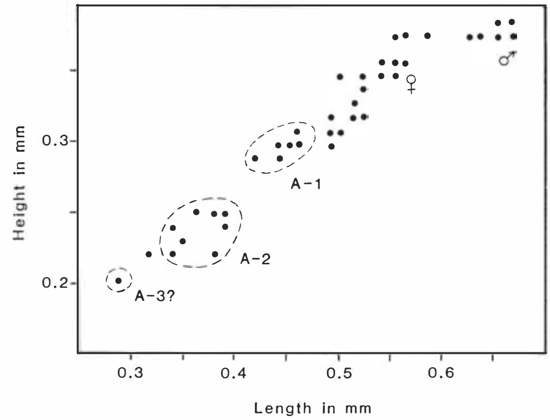


Fig. 36. Growth-stages of *Loxoconcha elliptica.* Males, females and last two growth stages identified.

N=63 LV

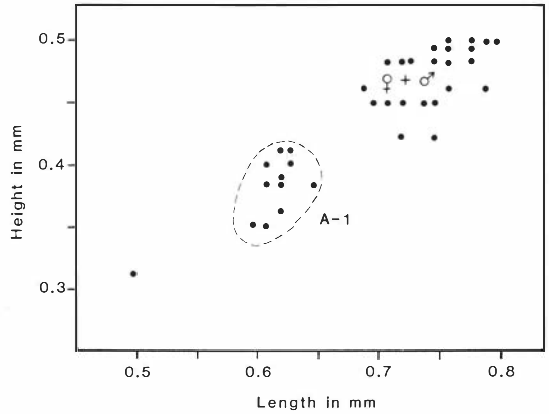


Fig. 34. Growth-stages of *Mutilus elegantulus.*

N=51 LV

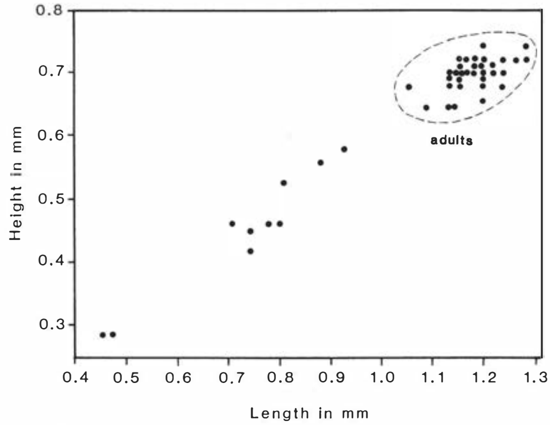


Fig. 37. Growth-stages of *Bosquetina carinella.* Adults and larval carapaces (undifferentiated).

N=71 LV

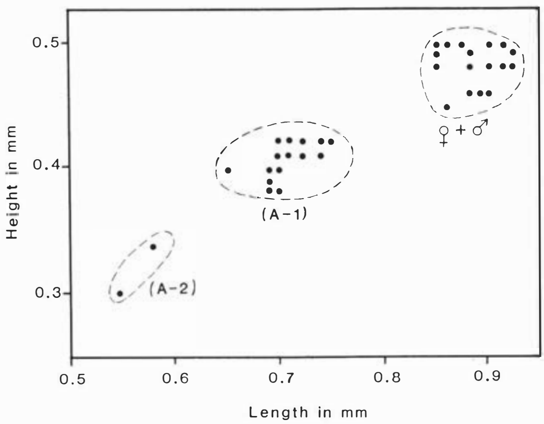


Fig. 38. Growth-stages of *Carinocythereis carinata.*

N=49 LV

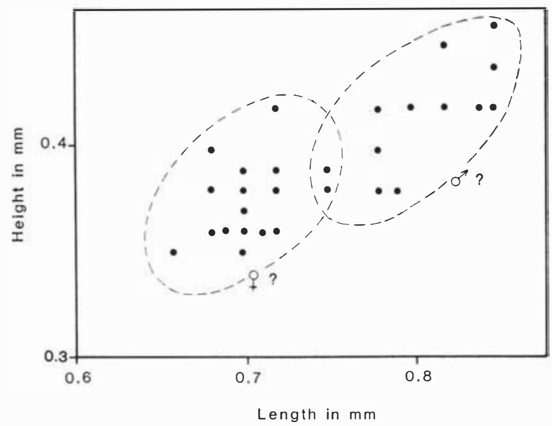


Fig. 40. Growth-stages of *Costa punctatissima.* Probably males and females.

N=45 LV

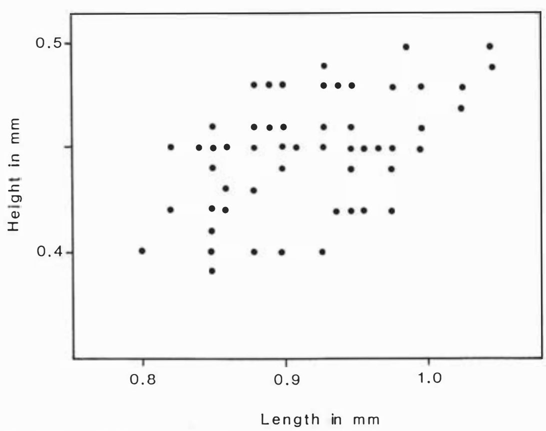


Fig. 39. Height-length plot for *Costa batei.* Probably males and females.

N=80 LV

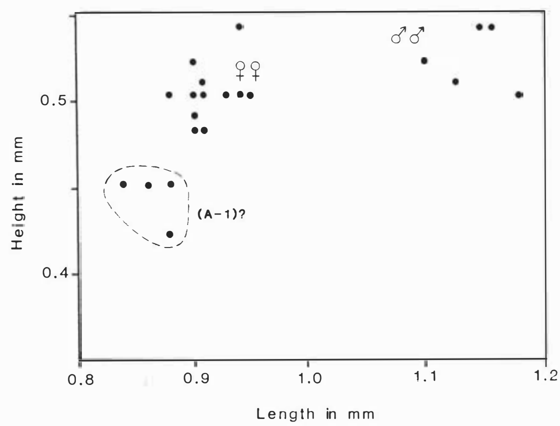


Fig. 41. Growth-stages of *Costa reymenti.* Males and females identified.

N=27 LV

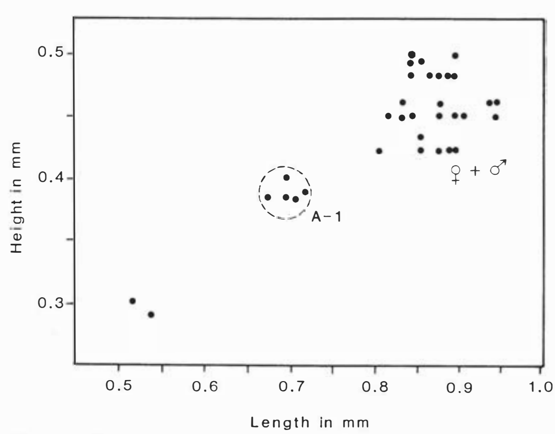


Fig. 42. Growth-stages of *Acanthocythereis hystrix.*

N=41 LV

forms, but to be favourable to species of *Leptocythere, Loxoconcha, Microcythere* and *Semicytherura.*

The present study has expanded our knowledge of the range of substrates acceptable to Mediterranean and Neogene to Recent species. Details of these observations are provided in the taxonomical section.

2. *Vertical distribution of the species*

One of the matters arising out of the present study concerns an awareness of the often considerable life-spans of ostracod species. Many of the forms included here are known from the Miocene onwards and have thus been in existence for 25 to 6 Ma. Some have even longer ranges, of up to 40 Ma. The lesson to be learned from this is that careful attention should be paid to the question of long-ranging species in work on older ostracods. Reyment (1984), for example, has drawn attention to vertical species distributions in the Cretaceous. The detailed analysis of the ostracod ranges (pp. 20–21) lends support to the age determinations by coccoliths and planktonic foraminifers in that the ponderation of the age-frequency distribution lies in the lower part of the Pliocene. This implies that there are two Pliocene transgressive events in southern Spain, albeit minor, if the foraminiferal datings of González-Donoso & de Porta (1977) are applicable.

Predation

Particularly the ostracod shells of the Almayate sequence show ample evidence of predation by gastropods. To a lesser degree, the pectinids in the same beds have been attacked. One conclusion of some importance is that there seems to be little relationship between susceptibility to attack and systematic location. About 32 % of the species have been drilled. High predational frequencies are shown by *Cytherella vulgata* and *Bosquetina carinella,* both of which have a smooth shell-surface. However, the intensity of attack for the reticulated form *Hermanites haidingeri* is almost as high. The highest values were observed for *Graptocythere hscripta* (almost 30 % bored!), *Urocythereis favosa* (>22 %), and *Protocytheretta obtusa* (<24 %). In general, judging from the data marshalled in Table 13, there does not seem to be any evidence for a correlation between the texture (ornamental state) of the surface of the shell and proneness to attack.

Various hypotheses for such a situation are to be found in the recent literature (summarized in Reyment *et al.,* 1987), including the suggestion that chemical exhalents from the prey-organism might have a dissuasive effect. Another possibility worth consideration seems to me to be that the behaviour of the prey might play a decisive role. It is well known that the tactile response of some ostracods to interference is to feign death. A prolonged dormant period in a prey individual could doubtless be well utilized by a gastropod predator.

If we now pass to the question of preferred drilling sites, perusal of Figs. 21–25 shows that a favoured site lies in the centrolateral field of the shell. Also popular are locations along the dorsal junction of the valves, obviously a site of easier penetration (however, some "popular" forms are never drilled on this feature). The centrolateral holes are clearly the outcome of the greater facility for drilling offered to larger juvenile naticids, which require to envelope their prey with their foot.

Finally, we note that drill-holes are uncommon in the living material studied here, which may well be a reflection of a pronounced change in ecological conditions. Although drilled pelecypod shells do occur on southern Spanish beaches, they are far from common.

An observation of potential palaeoethological significance concerns the fact that only larval stages of *Carinocythereis antiquata* and *C. carinata* have been drilled by naticids. Possibly further study of living material of this species could shed light on the adult migratory activities of marine ostracods (cf. Reyment *et al.,* 1987; Kitchell *et al.,* 1986). Another species of possible significance in this connection is *Quadracythere (Tenedocythere) prava* which, although abundant, occurs only as juveniles, particularly since the other species, *Quadracythere (Tenedocythere) salebrosa,* is represented by adults.

An interesting result of the work concerns the relatively high level of predation displayed by the Pliocene material of *Loxoconcha.* This is the first record of gastropod predation of species of this genus. The same observation applies for the Pliocene *Xestoleberis* in our collections.

Ontogeny

Although far from complete, the fossil material has provided information on several species, hithero unstudied with respect to the larval stages. As is not uncommon among ostracods, some species show quite distinct differences in the dimensions of the moults (e.g. *Cytherelloidea beckmanni, Neonesidea formosa*) whereas others show less decisive differences in the sizes of the larval shells (e.g. the two species of *Aurila*). Possibly, some of these cases may represent the effect of overlapping size-classes resulting from several generations, under somewhat different conditions, per year (or season).

Another result of significance concerns the location of males and females of *Xestoleberis communis* on the same line of ontogeny as larval stages. This condition is normal for species of *Cytherella,* but does not seem to have been observed among other families of ostracods. Briefly, this kind of ontogenetic progression proceeds without size-allometric differentiation between males and females, the only measurable difference with respect being registered in the isometric displacement of males beyond females on the ontogenetic gradient.

The depth of deposition of the Pliocene marls

A detailed analysis of the known bathymetric distributions of the species, with living relatives, occurring in the Pliocene collections was used for reconstructing the most likely depth inhabited by these species and hence the depth of accumulation of the carbonate sediments. The present work has shown, unfortunately, that there is still much to be done on the bathymetric relationships of living marine ostracods. Many species lack such information and the data available for most forms are approximate, often of an anecdotal nature. Nonetheless, in spite of the shortcomings of the record for living species, I believe that the analysis put forward here provides an acceptable solution, since it represents the averaged weight of evidence yielded from the consideration of the relatively great number of species. Data summarized in Table 15, have been extracted from several sources, including Müller (1894). The general impression yielded by this table is that the majority of the species occurring at Almayate are most commonly found in the near-shore zone. This conclusion is no way unexpected, fitting in, as it does, with the probable partially land-locked nature of the rugged Pliocene coastline of southern Spain. Although I have compared this environment with Anse de Kernic (Bretagne), I do not wish to imply an exact correspondence. Both have certainly a carbonate-rich ecology, but the primary source of the $CaCO_3$ in Bretagne is from the dissolution of abundant shell debris. The carbonate of the Spanish Pliocene occurrences seems to have come from precipitated $CaCO_3$ in some manner or other.

Notes on the faunal composition

Only one species of cytherellids occurs in the fossil material (*Cytherelloidea beckmanni*). There are five species of the bairdiid genus, *Neonesidea,* which is thus an important element in the associations. Another important group is the subfamily *Leptocytherinae,* represented by several species. However, *Leptocythere* s. str. belongs to the living fauna, whereas the species of *Callistocythere* are part of the Pliocene spectrum. Not unexpectedly, the trachyleberidids constitute the most diversified family of the collection and 31 species have been obtained from the Pliocene localities. This high degree of diversity in relation to the paucity of representatives of the group in the near-shore environment of present-day Spain is paralleled by that pertaining for the Hemicytheridae.

The remarkable dominance by *Aurila convexa* in the fossil material is one of the outstandingly interesting observations of the present study. Even *Aurila cimbaeformis* is very abundant. The conditions pertaining at the beginning of the Pliocene of the Mediterranean realm were favourable for an expansive phase in the *Aurila-Mutilus* group, a situation which was responsible for the large number of species of *Aurila* in the region. Also abundant in the Pliocene are individuals of *Mutilus elegantulus,* of interest because of the close relationship between *Mutilus* and *Aurila.*

Three species of *Microcythere* live today in the recent near-shore milieu of southern Spain, but none have been encountered in the Pliocene. Representatives of the *Loxoconcha* are abundant in both the fossil and Recent material. An analogous situation pertains for the Cytheruridae.

There are six species of *Xestoleberis* in the Pliocene material, but none were found in the offshore samples.

Bosquetina carinella has been demonstrated to be eubathyal, ranging in its depth-distribution from a littoral environment to 170 m, or more. Another species established as being eubathyal is *Acanthocythereis hystrix.*

Many genera are extremely rare, for example, *Basslerites, Buntonia;* particularly the rarity of the latter incites comment, bearing in mind the situation pertaining in Sicilian waters today.

Microcytherura spp. is abundant in the Recent collections but absent in the Pliocene material. Inasmuch as it seems unlikely that these species have all evolved in every recent time, other reasons should be considered for their last in the fossil associations of the Mediterranean. The most obvious cause in my opinion lies with their smallness and they may easily be overlooked in the usual picking procedures.

Systematics

General remarks

The systematics is mainly based on Howe (1963) and Hartmann & Puri (1974). Some 122 species belonging to 23 families were distinguished in the fossil and Recent samples collected from southern Spain; 34 living species were identified from the near-shore sites, of which 13 are also present at the Pliocene localities.

Sinse all the fossils are recrystallized, the taxonomy has been established on the outer characters of the shells. This has led to a rather "conservative" approach, a situation of which I am very aware. Moreover, I have been strongly influenced by the taxonomic considerations of other workers in the Mediterranean sphere. The data presented on each of the species have, of typographical necessity, and as is usual, been expressed in stereotyped form. Hence, what appears under the designation "Description" can vary with respect to contents. I have tried to concentrate on points of relevance for the present material. I also wish to make clear that the distributional information (under "Distribution") is restricted to the Mediterranean region.

The following families are represented in the material.

FAMILY CYPRIDINIDAE Baird, 1850

The family is represented by the single species *Asterope* cf. *marie.* It was colleted alive at Torre del Mar. Unfortunately the only carapace I had at my disposal became dehydrated, which made detailed investigation difficult.

FAMILY CYTHERELLIDAE Sars, 1866

The family is represented by *Cytherella abyssorum,* known only from the recent fauna at Torre del Mar, and *Cytherella vulgata,* which was collected from the Early Pliocene of Mezquitilla and which is still found off Torre del Mar.

All the *Cytherelloidea* material was referred to the single species *Cytherelloidea beckmanni.* About 30 % of the material from Almayate consists of juveniles which are difficult to distinguish from the moults of *Cytherelloidea sordida* Müller, 1894.

FAMILY BAIRDIIDAE Sars, 1866

This family is represented by the following five species: *Neonesidea corpulenta, N. formosa, N. frequens, N. longevaginata,* and *N. mediterranea.*

N. mediterranea which occurs in the Early Pliocene sediments of Almayate, Mezquitilla and Rio Guadalminar was collected alive from Rio Jara (Tarifa). It is a widespread form today in the Mediterranean.

The extra hinge "marginal teeth" were examined in the light of the *Neonesidea/Bairdoppilata* problem (Maddocks, 1969). No extra marginal teeth were observed in the present material. Maddocks (1969) believed she could distinguish *Bairdoppilata* on the basis of the appendages. Be this as it may, the criterion of the extra-hinge "teeth" as a stable taxonomic feature is suspect, owing to its instability at the infra-specific level (Reyment & Reyment, 1959).

FAMILY BYTHOCYPRIDIDAE Maddocks, 1969

This family is represented by *Bythocypris bosquetiana* It has been found in samples 2, 3 and 6 at Almayate, and in the upper and lower samples of Mezquitilla. *Bythocypris lucida* was found at Rio Guadalminar.

FAMILY CYTHERIDAE Baird, 1850

This family is represented by very limited material. A single carapace of *Microcytherura angulosa* was found in sample 3 at Almayate, and one carapace in the upper sample at Cerro de San Antón. A species of *Cytheromorpha* belonging to this family was found at Cerro de San Antón.

FAMILY LEPTOCYTHERIDAE Hanai, 1961

This family is represented by the *Leptocythere* s. str. and *Callistocythere. Leptocythere fabaeformis, L.* aff. *laqunae, L. levis, L. rara* and *Callistocythere diffusa* were obtained alive in the near-shore localities.

Callistocythere crispata C. flavidofusca C. intricatoides C. littoralis C. lobiancoi C. pallida were collected from the Pliocene localities.

Som species of the genus *Callistocythere* are rather variable with respect to the external characters which makes them difficult to identify. The surface sculpture varies in the same species from smooth to strongly ornamented. This, and the variation of the carapace outline leads me to suspect that I may be dealing with different species, or with some kind of polymorphism in shape and ornament.

Many ostracods show a tendency for variation in surface ornamentation. For example Brady (1866) observed that *Bairdia subdeltoidea* varies in this respect, and the variation is in the same direction for the same species, i.e. the variation may run through many shades of sculpture, from perfectly smooth to strongly punctate carapaces. Reyment (1963) did biometric analyses on *Veenia (Veenia) ornatoreticulata* and *Veenia acuticostata* and showed variation of several kinds: (a) sexual dimorphism, (b) fluctuation in the means, (c) polymorphism in the reticulation of the shell. Many ostracod species can show considerable variation in shape arising from moulting stages (and the preadult enviromental history of an individual cf. Hartmann (1982) and Abe (1983)), sexual dimorphism, environmental factors pertaining at the time of final moulting (environmental polymorphism), and geographical distance (Hartmann and Köhl, 1978).

FAMILY CYTHERIDEIDAE Sars, 1925

This family is represented by the single species *Cytheridea neapolitana.* It was only found in the Pliocene of Cerro de San Antón.

FAMILY CUSHMANIDEIDAE Puri, 1973

This family is represented by the two species *Hemicytherideis elongata* and *H. turbida.* These two species were found at both the Pliocene and Recent localities.

FAMILY NEOCYTHERIDEIDAE Puri, 1957

This family is represented by the three species *Neocytherideis fasciata, Pseudosammocythere similis* and *Sahnicythere retroflexa.* These were only obtained from the offshore sites.

FAMILY TRACHYLEBERIDIDAE Sylvester-Bradley, 1948

This is the most diversified family in the present collection. It is represented by the following thirty-one species, all of which were collected from the Pliocene localities. *Hiltermannicythere sphaerulolineata* also occurs off Torre del Mar. This discrepancy suggests substantially different distributional patterns for trachyleberidids today in relation to the Pliocene of the Western Mediterranean.

Bosquetina carinella, Occultocythereis dohrni, Acanthocythereis ascoli, A. hystrix, Carinocythereis antiquata, C. carinata, Cistacythereis pokornyi, Costa batei, C. aff. *batei, C. edwardsii, C. punctatissima, C. reymenti, Hiltermannicythere emaciata, H. quadridentata, H. retifastigata, H. rugosa, H. sphaerulolineata, H. stellata, H. turbida, Pterygocythereis jonesii, P. siveteri, Lixouria aquila, Echinocythereis scabra, Echinocythereis,* sp., *Henryhowella asperrima, Buntonia (B.) sublatissima dertonensis, B. (Rectobuntonia) subulata, Ruggieria tetraptera, R. tetraptera angustata* and *Basslerites berchoni.*

FAMILY HEMICYTHERIDAE Puri, 1953

This family is represented by fourteen species, all of which are present at the Pliocene localities. *Urocythereis favosa* and *U. margaritifera* were also collected alive off Torre del Mar. *Aurila convexa,* which is the most representative species in the Pliocene localities of southern Spain, was only found living off Tarifa.

Extra attention was paid to *Aurila cimbaeformis* and *A. convexa;* a detailed multivariate statistical analysis of eleven measures on the carapace discloses close agreement between the two taxa (Aranki & Reyment, in press). *A. cimbaeformis* has not been recorded living with any certainty, whereas *A. convexa* is widespread in the Mediterranean of today. The multivariate analysis by discriminant functions suggests that *A. cimbaeformis* could be a polymorphic variant of *A. convexa.* The canonical variate analysis indicates, however, that although there are agreements and overlap in the two species, at the sample-level, they are nonetheless distinct. Both species are, moreover, polymorphic with respect to lateral ornament. There is no size-trend over the time-period represented in the Almayate section (Aranki and Reyment, in press).

The following species belong to this family: *Graptocythere hscripta, Heterocythereis, albomaculata, Mutilus elegantulus, Aurila cimbaeformis, A. convexa, Hermanites haidingeri, "Bradleya" pliocenica?=?Heinia, Quadracythere (Tenedocythere) prava, Q. (T.) salebrosa, Urocythereis favosa, U. labyrinthica, U. margaritifera, Caudites calceolatus, Pachycaudites ungeri.*

Notes on the occurrence of Aurila:

Sissingh (1976) concluded that evolutionary rates in the Tertiary ostracods of the Mediterranean were slow. However, during the Late Miocene in the Eastern Mediterranean, a radiation seems to have taken place in *Aurila* in which a number of a new lines appeared. One of these lines is that of the *Mutilus* group. An even larger number of new *Aurila* representatives appeared in the eastern basin during the Early Pliocene transgressive phase. In total, some 40 Pliocene to Recent species and subspecies of *Aurila* are known at present from the Mediterranean. These may have occupied various specialized niches and so contributed to the post-Miocene ecological diversification of the ostracod fauna (Sissingh, 1976).

FAMILY CYTHERETTIDAE Triebel, 1972

This family is represented by the following four species: *Cytheretta adriatica, Flexus triebeli, Protocytheretta obtusa* and *Loculicytheretta pavonia.*

L. pavonia was collected alive off Torre del Mar.

FAMILY MICROCYTHERIDAE Klie, 1938

This family is represented by the three species, *Microcythere inflexa, M. levis* and *M. obliqua.* These were only found at the near-shore sites off Torre del Mar.

FAMILY LOXOCONCHIDAE Sars, 1925

This family is represented by *Hirschmannia* sp., which was collected from the Early Pliocene of Cerro de San Antón, and the following *Loxoconcha* species: *L. agilis, L. elliptica, L. obliquata, L. rhomboidea, L. tumida, L. turbida, L. variesculpta* and *L. versicolor.*

L. elliptica was collected alive from the Recent localities off Torre del Mar, Los Barrios, Estepona and Las Cuches. *L. rhomboidea* and *L. turbida,* which were collected from the Early Pliocene of Almayate, Mezquitilla, Cerro de San Antón, Las Palmares and respectively Limonar, were collected alive off Torre del Mar.

FAMILY PARACYTHERIDEIDAE Puri, 1957

This family is represented by *Paracytheridea depressa.* It was found at the Early Pliocene localities of Almayate, Mezquitilla, Valle Niza, Cerro de San Antón and Las Palmares.

FAMILY CYTHERURIDAE G.W. Müller 1894

This family is represented by the following species: *Eucytherura complexa, Pseudocytherura calcarata, Semicytherura acuticostata, S. alifera, S. costata, S. cribriformis, S. incongruens, S. inversa, S. sulcata, S.* sp. 1., *S.* sp. 2., *S.* sp. 3., *Cytheropteron rotundarum,* and *Cytheropteron* sp.

Semicytherura costata, S. incongruens, S. sulcata, and *S.* sp. 3 occur only at the Recent localities. *S. cribriformis* was collected from the Pliocene of Valle Niza and alive off Torre del Mar.

FAMILY XESTOLEBERDIDAE Sars, 1928

This family is represented by the following six species: *Xestoleberis communis, X. dispar X. fuscomaculata, X. margaritea, X. reymenti* and *X. ventricosa.* These were only found at the Lower Pliocene localities.

FAMILY BYTHOCYTHERIDAE Sars, 1866

This family is represented by *Bythocythere turgida, Monoceratina mediterranea* and *Pseudocythere caudata* in the Lower Pliocene of Almayate. *B. turgida* was also collected from Mezquitilla and Las Palmares.

FAMILY PARADOXOSTOMATIDAE Brady and Norman, 1889

This family is represented by the single species *Paradoxostoma simile.* It was collected alive off Torre del Mar.

FAMILY MACROCYPRIDIDAE G.W. Müller, 1912

This family is represented by *Macrocypris succinea* which was collected from the Lower Pliocene of Almayate and Mezquitilla.

FAMILY PONTOCYPRIDIDAE G.W. Müller, 1894

This family is represented by the species *Pontocypris accuminata* which occurs in the Early Pliocene of Almayate, Mezquitilla, Valle Niza, Cerro de San Antón and Rio Guadalminar, and *P. mytiloides* in the Early Pliocene of Cerro de San Antón. The species *Propontocypris intermedia,* occurs in the Lower Pliocene of Valle Niza and *P. pirifera* in the Lower Pliocene of Valle Niza and Mezquitilla. *P. pirifera* was also collected alive off Torre del Mar.

FAMILY CANDONIDAE Kaufmann, 1900

This family is represented by a single specimen *Paracypris* aff. *polita.* It was collected from he Lower Pliocene of Almayate and Mezquitilla.

FAMILY CYPRIDIDAE Baird, 1845

Eucypris virens ? (see notes on page 90).

Phylum	ARTHROPODA
Class	CRUSTACEA Pennant, 1777
Subclass	OSTRACODA Latreille, 1806
Order	MYODOCOPIDA Sars, 1866
Suborder	MYODOCOPA Sars, 1866
Family	CYPRIDINIDAE Baird, 1850
Subfamily	*CYLINDROLEBERIDINAE* G.W. Müller, 1894
Genus	*ASTEROPE* Philippi, 1840

Asterope cf. *marie* (Baird, 1850)
Plate 16, Figs. 1,2

1850 *Cypridina marie,* Baird, p. 257, pl. 17, figs. 5–7.
1868 *Cylindroleberis marie* (Baird), Brady, p. 465, pl. 33, figs. 18–22; pl. 41, fig.1.
1894 *Cylindroleberis oblonga* Grube.– G.W. Müller, p. 219, pl. 4, figs. 14–18, 39, 41, 49–55; pl. 5, figs. 1, 4, 5, 13, 14, 33, 41–44; pl. 8, fig. 4.
1928 *Asterope marie* (Baird), Sars, p. 17, pl. 9, pl. 10, fig. 1.

Description: The carapace is elongate, subovate, cylindrical in lateral view. The anterior margin is obtusely rounded with a marked incision in the lower central-posterior region. The posterior margin is narrowly rounded. The dorsal margin is almost straight. The ventral margin is evenly concave. The valve is ornamented with a faint longitudinal ventral ridge. The valve-surface is smooth, thin, pellucid, and very feebly calcified.

N.B. Untreated specimens dehydrate very readily (and may thus easily be lost.) The figured specimen is damaged and has thus a bent dorsal margin which does not correspond to its original appearance (almost straight dorsal margin).

Dimensions: Length = 1.34 mm, height = 0.62 mm, breadth = 0.22 mm (figured carapace).
Material: One carapace.
Age: Recent.
Distribution: [2]
Recent: Spain, (Torre del Mar), Mediterranean coast of France, Bay of Naples.

Ecology: Shallow marine environment. Sars (1928) recorded this species at depths ranging from 35 to 100 m off the south and west coasts of Norway. At Torre del Mar this species was collected at a depth of 8 m. Müller (1894) observed the species to live on calcareous algae, seaweed, and other algae, and to be rare in the Bay of Naples. It is rare at Torre del Mar. *A. marie* has been recorded from the British Isles and the west coasts of Norway and Sweden (Sars, 1928).

Order	PODOCOPIDA G.W. Müller, 1894
Suborder	PLATYCOPA Sars, 1866
Family	CYTHERELLIDAE Sars, 1866
Subfamily	*CYTHERELLINAE Pokorny, 1958*
Genus	*CYTHERELLA Jones, 1849*

All species placed here belong to *Cytherella* s. str.

[2] In all cases, the cited distributions are for the Mediterranean only.

Cytherella abyssorum Sars, 1865
Plate 16, Figs. 3, 4

1865 *Cytherella abyssorum,* Sars, p. 127.
1868 *Cytherella scotica* Brady.– Brady, p. 473, pl. 34, figs. 18–21.
1928 *Cytherella abyssorum* Sars.– Sars, p. 41, pl. 18, pl. 19.
1941 *Cytherella abyssorum* Sars.– Elofson, p. 248.
1960 *Cytherella abyssorum* Sars.– Reyment, p. 50, figs. 7, 8.

Remarks: The material referred here agrees with the characteristics of *C. abyssorum.* The specimens bear antero- and postero-marginal spines. Reyment (1960) noted small spines along the posterior margin. I have only fragments of this species in the present collection. *C. abyssorum* has a broad geographical distribution outside the Mediterranean, and has been recorded from the west coast of Norway (Sars, 1928), British Isles (Brady, 1868), Kattegat (Elofson, 1941), (Reyment, 1960), Atlantic Ocean (*Valorous* Expedition).

Age: Recent.
Distribution:
Recent: Spain, (Torre del Mar), Nice.

Ecology: Shallow and deep marine environments. Sars (1928) noted that this species cannot be a good swimmer, and must be a bottom creeper, and presumably, also, a burrower. Reyment (1960) suggested that the species requires an environment with a normal salinity. The recorded depth range is from 6 to 750 m. At Torre del Mar, fragments were collected from a depth of 12 m.

Cytherella vulgata Ruggieri, 1962
Plate 7, Fig. 10; Plate 16, Fig. 5

1962 *Cytherella vulgata,* Ruggieri, p. 9, pl. 1, figs. 9, 10.
1972 *Cytherella (Cytherella) vulgata* Ruggieri.– Sissingh, p. 72, pl. 2, fig. 2.
1975 *Cytherella vulgata* Ruggieri.– Bonaduce, Ciampo, and Masoli, p. 21, pl. 4, figs. 9–11.

Remarks: The carapace is subovate-elliptical in lateral view, with the characteristics of *C. vulgata.* It differs from the type species by being smoothly furrowed, and the absence of minute papillae posteriorly. Sissingh (1972, p. 86) observed smooth forms in material from Crete and Algeria. It has yet to be ascertained whether the ornamental variability is connected with polymorphism, and what the role of environmental factors could be.

Dimensions: Length = 0.76 mm, height = 0.44 mm, breadth = 0.20 mm (right valve).
Material: 41 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Adriatic Sea (ubiquitous).
Pleistocene: Italy, Rhodes.
Pliocene: Spain (Mezquitilla), Italy, Karpathos, Rhodes, Crete.
Miocene: Algeria (Carnot), Sicily (Enna), Gavdos, Crete.

Ecology: Shallow marine. At Torre del Mar, our material was collected in coarse sandy to gritty sediment at a depth of 5 m. It is rare. Bonaduce *et al.* (1975, p. 21) recorded the species from between 70 and 120 m, where it was observed to be common on very sandy pelite and fine sand. At Mezquitilla, *C. vulgata* is abundant in the lower and middle samples; drill-holes of predaceous gastropods occur in about 15 % of the material. (see Fig. 21: 3).

Genus *CYTHERELLOIDEA* Alexander, 1929

Cytherelloidea beckmanni Barbeito-Gonzalez, 1971
Plate 1, figs. 1, 2

1971 *Cytherelloidea beckmanni,* Barbeito-Gonzalez, p. 262, pl. 2, figs. 1c, 2c, 3c, pl. 45, figs. 14, 15.
1972 *Cytherella (Cytherelloidea) beckmanni* (Barbeito-Gonzalez), Sissingh, p. 72, pl. 2 fig. 3.
1985 *Cytherelloidea beckmanni* Barbeito-Gonzalez.– Stambolidis, p. 184, pl. 1, figs. 1, 2.

Description: The carapace is subrectangular in lateral view. The anterior end is evenly rounded and with or without marginal denticulations; the posterior end is narrowly truncated and posteroventrally angular. The dorsal margin is slightly convex; the ventral margin is concave in the middle. The valve-surface bears two strong longitudinal ridges and a deep muscle-scar pit. The valve-surface is largely covered with a honeycomb-pattern of pitlets. The right valve is larger than the left. This species is close to *C. sordida* (Müller), but it differs in having considerably coarser pits.

Dimensions: Length = 0.88 mm, height = 0.46 mm, breadth = 0.15 mm (left valve).
Material: More than 250 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Aegean Sea.
Pleistocene: Rhodes.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar), Greece (Karpathos, Rhodes, Crete).
Miocene: Crete.

Ecology: Benthonic; shallow marine (littoral), near-shore. Gastropod drill-holes occur in 6.2 % of the shells from Almayate (see Fig. 21: 1). The percentage of adults to instars at Almayate is 28.5 %

Suborder PODOCOPA Sars, 1866
Super-family BAIRDIACEA Sars, 1866
Family BAIRDIIDAE Sars, 1866
Genus *NEONESIDEA* Maddocks, 1969

Neonesidea corpulenta (Müller, 1894)
Plate 1, Figs. 3, 4

1894 *Bairdia corpulenta,* Müller, p. 272, pl. 13, figs. 39, 40, pl. 14, figs. 8, 9, 11, 24; pl. 15, fig. 24.
1972 *Neonesidea corpulenta* (Müller), Sissingh, p. 76, pl. 2, fig. 12.
1975 *Bairdia corpulenta* Müller.– Bonaduce, Ciampo, and Masoli, p. 22, pl. 5, figs. 1–5, 7.
1976 *Neonesidea corpulenta* (Müller), Breman, p. 46, pl. 1, fig. 7; pl. 5, fig. 64.

Description: The carapace is typically bairdioid being ovate to subtrapezoidal in lateral view. The dorsal margin is smoothly convex, the ventral margin sinuous. The greatest height lies in the anterior half of the carapace. The carapace is heavily calcified.

Dimensions: Lenght = 0.78–0.98 mm, height = 0.39–0.58 mm, breadth = 0.22–0.28 mm (left valves).
Material: 56 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Italian Adriatic Coast.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Valle Niza), Greece (Karpathos, Crete).

Ecology: Shallow marine, near-shore species. Stated to prefer sand and silt Bonaduce *et al.* (1975) and to live on calcareous algae (Müller, 1894).

Neonesidea formosa (Brady, 1868)
Plate 1, Figs. 12, 13; Plate 2, Figs. 1, 2

1868 *Bairdia formosa,* Brady, p. 221, pl. 14, figs. 5–7.
1894 *Bairdia serrata,* Müller, p. 273, pl. 13, fig. 41; pl. 14, figs. 13–15; pl. 15, fig, 23.
1972 *Bairdia formosa* Brady.– Sissingh, p. 77, pl. 3, fig. 1.
1975 *Bairdia formosa* Brady.– Bonaduce, Ciampo, and Masoli, p. 23, pl. 6, figs. 1–4.
1976 *Neonesidea formosa* (Brady), Breman, 47, pl. 1, fig. 10; pl. 5, fig. 66.

Description: The carapace is typically bairdioid being subtrapezoidal in lateral view. The anterior margin of the left valve is provided with denticles; the right valve is with or without denticles along the anterior margin. The dorsal margin is steeply arched.

Dimensions: Length = 1.05 mm, height = 0.62 mm, breadth = 0.25 mm (left valve).
Material: More than 300 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Mediterranean Sea in general.
Pleistocene: Rhodes, Crete.
Pliocene: Spain, (Almayate, Mezquitilla), Karpathos, Rhodes.

Ecology: Shallow marine (neritic and littoral). Bonaduce *et al.* (1975, p. 23) recorded this species at depths ranging from 10 to 20 m in the Adriatic, and noted it to prefer sand and silt. Müller (1894) found it in abundance among calcareous algae in the Bay of Naples. Predator drill-holes occur in 1.5 % of the material collected from Almayate (see Fig. 21: 2).

Neonesidea frequens (Müller, 1894)
Plate 1, Figs. 10, 11

1894 *Bairdia frequens,* Müller, p. 270, pl. 13, fig. 36; pl. 14, figs. 4, 23.
1976 *Neonesidaea frequens* (Müller), Breman, p. 47, pl. 1, fig. 8; pl. 5, fig. 65.

Remarks: The carapace is typically bairdioid. The anterior margins of both valves lack denticles. The valve-surface is punctate.

Dimensions: Length = 1.03 mm, height = 0.70 mm, breadth = 0.27 mm (left valve).
Material: 86 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea.
Pliocene: Spain (Almayate, Mezquitilla).

Ecology: Shallow marine; (neritic, littoral). Stated to prefer medium and fine sand. (Bonaduce *et al.*, 1975). Lives on *Posidonies cymodocées* and among calcareous algae, where it may be abundant (Müller, 1894, p. 270). Bodergat (1983) recorded it as occurring in salinities up to 38 ‰. At Almayate, the gastropod drill-holes occur in 2.6 % of the material collected (see Table 13).

Neonesidea longevaginata (Müller, 1894)
Plate 1, Figs. 5, 6

1894 *Bairdia longevaginata,* Müller, p. 271, pl. 13, figs. 30, 31; pl. 14, figs. 6, 7, 27.
1972 *Neonesidea longevaginata* (Müller), Sissingh, p. 76, pl. 2, fig. 13.
1975 *Bairdia longevaginata* Müller.– Bonaduce, Ciampo, and Masoli, p. 23, pl. 5, figs. 8–11.

Remarks: The carapace is typically bairdioid. The anterior margin is evenly rounded and without denticles. The posterior margin has a distinct caudal process. The valve-surface is finely pitted. The characteristic features of this species are the broad, convex dorsal margin, and the sharply pointed posterior.

Dimensions: Length = 1.23 mm, height = 0.63, breadth = 0.32 mm (right valve).
Material: 25 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea.
Pleistocene: Rhodes.
Pliocene: Spain (Almayate, Mezquitilla, Rio Guadalminar, Valle Niza), Rhodes.

Ecology: Shallow marine, near shore environment. Müller (1894, p. 271) found this species living among algal mats, noting it to be rare.

Neonesidea mediterranea (Müller, 1894)
Plate 1, Figs. 7–9; Plate 16, Fig. 6

1894 *Bairdia mediterranea,* Müller, p. 270, pl. 13, fig. 27; pl. 14, figs. 1, 2, 26.
1971 *Bairdia mediterranea* Müller.– Barebeito-Gonzalez, p. 265, pl. 4, figs. 1c, 2c.
1975 *Bairdia mediterranea* Müller.– Bonaduce, Ciampo, and Masoli, p. 23, pl. 5, fig. 6.
1985 *Bairdia mediterranea* Müller.– Stambolidis, p. 186, pl. 1, figs. 3–5.

Description: The carapace is typically bairdioid, the shape being ovate to subtrapezoidal in lateral view. The characteristic feature of this species are (1) the flat dorsal margin, (2) the broad anterior margin forming the entire anterior part, and (3) the short posterior part placed about at the middle height of the shell. There are no denticles along the posteroventral margin. The surface is smooth.

Dimensions: Length: = 1.07 mm, height = 0.60 mm, breadth = 0.25 mm (right valve).
Material: 160 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent to Holocene: Spain (Tarifa), Bay of Naples, Adriatic Sea, Aegean Sea.
Pliocene: Spain (Almayate, Mezquitilla, Rio Guadalminar).

Ecology: Shallow marine (neritic and littoral). At Tarifa *N. mediterranea* was collected from a depth of 1 m. Bonaduce *et al.* (1975, p. 23) reported this species from depths not exceeding 110 m in the Adriatic Sea and claimed that the highest frequencies occur around 70 m. It is stated to prefer medium sand but also to be frequent on fine sand (Bonaduce *et al.,* 1975). Müller (1894, p. 271) noted it to live among calcareous algae. Predator drill-holes occur in 7.6 % of the Almayate material: see Fig. 21: 4). This species has also been collected from Rio Jara near Tarifa.

FAMILY BYTHOCYPRIDIDAE Maddocks, 1969
Genus *BYTHOCYPRIS* Brady, 1880

Bythocypris bosquetiana (Brady, 1866)
Plate 2, Figs. 3–5

1866 *Bairdia bosquetiana,* Brady, p. 364, pl. 57, fig. 5.
1894 *Bythocypris bosquetiana* Brady.– Müller, p. 275,pl. 13, fig. 38; pl. 14, figs. 16–18, 20, 31; pl. 15, figs. 13–17, 26, 27, 34.
1928 *Bythocypris bosquetiana* (Brady), Sars, p. 64, pl. 29.
1972 *Bythocypris bosquetiana* (Brady), Sissingh, p. 78, pl. 3, fig. 7.
1976 *Bythocypris bosquetiana* (Brady), Breman, p. 47, pl. 2, fig. 12.

Description: The carapace is bean-shaped, and laterally compressed. The dorsal margin is gently arched, the ventral margin concave. The anterior end is rounded and broad. The posterior end is acutely rounded and narrower. The surface is smooth.

Remarks: According to Van Morkhoven (1962, p. 37), *Bythocypris reniformis* Brady 1880 is the young of *Bythocypris bosquetiana.* This question does not seem to have been finally resolved by later workers.

Dimensions: Length = 0.62–1.08 mm, height = 0.38–0.58 mm, breadth = 0.13–0.15 mm (left valves).
Material: 65 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Italy, Adriatic Sea.
Pliocene: Spain (Almayate, Mezquitilla), Crete.
Miocene: Crete.

Ecology: Shallow marine (lower infralittoral) offshore and deeper marine environments (Van Morkhoven, 1962). Lives among calcareous algae, where Müller (1894, p. 275) reported it to be rare. This species lives today in the Atlantic Ocean (Brady, 1866).

Bythocypris lucida (Seguenza, 1880)
Plate 2, Fig. 6

*1880 *Cytheridea lucida,* Seguenza, p. 290, pl. 16, fig. 51.
1964 *Bythocypris lucida* (Seguenza), Dieci & Russo, p. 56, pl. 14, fig. 7.
1972 *Bythocypris lucida* (Seguenza), Sissingh, p. 78, pl. 3, figs. 8, 9.
1982 *Bythocypris lucida* (Seguenza), Carbonnel, p. 24, pl. 4, figs. 20, 21.

Description: The carapace is bean-shaped in lateral view. The anterior margin is evenly rounded. The posterior margin is obliquely rounded and tapering ventrally. The dorsal margin is convex. The ventral margin is concave. The valve is thin-shelled and smooth.

Dimensions: Length = 0.68 mm, height = 0.35 mm, breadth = 0.12 mm (right valve).
Material: Two valves.
Age: Late Miocene to Late Pliocene.
Distribution:
Pliocene: Spain (Rio Guadalminar, Ampurdan), Italy (Reggio di Calabria), Crete.
Miocene: Greece (Crete).

Super-family	CYTHERACEA Baird, 1850
Family	CYTHERIDAE Baird, 1850
Subfamily	*CYTHERINAE* Baird, 1850
Tribe	*CYTHERINI* Baird, 1850
Genus	*CYTHEROMORPHA* Hirschmann, 1909

Cytheromorpha sp.
Plate 11, Fig. 1

Description: The carapace is tumid, subrectangular in lateral view. The anterior margin is evenly rounded, the posterior margin obtusely rounded. The dorsal margin is almost straight, the ventral margin somewhat sinuous. The valve-surface bears a faintly expressed polygonal reticulation; it is faintly depressed in the dorsocentral region. The valve is heavily calcified.

Remarks: This species is close to *Cytheromorpha fuscata* (Brady, 1869) but the lack of the weak lateral wing-like extension makes this identification uncertain; it may possibly be a male individual of the above mentioned species. It also resembles *Cytheremorpha nana* Bonaduce *et al.* (1975) but differs by being much larger. Another possibility for the generic assignation of this species is *Kuiperiana.* I have only a single left valve in the current collection.

Dimensions: Length = 0.56 mm, height = 0.32 mm, breadth = 0.15 mm (left valve).
Age: Early Pliocene.
Occurrence: Spain (Cerro de San Antón).

Genus *MICROCYTHERURA* G.W. Müller, 1894

Microcytherura angulosa (Seguenza, 1880)
Plate 2, Fig. 7

*1880 *Cytheridea angulosa,* Seguenza, p. 363, pl. 17, figs. 47, 47a.
1952 *Tetracytherura angulosa* (Seguenza), Ruggieri, p. 87, pl. 6, figs. 7, 8.
1971 *Microcytherura angulosa* (Seguenza), Barbeito-Gonzalez, p. 303, pl. 27, fig. 1f.
1972 *Tetracytherura irregularis* (Terquem), Sissingh, p. 147.
1972 *Microcytherura angulosa* (Seguenza), Uffenorde, p. 94, pl. 6, fig. 1.
1975 *Tetracytherura angulosa* (Seguenza), Bonaduce, Ciampo, and Masoli, p. 89, pl. 46, figs. 1–7.
1976 *Microcytherura angulosa* (Seguenza), Breman, p. 49, pl. 6, fig. 82.

Description: The carapace is subtrapezoidal in lateral view. The anterior end is broadly rounded and the posterior end obliquely developed. The lateral surface of the valves is covered by irregularly rounded punctae. The valves are heavily calcified.

Remarks: This species probably occurs in the Oligocene and Miocene of Germany according to observations of Lienenklaus (1894, p. 239), cited from Ruggieri (1952, p. 87).

Dimensions: Length = 0.46 mm, height = 0.26 mm, breadth = 0.15 mm (left valve).
Material: 4 valves.
Age: Late Oligocene to Recent.
Distribution:
Recent and Holocene: Mediterranean Sea in general.
Pleistocene: Rhodes, Crete.
Pliocene: Spain (Almayate, Cerro de San Antón), Italy (Capocolle near Forli and Castell'Arquato). Greece (Karpathos, Rhodes, Crete).

Ecology: Marine (epi-neritic, infralittoral, circalittoral, eurybathic). Bonaduce *et al.* (1975, p. 89) found the species to be most common between 75 and 120 m. It lives on *Amphioxus* sands.

FAMILY LEPTOCYTHERIDAE Hanai, 1961
Subfamily *LEPTOCYTHERINAE* Hanai, 1957
Genus *LEPTOCYTHERE* Sars, 1928

All species referred here belong to *Leptocythere* s. str. Several species occur, but all are very rare.

Leptocythere fabaeformis (Müller, 1894)
Plate 18, Fig. 5

1894 *Cythere fabaeformis,* Müller, p. 356, pl. 27, fig. 35; pl. 29, figs. 11, 16.
1964 *Leptocythere fabaeformis* (Müller), Puri, Bonaduce, and Malloy, p. 114.
1968 *Leptocythere fabaeformis* (Müller), Masoli, p. 17, pl. 1, fig. 10; pl. 5, figs, 66–68.

Description: The carapace is reniform subquadrangular in lateral view. The dorsal margin is slightly arched. The ventral margin is almost parallel to the dorsal margin and sinuous anterior of the midpoint. The anterior margin is obliquely rounded. The posterior margin has a distinct posterior angle. The valve is depressed in the postero-ventral region. The valve-surface is smoothly pitted, with fine hairs in these pits, particularly in the central region of the valve-surface.

Dimension: Length = 0.63 mm, height = 0.28 mm, Breadth = 0.14 mm (figured carapace).
Material: One carapace.
Age: Recent
Distribution:
Recent: Spain (Torre del Mar), Bay of Naples, Adriatic Sea.

Ecology: Shallow marine; at Torre del Mar this species was collected from a depth of 12 m on fine sand. In the Adriatic Sea, at Isonzo and the lagoon of Grado, it was found at depths between 7 and 8 m (Masoli, 1968, p. 18). Müller (1894) found the species on sandy substrates among living *Posidonia* and *Caulerpa* where he noted it to be rare.

Leptocythere aff. *lagunae* Hartmann, 1958
Plate 18, Fig. 8

1958 *Leptocythere (L.) lagunae,* Hartmann, p. 226, pl. 34, figs. 1–5.

Description: The carapace is oblong-elongate in lateral view. The anterior margin is broadly rounded. The posterior margin is subacute. The dorsal margin is almost straight, the ventral margin sinuous. The valve-surface is strongly sculptured with a well-marked sulcal depression in the dorsocentral region.

Remarks: The present specimen differs from the holotype in being smaller and more strongly ornate. It is smaller than *L. paralagunae* Maybury & Whatley (1980) which was reported from the Upper Pliocene of St. Erth.

Dimensions: Length = 0.41 mm, height = 0.20 mm, breadth = 0.08 mm (figured carapace).
Material: One, presumably, male carapace.
Age: Recent.
Distribution:
Recent: Spain (Torre del Mar).

Ecology: Leptocythere lagunae is known from shallow marine and brackish water environments (Hartmann, 1960, p. 423). At Torre del Mar, the specimen provisionally referred to *L. lagunae* was collected from a depth of 10 m in normal marine salinity.

Leptocythere levis (Müller, 1894)
Plate 18, Fig. 7

1894 *Cythere levis,* Müller, p. 357, pl. 27, fig. 31; pl. 28, figs. 11, 12.
1950 *Leptocythere macallana levis* (Müller), Ruggieri, p. 44, pl. 1, fig. 13, text-fig.33.
1972 *Leptocythere levis* (Müller), Sissingh, p. 91.
1975 *Leptocythere levis* (Müller), Bonaduce, Ciampo, and Masoli, p. 32, pl. 17, figs. 1–3.
1976 *Leptocythere levis* (Müller), Breman, p. 49, pl. 6, fig. 85.

Description: The carapace is elongate subreniform in lateral view. The anterior margin is slightly convex, the ventral margin sinuous, with a posterodorsal ridge. The anterior margin is broadly rounded, the posterior margin obtusely truncate. The valve-surface is punctate, the valves are thin and pellucid.

Remarks: This species corresponds well with the Müller's (1894) description but it differs from the type by being extremely large and more punctate.

Dimensions: Length = 0.65 mm, height = 0.28 mm, breadth = 0.13 mm (figured carapace).
Material: One carapace.
Age: Late Pliocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Bay of Naples, Adriatic Sea, Port Said.
Pleistocene: Italy (Consenza), Rhodes.

Ecology: Shallow marine, nearshore environment. Müller (1894) found the species living among *Posidonia* and *Caulerpa,* and to be abundant on sandy substrates. Bonaduce *et al.* (1975) noted that it is rare in the Adriatic Sea at depths of less than 50 m. At Torre del Mar it was collected from a depth of 12 m where it is rare and could well have been transported from deeper water.

Leptocythere rara (Müller, 1894)
Plate 18, Fig. 6

1894 *Cythere rara,* Müller, p. 355, pl. 27, fig. 32; pl. 29, figs. 12, 14.
1975 *Leptocythere rara* (Müller), Bonaduce, Ciampo, and Masoli, p. 34, pl. 15, figs, 10–14. Text-figs. 17, 18.
1976 *Leptocythere rara* (Müller), Breman, p. 50, pl. 6, fig. 87.

Remarks: The specimens referred here differs from the type in being more heavily pitted as well as markedly larger.

Dimensions: Length = 0.52 mm, height = 0.26 mm, breadth = 0.10 mm (figured carapace).
Material: 4 valves.
Age: Recent.
Distribution:
Recent: Spain (Torre del Mar), Bay of Naples, Adriatic Sea.

Ecology: Shallow marine. Müller (1894) found it to be rare in the Bay of Naples, where it lives on sand among *Posidonia.* Bonaduce *et al.* (1975) recorded the species in the Adriatic Sea at a depth of 225 m with its optimum corresponding to depths lower than 50 m. At Torre del Mar it was collected from a depth of 12 m where it is rare.

Genus *CALLISTOCYTHERE* Ruggieri, 1953
Callistocythere diffusa (Müller, 1894)
Plate 19, Figs. 1–3

1894 *Cythere diffusa,* Müller, p. 354, pl. 27, fig. 25; pl. 28, figs. 16, 28.
1970 *Callistocythere diffusa* (Müller), Uffenorde, p. 67.
1975 *Callistocythere diffusa* (Müller), Bonaduce, Ciampo, and Masoli, p. 36.
1981 *Callistocythere* cf. *diffusa* (Müller), Mostafawi, p. 141, pl. 3, figs. 14–16.
1985 *Callistocythere diffusa* (Müller), Stambolidis, p. 190.

Description: The carapace is elongate to subrectangular in lateral view. The dorsal margin is almost straight, the ventral margin sinuous. The valve-surface is ornamented with undulating ridges and reticulations, mainly in the central region. The anastomizing pattern of the ribbing is a particular feature of this form (cf. Plate 19, Figs. 2, 3). The shell is heavily calcified.

Dimensions: Length = 0.49 mm, height = 0.28 mm, breadth = 0.09 mm (right valve).
Material: Two valves.
Age: Late Pliocene to Recent.
Distribution:
Recent and Holocene: Spain (Estepona), Bay of Naples, Tyrrhenian Sea, Adriatic Sea, Limski Channel.
Pliocene: Greece (Kos).

Remarks: This species has also been reported from the Black Sea and Azov Sea by Schornikow (1966). It is the least common of the representatives of *Callistocythere* in our collections.

Ecology: Shallow marine (littoral to epi-neritic), living on calcareous algae, frequent between detrital *Posidonia.* Müller (1894, p. 254) observed it to be frequent in the Bay of Naples. It is rare at Estepona where it was found in only one sample, associated with calcaerous algae. Bonaduce *et al.* (1975) noted it to be rare in the Adriatic Sea and to occur at depths not exceeding 120 m.

Callistocythere flavidofusca (Ruggieri, 1950)
Plate 3, Fig. 3

1950 *Leptocythere flavidofusca,* Ruggieri, p. 46, pl. 1, figs. 6, 7. Text-fig. 31.
1972 *Callistocythere flavidofusca* (Ruggieri), Sissingh, p. 90.
1975 *Callistocythere flavidofusca* (Ruggieri), Bonaduce, Ciampo, and Masoli, p. 36, pl. 12, figs. 6–11.
1976 *Callistocythere flavidofusca* (Ruggieri), Breman, p. 51, pl. 7, fig, 94.
1981 *Callistocythere flavidofusca* (Ruggieri), Mostafawi, p. 139, pl. 4, figs. 10–12.

Description: The carapace is elongate, subrectangular in lateral view. The lateral surfaces of the valves are ornamented with strongly developed ridges, and broad, anastomizing ribs (Plate 3, Fig. 3) which is a characteristic feature of this species. There is strong sexual dimorphism; the males are shorter and narrower than the females (cf. Ruggieri, 1950, p. 46).

Dimensions: Length = 0.58 mm, height = 0.32 mm, breadth = 0.14 mm (female left valve).
Material: 30 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Adriatic Sea.
Pleistocene: Italy, (Imola).
Pliocene: Algeria, Spain (Almayate, Limonar), Greece (Karpathos, Kos, Crete).
Miocene: Italy.

Ecology: Shallow marine (neritic and littoral). Bonaduce *et al.* (1975) found the species at depths not exceeding 120 m and to be abundant at a depth of 70 m in the Adriatic Sea, and to prefer a medium-grained sandy substrate.

Callistocythere littoralis (Müller, 1894)
Plate 2, Figs. 8–10

1894 *Cythere littoralis,* Müller, p. 353, pl. 28, fig. 18.
1971 *Callistocythere littoralis* (Müller), Barbeito-Gonzalez, p. 274, pl. 9, figs. 1f, 2f.
1975 *Callistocythere littoralis* (Müller), Bonaduce, Ciampo, and Masoli, p. 39, pl. 11, figs. 1–7, text-fig. 21.
1980 *Callistocythere littoralis* (Müller), Athersuch & Whittaker in: Stereo-Atlas 7 (11): 61–66.

Description: The carapace is elongate to subquadrate and compressed laterally. The dorsal margin is almost straight, the anterior end is broadly rounded; the posterior end is flatly rounded with a prominent posterodorsal cardinal angle. The ventral margin is sinuous in the anterior half. The valve-surfaces are ornamented with pitted, undulating, ridges. The anterior and posterior marginal ridges are well-developed. The valves are heavily calcified.

Dimensions: Length = 0.59 mm, height = 0.34 mm, breadth = 0.12 mm (right valve).
Material: 85 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Greece (Naxos), Turkey (Tenedos).
Pleistocene: Italy.
Pliocene: Spain (Almayate, Mezquitilla, Valle Niza), Greece (Kos).

Remarks: This species has also been reported from the Atlantic coast of France, Britain, Irish Sea and the North Sea.

Ecology: Shallow marine (neritic, littoral and sublittoral zones). Müller (1894) found no males in his samples from the Bay of Naples where the species occurs at depths of 10 m and less, and where it lives among seaweed and algae. Bonaduce *et al.* (1975, p. 40) found the species to occur at depths of down to 135 m and to be most common between 110 and 135 m, preferring very sandy pelite, but also occuring on sandy pelite and sandy silt.

Callistocythere lobiancoi (Müller, 1912)
Plate 3, Fig. 1

1894 *Cythere elegans,* Müller, p. 352, pl. 28, figs. 20, 29.
1912 *Cythere lobiancoi,* Müller, p. 318 (new name).
1971 *Callistocythere lobiancoi* (Müller), Barbeito-Gonzalez, p. 275, pl. 10. figs, 1c, 2c.
1972 *Callistocythere lobiancoi* (Müller), Uffenorde, p. 68, pl. 7, fig. 4.
1975 *Callistocythere lobiancoi* (Müller), Bonaduce, Ciampo, and Masoli, p. 40, pl. 13, figs. 1–7.
1976 *Callistocythere lobiancoi* (Müller), Breman, p. 52, pl. 7, Fig. 40.

Description: The carapace is elongate to subquadrangular and compressed laterally. It is characterized by a deeply incised, regular type of sculpture, which is interrupted in the area above the dorsal muscle scars. The dorsal margin is nearly straight. The anterior margin is broadly rounded, the posterior narrowly rounded. The posterodorsal cardinal angel is prominent. The ventral margin is sinuous; the carapace is heavily calcified.

Dimensions: Length = 0.50 mm, height = 0.28 mm, breadth = 0.10 mm (right valve)
Material: 36 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Aegean Sea, Limski Channel.
Pliocene: Spain (Almayate, Mezquitilla).

Ecology: Benthonic; shallow marine, near-shore species, occurring above 50 m (cf. Bonaduce *et al.*, 1975, p. 40). Lives on detritus, and occurs on different kind of bottoms, usually of a sandy nature.

Callistocythere pallida (Müller, 1894)
Plate 3, Fig. 2

1894 *Cythere pallida,* Müller, p. 354, pl. 28, fig. 17.
1953 *Leptocythere (Callistocythere) pallida* (Müller), Ruggieri, p. 102, fig. 24.
1962 *Callistocythere pallida* (Müller), Ruggieri, p. 52, pl. 6, figs. 3, 4.
1972 *Callistocythere pallida* (Müller), Sissingh, p. 90.
1972 *Callistocythere pallida* (Müller), Uffenorde, p. 68, pl. 7, fig. 5.
1975 *Callistocythere pallida* (Müller), Bonaduce, Ciampo, and Masoli, p. 40, pl. 10, figs. 6–12.

Description: The carapace is elongate to subquadrate and compressed laterally, the anterior end is broadly rounded. The posterior end is rounded and narrower. The dorsal margin is almost straight. The ventral margin is sinuous in the anterior half; the oblique groove near the anterior margin is marked and deep, and the posterodorsal cardinal angle is prominent. The valve-surface is ornamented with a variable pattern of randomly curved riblets and bulges.

Dimensions: Length = 0.42 mm, height = 0.25 mm, breadth = 0.10 mm (right valve).
Material: More than 300 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Crotone, Adriatic Sea, Limski Channel.
Pleistocene: Italy (Catanzaro, Calabria, Naples, Crotone), Greece (Rhodes, Crete).
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón), Greece (Karpathos, Rhodes, Crete).
Miocene: Crete.

Ecology: Shallow marine. Lives on bottoms of various kinds, including detrital substrates, rare on calcareous algae (Müller, 1894, p. 355). Found by Bonaduce *et al.* (1975, p. 40) down to a depth of 40 m.

Callistocythere rastrifera (Ruggieri, 1953)
Plate 3, Fig. 4

1953 *Leptocythere (Callistocythere) rastrifera,* Ruggieri, p. 100, pl. 3, figs. 25, 25a; pl. 4, figs. 28, 33; pl. 6, fig. 59.
1972 *Callistocythere rastrifera* (Ruggieri), Sissingh, p. 90.
1975 *Callistocythere rastrifera* (Ruggieri), Bonaduce, Ciampo, and Masoli, p. 40, pl. 17, figs. 11–14.
1976 *Callistocythere rastrifera* (Ruggieri), Breman, p. 52, pl. 7, fig. 99.
1981 *Callistocythere rastrifera* (Ruggieri), Mostafawi, p. 140, pl. 3, figs. 9–11.

Description: The heavily calcified carapace is elongate to subrectangular in lateral view. The anterior margin is broadly rounded. The posterior margin is obliquely truncated and narrow. The dorsal margin is almost straight. The ventral margin is sinuous. The valve-surface is reticulate with undulating ridges, the spaces between which are coarsely pitted. The ornament is arranged in two tiers.

Dimensions: Length = 0.46 mm, height = 0.22 mm, breadth = 0.08 mm (left valve)
Material: 30 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent to Holocene: Algeria (Bay of Bou-Ismael), Adriatic Sea.
Pleistocene: Italy (Calabria). Rhodes.
Pliocene: Algeria, Spain (Almayate, Mezquitilla), Greece (Karpathos, Kos, Rhodes).

Ecology: Shallow marine. Bonaduce *et al.* (1975) found this species in the Adriatic Sea above 180 m with an optimum at depths between 40 and 80 m. It is stated to prefer fine sand.

Family CYTHERIDEIDAE Sars, 1925
Subfamily CYTHERIDEINAE Sars, 1925
Genus CYTHERIDEA Bosquet, 1852

All species referred here belong to *Cytheridea* s. str.

Cytheridea neapolitana Kollmann, 1960
Plate 12, Figs. 2, 3

1894 *Cytheridea mülleri* (Münster), G.W. Müller, p. 362, pl. 39, figs. 3, 26, 28–34.
1960 *Cytheridea neapolitana,* Kollmann, p. 152, pl. 7, figs. 7–10, text-figs. 3a, b, d.
1967 *Cytheridea (Cytheridea) acuminata* Bosquet, 1852 *neapolitana* Kollmann, 1958. – Ruggieri, p. 358, pl. 37, fig. 7.
1972 *Cytheridea acuminata neapolitana* Kollmann. – Sissingh, p. 87, pl. 5, fig. 5.
1972 *Cytheridea neapolitana* Kollmann.–Uffenorde, p. 59, pl. 5, fig. 8.
1975 *Cytheridea neapolitana* Kollmann.–Bonaduce, Ciampo, and Masoli, p. 60, pl. 34, figs 6–7.
1976 *Cytheridea acuminata neapolitana* Kollmann. – Breman, p. 53, pl. 6, fig. 74.
1981 *Cytheridea neapolitana* Kollmann.–Mostafawi, p. 143, pl. 5, figs. 8–11.
1982 *Cytheridea neapolitana* Kollmann.–Carbonnel, p. 32, pl. 6, figs. 3, 5, 10, 12.

Description: The carapace is subtrapezoidal to subtriangular in lateral view. The anterior margin is evenly rounded, the posterior margin obliquely truncate. The dorsal margin is convex, the ventral margin concave. The valve-surface is pitted in concentric rows (Plate 12, Fig. 3; stereopair). The valves bears antero- and postero-marginal denticulations.

Dimensions: Length = 0.80 mm, height = 0.29 mm, breadth = 0.16 mm (left valve).
Material: 8 valves.
Age: Middle Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Limski Channel.
Pleistocene: Rhodes, Crete.
Pliocene: Algeria, Spain (Cerro de San Antón, Limonar, Ampurdan), Greece (Kos, Rhodes).
Miocene: Italy.

Remarks: Ruggieri (1967) recorded the species from the Middle Miocene of the Vienna Basin.

Ecology: Marine; lives on calcareous algae and seaweed (Müller, 1894). Bonaduce *et al.* (1975, p. 60) recorded it at optimum depths of less than 125 m in the Adriatic Sea, although it is known to occur down to a depth of 165 m. It was noted by Bonaduce *et al.* (1975) to be very common on very sandy pelite, but also to be present on every type of substrate.

Family CUSHMANIDEIDAE Puri, 1973

Genus HEMICYTHERIDEIS Ruggieri, 1952

Hemicytherideis elongata (Brady, 1868)
Plate 12, Fig. 4; Plate 17, Figs. 1–4

1868 *Cytheridea elongata,* Brady, p. 421, pl. 28, figs. 13–16.
1952 *Hemicytherideis elongata* (Brady), Ruggieri, p. 66, pl. 2, figs. 2–6.
1957 *Hemicytherideis elongata* (Brady), Wagner, p. 44, pl. 16, figs. 1–5.
1968 *Hemicytherideis elongata* (Brady), Masoli, p. 34, pl. 2, fig. 17; pl. 2, fig. 17; pl. 9, figs. 123–125.
1971 *Hemicytherideis elongata* (Brady), Barbeito-Gonzalez, p. 288, pl. 20, figs. 1a, 2a.
1972 *Cushmanidea elongata* (Brady), Uffenorde, p. 57.
1972 *Hemicytherideis elongata* (Brady), Sissingh, p. 82.
1979 *Hemicytherideis elongata* (Brady), Yassini, p. 106, pl. 9, fig. 15.
1979 *Hemicytherideis elongata* (Brady), Yassini, p. 382, pl. 3, figs. 24, 251.

Description: The carapace is elongate ovate, subrectangular in lateral view. The anterior margin is broadly rounded and provided with small anteromarginal denticulations. The posterior margin is obliquely rounded. The dorsal margin is convex, the ventral margin sinuous. The inner lamella and the line of concrescence are widest anteriorly. The valve-surface is smoothly pitted, and striated ventrally with faint longitudinal ridges, running anteriorly, and forming concentric zigzag ridges. The soft parts observed in the material correspond well with those figured by Brady (1868). Plate 17, Figs. 2 and 3 give internal views of Recent specimens showing extremities.

Dimensions:
Length = 0.45–0.78 mm, height = 0.22–0.33 mm, breadth = 0.10–0.15 mm (left valves).
Material: 22 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar, Torrenueva), Bay of Naples, Adriatic Sea, Limski Channel.
Pleistocene: Italy, Rhodes, Crete.
Pliocene: Algeria, Spain (Mezquitilla, Cerro de San Antón, Limonar), Crete, Rhodes, Turkey.
Miocene: Crete, Turkey.

Remarks: This species has a broad geographical distribution outside the Mediterranean region. It occurs in Great Britain, Ireland, Bay of Biscay, and in the Pleistocene of Scotland and Ireland (Brady, 1868). Elofson (1941, p. 267) recorded it from the Kattegat. Wagner (1957) recorded the species from the Holocene of Holland. Neil *et al.* (1964, p. 325) found it off the west coast of Florida.

Ecology: Shallow marine (littoral) nearshore environment in the Mediterranean. This species has the same environmental requirements as *H. turbida* (Müller). Bonaduce *et al.* (1975, p. 62) found it to be widely distributed in the Adriatic, and to occur at depths of down to 120 m, optimally 40–80 m.; the greatest number of specimens seem to have been found on medium sand, but it may be present on all types of bottom, excluding silt and silty pelite. At Torre del Mar, it was found at depths of between 5 and 12 m.

Hemicytherideis turbida (Müller, 1894)
Plate 17, Figs. 5–7

1894 *Cytheridea turbida,* Müller, p. 361, pl. 30, figs. 28, 31–33, 40–45, 47.
1973 *Hemicytherideis turbida* (Müller), Sissingh, p. 33, pl. 1, fig. 2.

Remarks: This species occurs in the same microenvironment in southern Spain as *Hemicytherideis elongata* (Brady) in the present collection. It differs slightly from *H. elongata* in being more acuminate, somewhat shorter, less ornamented, and in the narrow anterior inner lamella. Soft parts are shown in Plate 17, Fig. 7.

Sissingh (1973) recalled that Gramann (1969) found *H. turbida* in the Pontian at Choumnikon Beds of the Strimon Basin, probably as reworked material. *Faute de mieux,* I presume that this species has the same stratigraphic range as *H. elongata;* unfortunately, a decision here is difficult as authors seem to have confused the two forms.

Dimensions:
Length = 0.30–0.66 mm, height = 0.18–0.30 mm, breadth = 0.08–0.13 mm (left valves).
Material: 20 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar, Torrenueva), Bay of Naples.
Pleistocene: Italy (Santa Maria di Catanzaro).
Pliocene: Spain (Mezquitilla).
Miocene: Greece (Strimon Basin).

Ecology: Shallow marine; (littoral), near shore-environment. (see *H. elongata*). Abundant at depths down to 90 m, optimally distributed between 45 and 60 m (Puri *et al.*, 1964). At Torre del Mar it was collected at depths of 10 and 12 m. It is also present in the material from Torrenueva. It is interesting that *H. turbida* does not occur in the Almayate Pliocene.

Family NEOCYTHERIDEIDAE Puri, 1957
Genus NEOCYTHERIDEIS Puri, 1952

Neocytherideis fasciata (Brady & Robertson, 1874)
Plate 17, Fig. 11

1874 *Cytherideis fasciata,* Brady & Robertson, p. 117, pl. 6, figs. 1–5.
1894 *Cytherideis foveolata* Brady.–Müller, p. 381.
1953 *Cytherideis fasciata* (Brady & Robertson), Ruggieri, p. 106.
1973 *Neocytherideis fasciata* (Brady & Robertson), Sissingh, p. 33, pl. 1, fig. 3.
1975 *Neocytherideis fasciata* (Brady & Robertson), Bonaduce, Ciampo, and Masoli, p. 62, pl. 35, figs. 6–10.
1976 *Neocytherideis fasciata* (Brady & Robertson), Breman, p. 56, pl. 6, fig. 79.
1985 *Neocytherideis fasciata* (Brady & Robertson), Stambolidis, p. 196.

Description: The carapace is elongate in lateral view. The valve surface is smoothly pitted and there is a weak sulcus located dorsocentrally, and with transverse furrows anteriorly. A rippled pattern is developed in the anterior part at the carapace (cf. Hartmann (1982) who discussed the possible significance of ornament of this kind).

Dimensions: Length = 0.68 mm, height = 0.23 mm, breadth = 0.10 mm (left valve).
Material: 17 valves.
Age: Early Pleistocene to Recent.
Colalongo (1968) found *N. fasciata* to be common in deposits in the Calabrian Santerno section and rare just below the assumed Pliocene/Pleistocene boundary (Sissingh, 1973, p. 34).
Distribution:
Recent and Holocene: Spain (Torre del Mar), Bay of Naples, Adriatic Sea, Aegean Sea, Coast of Port Said.
Pleistocene: Italy (Calabria), Sicily (Rizzolo).

Remarks: This species has a broad geographical distribution outside the Mediterranean. It occurs in British coastal waters, Bay of Biscay, and the Cabo Verde Isles.

Ecology: Shallow marine (littoral and infralittoral), Müller (1894) found it to be abundant at a depth of 10 m at Cumae and to live among *Posidonia.* Puri *et al.* (1964) reported a depth-range of 5 to 100 m in the Bay of Naples. Breman (1976, p. 133) gave the depth-range in the Adriatic Sea to be 5 to 70 m., with an optimum at 5–20 m on a substrate mixed sand/mud. Stambolidis (1985) found this form in the Evros-Delta at a depth of 3.5 m in muddy sediments (temp. 23.5°C and salinity 38.8 ‰). At Torre del Mar, it was collected from a depth of 12 m.

Genus PSEUDOSAMMOCYTHERE Carbonnel, 1966

Pseudosammocythere similis (Müller, 1894)
Plate 17, Fig. 9

1894 *Krithe similis,* Müller, p. 359, pl. 30, figs. 2, 17–21.
1971 *Krithe similis* Müller.–Barbeito-Gonzales, p. 289, pl. 20, figs. 1f, 2f.
1972 *Pseudosammocythere similis* (Müller), Sissingh, p. 85, pl. 4, fig. 8.
1975 *Pseudosammocythere similis* (Müller), Bonaduce, Ciampo, and Masoli, p. 67.
1976 *Pseudosammocythere similis* (Müller), Breman, p. 55, pl. 2, fig. 25.

Remarks: The carapace is elongate ovate in lateral view, with the characteristics of the species, including the strongly asymmetric rounding of the anterior margin. The valve-surface is smooth with faint ripples. The valve is thin-shelled and pellucid.

Dimensions: Length = 0.48 mm, height = 0.23 mm, breadth = 0.08 mm (right valve).
Material: 6 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Bay of Naples, Adriatic Sea.
Pleistocene: Rhodes.
Pliocene: Rhodes, Crete.

Ecology: Shallow marine (littoral). Lives on *Posidonia* and calcareous algae Müller (1894). At Torre del Mar, where it is rare, it was collected from a depth of 12 m.

Genus SAHNICYTHERE Athersuch, 1982

Sahnicythere retroflexa (Klie, 1936)
Plate 18, Figs. 1–4

1868 *Cytherideis subulata,* Brady, p. 454, pl. 35, figs. 43–46.
*1936 *Cytherideis retroflexa,* Klie, p. 52, figs. 4–11.
1971 *Sahnia subulata* (Brady), Barbeito-Gonzalez, p. 289, pl. 20, figs. 1d–3d.
1975 *Sahnia subulata* (Brady), Bonaduce, Ciampo, and Masoli, p. 63, pl. 36, figs. 1–4, text-fig. 27.

1982 *Sahnicythere retroflexa* (Klie), Athersuch, p. 235, pl. 3, figs. 1–8; figs. 2a–e, g–k.
1985 *Sahnia subulata* (Brady), Stambolidis, p. 197.

Description: The carapace is elongate, subovate-fusiform in lateral view. The dorsal margin is convex. The ventral margin is sinuous in the middle. The valve-surface is sulcated in the dorso-central region and finely punctate with conical pits of variable shape (Plate 18 Fig. 3). The valves are thin-shelled. The internal aspect of a right valve is illustrated in Plate 18, Fig. 4 (stereopair).

Remarks: Athersuch (1982) established a new genus *Sahnicythere* (lapsus *Sahicythere)* for this species to replace the erroneously erected *Sahnia* (Puri, 1952), with the type species *Sahnicythere retroflexa* (Klie, 1936). Athersuch (1982, p. 235) stated that he was unable to verify the presence of *Sahnicythere retroflexa* in the Mediterranean, although specimens illustrated as *Sahnia subulata* by Bonaduce *et al.* (1975) closely resemble this species in his opinion. I believe, however, that the material figured by Bonaduce *et al.* (1975) belongs to *Sahnicythere retroflexa.*

Dimensions:
Length = 0.43–0.55 mm, height = 0.15–0.20 mm, breadth = 0.09–0.09 mm (left valves).
Material: 12 valves.
Age: Pleistocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Adriatic Sea, Aegean Sea, Levant.

Remarks: This species was originally described from Great Britain, it also occurs in Ireland, Bay of Biscay, and the Cabo Verde Isles. Brady (1868, p. 454) reported it as "fossil Glacial" from Scotland.

Ecology: Brackish and shallow marine (epi-neritic), nearshore environment. At Torre del Mar it was collected from depths of 10, 12 and 20 m., and is possibly autochthonous.

Family TRACHYLEBERIDIDAE Sylvester–Bradley, 1948

Genus BOSQUETINA Keij, 1957

Bosquetina carinella (Reuss, 1850)
Plate 3, Figs. 5, 6; Plate 12, Fig. 7

1850 *Cypridina carinella,* Reuss, p. 76, pl. 10, fig. 10.
1894 *Cythereis dentata,* Müller, p. 379, pl. 32, figs. 23, 27, 31.
1962 *Bosquetina carinella* (Reuss), Ruggieri, p. 45.
1972 *Bosquetina carinella* (Reuss), Sissingh, p. 93.
1975 *Bosquetina dentata* (Müller), Bonaduce, Ciampo, and Masoli, p. 48, pl. 31, figs. 9, 10.
1976 *Bosquetina carinella* (Reuss), Breman, p. 60, pl. 8, fig. 116a, b.

Description: The carapace is heavily calcified, subtriangular in lateral view, and triangular in rear view. The anterior end is broadly rounded with prominent spines; the posterior end subacute. The dorsal margin is nearly straight, the ventral outline is convex. The valves are smooth to finely pitted, and each valve has a distinct ventro-lateral keel or ridge, a characteristic feature of the genus. The anterior and posteroventral margins are provided with several denticles.

Remarks: Bonaduce *et al.* (1975, p. 48) suggested that *Bosquetina dentata* (Müller) could be a present-day representative of *Bosquetina carinella,* but without specifying their reasons for this assumption. Ruggieri (1962, p. 46) drew attention to the fact that Méhes had found this species in the Late Oligocene of Budapest.

Dimensions: Length = 1.25 mm, height = 0.75 mm, breadth = 0.36 mm (right valve).
Material: 165 valves.
Age: Late Oligocene to Recent.
Distribution:
Recent and Holocene: Mediterranean Sea in general.
Pleistocene: Calabria, Sicily, Rhodes.
Pliocene: Spain (Almayate, Mezquitilla, Rio Guadalminar), Italy (Calabria, Piemonte, Castel-l'Arquato, Romagna), Greece (Karpathos, Rhodes, Crete).
Miocene: France, Italy (Calabria, Romagna), Gavdos, Crete

Ecology: Shallow to fairly deep-marine (infra-neritic). Lives among calcareous algae (Müller, 1894, p. 379). Stated to prefer medium sand, fine sand and very sandy pelite. Living representatives are reported to be found mostly in deep water and Bonaduce *et al.* (1975, p. 48) consider that the distribution of the species increases with increasing depth, with an optimal range of 120–170 m. Naticid drill-holes occur frequently at Almayate (14.6 %) and indicate a shallow endobionthic environment for the Almayate individuals (see Fig. 24: 7), (cf. Ziegelmeier (1954) for a discussion of the depth-requirements of naticid drills). The present occurrence is clearly of interest because it links the vertical distribution of the species to a littoral environment and thus establishes its eubathyal nature.

Genus OCCULTOCYTHEREIS Howe, 1951

Occultocythereis dohrni Puri, 1963
Plate 12, Fig. 1

1894 *Cythereis lineata,* G.W. Müller, p. 377, pl. 29, figs. 21, 26; pl. 31, figs. 25–30, 33.
1962 *Occultocythereis bituberculata* (Reuss), Ruggieri, p. 20, pl. 1, fig. 20.
1963 *Occultocythereis dohrni,* Puri, p. 373 (new name).
1972 *Occultocythereis dohrni* Puri.–Sissingh, p. 110.
1975 *Occultocythereis dohrni* Puri.–Bonaduce, Ciampo, and Masoli, p. 50, pl. 26, figs. 1–5.
1976 *Occultocythereis dohrni* Puri.–Breman, p. 64, pl. 9, fig. 125.

Description: The carapace is compressed and elongate subrectangular in lateral view. The anterior margin is broadly rounded. The posterior margin is obtusely rounded, and projected mid-posteriorly, with a prominent cardinal angle posterodorsally. The dorsal margin is almost straight. The ventral margin is slightly sinuous. The valve-surface is ornamented with a wing-like projection bearing marginal denticulations anteriorly and posteriorly. The shell is heavily calcified.

Dimensions: Length = 0.50 mm, height = 0.30 mm, breadth = 0.06 mm (figured carapace).
Material: 4 valves and carapaces.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Italy (Crotone), Bay of Naples, Adriatic Sea, Malta.
Pleistocene: Rhodes.
Pliocene: Spain (Mezquitilla, Cerro de San Antón), Italy (Rio Riorzo near Castell'Arquato), Crete, Karpathos, Rhodes.
Miocene: Gavdos, Crete.

Ecology: Shallow marine, near-shore environment (Bonaduce *et al.,* 1975). Müller (1894) found it among calcareous algae, and to be rare in the Bay of Naples.

Genus ACANTHOCYTHEREIS Skogsberg, 1928

Acanthocythereis ascoli (Puri, 1963)
Plate 3, Fig. 7

1894 *Cythereis ornata,* Müller, p. 369, pl. 29, fig. 20; pl. 31, fig. 13; pl. 36, fig. 18 (nec *Cypridina ornata* Bosquet, 1847).
1953 *Cythereis ornata* Müller.–Ruggieri, p. 66, pl. 1, fig. 1.
1963 *Acanthocythereis ascoli* Puri, p. 5 (new name).
1975 *Acanthocythereis ascoli* (Puri). – Bonaduce, Ciampo, and Masoli, p. 48, pl. 27, figs. 8–12.

Remarks: This species differs from *A. hystrix* in being narrower, and in having an evenly rounded anterior margin.

Dimensions: Length = 0.94 mm, height = 0.42 mm, breadth = 0.22 mm (figured right valve).
Material: Two valves.
Age: Early Pliocene to Recent.
Distribution:
Recent: Bay of Naples, Adriatic Sea.
Pleistocene: Italy (Crotone).
Pliocene: Spain (Mezquitilla).

Ecology: Shallow marine environment; lives on calcareous algae (Müller, 1894). In the Adriatic Sea it was found to range from the near-shore to a depth of 120 m (Bonaduce *et al.,* 1975). It is rare.

Acanthocythereis hystrix (Reuss, 1850)
Plate 3, Figs. 8–10

1850 *Cypridinia hystrix,* Reuss, p. 74, pl. 10, figs. 6a–c.
1953 *Cythereis hystrix* (Reuss), Ruggieri, p. 65, pl. 1, fig. 2.
1962 *Trachyleberis (T.) hystrix* (Reuss), Ruggieri, p. 18, pl. 1, fig. 21.
1969 *Trachyleberis hystrix* (Reuss), Uliczny, p. 104.
1972 *Acanthocythereis hystrix* (Reuss), Sissingh, p. 92.
1975 *Acanthocythereis hystrix* (Reuss), Bonaduce, Ciampo, and Masoli, p. 48.
1976 *Acanthocythereis hystrix* (Reuss), Breman, p. 56, pl. 7, fig. 102.
1979 *Acanthocythereis hystrix* (Reuss), Athersuch in: Stereo-Atlas 6 (2): 133–140.

Description: The carapace is elongate subrectangular in lateral view, the anterior margin is broadly rounded, the posterior margin obliquely outlined. The dorsal and ventral margins are almost straight, but the former margin may, in right valves, be slightly concave (Plate 3, Fig. 9). Breman's (1976), pl. 7, Fig. 102 suggests that the dorsal and ventral margins converge more markedly than in the present material. Such a development may be a normal ecologically controlled morphological reaction (cf. Clark, 1976) The valve-surface is coarsely sculptured and reticulate with long spines and papillae. The prominent eye-tubercle is surrounded by spines. The reticulation pattern mentioned by Sissingh (1972, p. 92) is present in our material. A right hinge is figured in Plate 3, Fig. 10.

Dimensions: Length = 0.90 mm, height = 0.48 mm, breadth = 0.20 mm (left valve).
Material: More than 100 valves.
Age: Middle Miocene to Recent.
Distribution:
Recent and Holocene: Aegean Sea, Adriatic Sea, Italy, Cyprus, NW Africa.

Pleistocene: Rhodes.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar, Las Palmares, Valle Niza), Italy, Greece (Kefallinia, Karpathos, Crete, Rhodes).
Miocene: Sicily (Enna), Gavdos, Crete.

Remarks: This species has also been reported from the Miocene of Czechoslovakia and Austria. It is one of the more abundant and widely distributed species in our collection.

Ecology: Shallow marine (neritic and littoral), eubathyal. Bonaduce *et al.* (1975, p. 48) recorded the species from between 125 and 170 m. in the Adriatic. Stated to prefer fine sand and very sandy pelite. A naticid drill-hole was seen in one specimen from Almayate.

Subfamily TRACHYLEBERIDINAE
Sylvester–Bradley, 1948
Tribe COSTAINI Hartmann and Puri, 1974
Genus CARINOCYTHEREIS Ruggieri, 1956

Carinocythereis antiquata (Baird, 1850)
Plate 5, Figs. 4–6

1850 *Cythereis antiquata,* Baird, p. 176, pl. 20, fig. 2.
1894 *Cythereis antiquata* Baird.–Müller, 374, pl. 29, fig. 18, 28; pl. 31, figs. 1, 5, 6.
1950 *Favella (?) antiquata* (Baird), Ruggieri, p. 23, pl. 1, fig. 1.
1972 *Carinocythereis antiquata* (Baird), Sissingh, p. 97, pl. 6, fig. 10.
1972 *Carinocythereis antiquata antiquata* (Baird), Uffenorde, p. 70, pl. 7, fig. 7.
1975 *Carinocythereis antiquata* (Baird), Bonaduce, Ciampo, and Masoli, p. 49, pl. 25, figs. 8–10.
1976 *Carinocythereis antiquata antiquata* (Baird), Breman, p. 57, pl. 7, fig. 103.

Remarks: The characteristics of this species are the surface ornament of dispersed pustules and the thin longitudinal ridges. The prominent eye-tubercle is a further feature of note. Bonaduce *et al.* (1975, p. 49) consider *C. antiquata* to display ornamental polymorphism. The present material is insufficient to assist in resolving this question.

Dimensions: Length = 0.88 mm, height = 0.45 mm, breadth = 0.24 mm (left valve).
Material: 19 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Limski Channel.
Pleistocen: Rhodes.
Pliocene: Spain (Almayate, Mezquitilla), Italy, Rhodes.

Remarks: This species was originally described from the Isle of Skye, Scotland, and has a wide distribution.

Ecology: Shallow marine (epi-neritic, infra-neritic), depth around 70 m in the Adriatic Sea. Stated to prefer medium and fine sand. Müller (1894, p. 375) referred to seaweed, algae and detritus as substrates on which the species was found. Naticid drill-holes occur only in juveniles. This observation is worthy of further study on suitable material as it could be of palaeoethological significance in relation to postulated growth-stage correlated migration in some species of ostracods (cf. Reyment *et al.*, 1987).

Carinocythereis carinata (Roemer, 1838)
Plate 5, Figs. 3, 7; Plate 12, Fig. 12

1838 *Cytherina carinata,* Roemer, p. 518, pl. 5, fig. 28.
1956 *Carinocythereis carinata* (Roemer), Ruggieri, p. 165, text-fig. 1.
1962 *Carinocythereis carinata* (Roemer), Ruggieri, p. 32, pl. 3, fig. 8, 9.
1969 *Carinocythereis carinata* (Roemer), Uliczny, p. 76, pl. 16, fig. 6; pl. 18, fig. 6.
1969 *Carinocythereis antiquata* (Baird), Uliczny, p. 73, pl. 4, figs. 9–10; pl. 16, fig. 5.
1969 *Carinocythereis carinata* (Roemer), Yassini, p. 50.
1972 *Carinocythereis carinata* (Roemer), Sissingh, p. 98, pl. 6, fig. 12.
1972 *Carinocythereis antiquata* (Baird), Uffenorde, p. 72.
1976 *Carinocythereis carinata* (Roemer), Breman, p. 57, pl. 7, fig. 105.
1979 *Carinocythereis carinata* (Roemer), Ruggieri & Russo, p. 30, pl. 2, fig. 8, text-figs. 1, 2.
1985 *Carinocythereis carinata* (Roemer), Stambolidis, p. 199, pl. 2, figs. 6–7.

Description: The carapace is elongate to subrectangular in lateral view. The dorsal and ventral margins are almost straight, and there is a prominent eye-tubercle. The anterior end is broadly rounded, the posterior end subtriangular and compressed, bearing four to five prominent spines. The valve-surface is heavily calcified and ornamented with four "knotty" longitudinal ridges which are sometimes interrupted, and occasionaly perforated. A comparison among the specimens available indicates great variability in the lateral ornamentation, which seems to result from polymorphism, a question requiring the detailed analysis of large samples for its resolution. This type of polymorphism is possibly ecophenotypic nature, analogous to that described by Ducasse & Cirac (1981) and Reyment (1985).

Dimensions: Length = 0.90 mm, height = 0.48 mm, breadth = 0.25 mm (left valve).
Material: About 200 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Mediterranean Sea in general.
Pleistocene: Italy, Rhodes, Crete.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Las Palmares, Valle Niza), Italy (Castell'Arquato, Piacenza), Greece (Karpathos, Rhodes, Crete).
Miocene: Sicily, Crete.

Remarks: This species has also been reported from the Atlantic, and Indo-Pacific regions.

Ecology: Benthonic; shallow marine (epi-neritic, infra-neritic) Yassini (1969, p. 51) reported this species from depths ranging between 40 to 200 m and 35 ‰ salinity. It lives on sandy bottoms with some admixed mud. Naticid drill-holes occurs rarely and only in juveniles. (see note on p. 57 above for *C. antiquata*).

Genus CISTACYTHEREIS Uliczny, 1969

Cistacythereis pokornyi (Ruggieri, 1962)
Plate 7, Fig. 9

1962 *Cistacythereis pokornyi,* Ruggieri, p. 32, pl. 4, figs. 1–4.
1969 *Cistacythereis pokornyi hellenica,* Uliczny, p. 85, pl. 7, figs. 1, 2; pl. 16, fig. 10.
1972 *Cistacythereis* sp. cf. *C. pokornyi hellenica* Uliczny.—Sissingh, p. 99, pl. 7, fig. 2.
1981 *Cistacythereis pokornyi* (Ruggieri), Doruk in: Stereo-Atlas 8 (1): 71–74.
1985 *Cistacythereis pokornyi* (Ruggieri), Stambolidis, p. 202, pl. 3, figs. 7–8.

Remarks: I have only one carapace at my disposal. It is characterized by being coarsely ornamented. It corresponds well with the description of Ruggieri (1962).

Dimensions: Length = 0.75 mm, height = 0.38 mm, breadth = 0.26 mm (carapace).
Age: Late Miocene to Recent.
Distribution:
Sub-Recent: Greece (Evros-Delta).
Pleistocene: Crete.
Pliocene: Spain (Mezquitilla), Italy, Greece, Cyprus.
Miocene: Italy.

Ecology: Shallow marine; Stambolidis (1985) found isolated valves in the Evros-Delta at depths between 3.5–12.5 m and in salinities between 36–39 ‰.

Genus COSTA Neviani, 1928

Costa batei (Brady, 1866)
Plate 5, Figs. 12–15

1866 *Cythereis batei,* Brady, p. 384, pl. 60, fig. 8, a–d.
1894 *Cythereis hamata,* Müller, p. 373, pl. 29, fig. 19, pl. 31, figs. 14–16.
1952 *Rectotrachyleberis hamata* (Müller), Ruggieri, p. 96.
1953 *Cythereis batei* (Brady), Ruggieri, p. 67, pl. 1, figs. 4, 4a.
1972 *Costa batei batei* (Brady), Sissingh, p. 100, pl. 7, fig. 3.
1973 *Costa batei* (Brady), Doruk in: Stereo-Atlas 1(4): 249–252.
1975 *Costa batei* (Brady), Bonaduce, Ciampo, and Masoli, p. 51, pl. 7, fig. 3.

Description: The carapace is subrectangular in lateral view, the valves are laterally compressed anteriorly and posteriorly in dorsal aspect. The anterior and posterior marginal denticulations are prominent, and can be seen to be in a double row if viewed in ventral aspect (Plate 5, Fig. 14). The valve-surface has three longitudinal costae, lined by breached reticulations; the intercostal zones are smooth. The males are longer than the females.

Remarks: Ruggieri (1952) designated *Cythereis hamata* as the type species of the genus *Rectotrachyleberis,* and considered *Rectotrachyleberis* as a junior synonym of *Costa.* Van Morkhoven (1963, p. 200) claimed a subgeneric distinction to apply, as the degree of reticulation is variable, even within species, and suggested retaining *Rectotrachyleberis* as a valid subgenus of *Costa* (see Doruk, 1973, p. 249). Sissingh (1972, p. 100) did not retain this subgenus because it is only based on the nature of the lateral ornamentation, a labile feature. For further discussion see Ruggieri (1952); Van Morkhoven (1963); Sissingh (1972) and Doruk (1973). I prefer to adhere to Ruggieri's and Doruk's position by regarding *Rectotrachyleberis* as a synonym of *Costa.*

Dimensions: Length = 0.87 mm, height = 0.45 mm, breadth = 0.22 mm (right valve).
Material: More than 250 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Tyrrhenian sea, Monaco, Turkey, Levant.
Pleistocene: Rhodes, Turkey.

Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar, Valle Niza), Karpathos, Rhodes, Turkey.
Miocene: Turkey.

Ecology: Benthonic, shallow marine (neritic and littoral), environment. Lives among calcareous algae, occasionally on other algae (Müller, 1894, p. 373) Naticid drill-holes occur in 12.9 % of the specimens from Almayate (see Fig. 23: 1), thus indicating that the interstitial environment is also inhabited.

Costa aff. *batei* (Brady, 1866)
Plate 5, Fig. 16

Description: The carapace is subrectangular in lateral view, the valves are laterally compressed anteriorly and posteriorly, the surface has three longitudinal ridges, almost identical with those of *Costa batei* Brady in general appearance. It differs from *C. batei* in having a longer caudal process which is situated subcentrally to subventrally. This species is rather long and broad. I have only one carapace at my disposal, therefore I could not investigate the question of infra-specific variation.

Dimensions: Length = 1.03 mm, height = 0.50 mm, breadth = 0.22 mm (figured carapace).
Material: One carapace.
Age: Early Pliocene.
Occurrence: Peñon de Almayate.

Costa edwardsii (Roemer, 1838)
Plate 6, Fig. 4

1838 *Cytherina edwardsii,* Roemer, p. 518, pl. 6, fig. 27.
1950 *Trachyleberis edwardsii* (Roemer), Ruggieri, p. 15, text-fig. 4.
1961 *Costa edwardsii edwardsii* (Roemer), Ruggieri, p. 3, pl. 8, figs. 1–5, text-fig. 1.
1969 *Costa edwardsii edwardsii* (Roemer), Uliczny, p. 87.
1972 *Costa edwardsii* (Roemer), Sissingh, p. 100, pl. 7, fig. 4.
1973 *Costa edwardsii* (Roemer), Doruk in: Stereo-Atlas 1 (4): 245–248.
1975 *Costa edwardsii* (Roemer), Bonaduce, Ciampo, and Masoli, p. 51.

Remarks: The taxonomic status of this species is somewhat in doubt. As noted by Ruggieri (1961, p. 4), it was founded on fossil specimens (Roemer, 1831), with a summary diagnosis and poorly figured, and subsequently provided with a "neotype" by Ruggieri (1950). The present material was compared with the neotype.

Dimensions: Length = 0.80 mm, height = 0.42 mm, breadth = 0.20 mm (figured right valve).
Material: One valve.
Age: Late Miocene to Recent.
Distribution:
Holocene: Adriatic Sea, Aegean Sea, Levant.
Pleistocene: France, Sicily (Palermo), Turkey.
Pliocene: Spain (Almayate), Crete, Turkey.
Miocene: Gavdos, Crete.

Ecology: Benthonic; shallow marine. Bonaduce *et al.* (1975, p. 52) refer to an optimum depth-range of 70–125 m, but also noted occurrences at a depth of 25 m (Naples) and 45 m (Adriatic). Stated to prefer medium sand and fine sand, to silty bottoms. Ruggieri (1961, p. 5) considered it to live at "moderate" depths.

Costa punctatissima Ruggieri, 1961
Plate 5, Figs. 8–11

1961 *Costa punctatissima,* Ruggieri, p. 7, pl. 8, figs. 10–12.
1961 *Costa* sp. aff. *punctatissima* Ruggieri, p. 8, fig. 14.
1969 *Costa punctatissima punctatissima* Ruggieri. – Uliczny, p. 88, pl. 7, fig. 3.
1969 *Costa punctatissima samiensis* n. ssp. Uliczny, p. 89; pl. 7, fig. 4; pl. 17, fig. 1.
1972 *Costa punctatissima punctatissima* Ruggieri. – Sissingh, p. 101, pl. 7, fig. 5.
1973 *Costa punctatissima* Ruggieri.–Doruk in: Stereo-Atlas, 1 (4): 253–256.

Description: The carapace is typically costate; it is subtrapezoidal in lateral view and is characterized by the entire surface being reticulated. There are fossae between the dorsal, median, and ventral costae. There is obvious sculptural polymorphism in, for example, the ribbing. A left hinge is illustrated in Plate 5, Fig. 11.

Dimensions: Length = 0.80 mm, height = 0.42 mm, breadth = 0.20 mm (right valve).
Material: 90 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Aegean Sea.
Pleistocene: Italy, Greece (Crete), Turkey, Cyprus.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Rio Guadalminar), Italy (Castell'Arquato, the original record), Greece (Crete), Turkey, Cyprus.

Ecology: Benthonic; shallow marine (neritic and littoral). Naticid drill-holes occur in 2.4 % of the specimens from Almayate (see Fig. 23: 3).

Costa reymenti sp. nov.
Plate 6, Figs. 1–3.

Derivatio nominis: named in honour of Prof. R.A. Reyment.
Holotype: The specimen figured in Plate, 6, Fig. 1, No. PMSp450.
Paratypes: 85 valves.
Type locality: Almayate, southern Spain.
Age: Early Pliocene.

Diagnosis: Broadly rounded anterior margin, weak costal ridges, absence of reticulation in the intercostal zones. Holamphidont hinge.

Description: The anterior margin is broadly rounded, with prominent marginal denticulations (Plate 6, Fig. 2); the posterior margin is obtuse and projected posteroventrally with prominent denticulations on the posteroventral margin. The valves are laterally compressed anteriorly and posteriorly, and almost parallel in outline. Maximum height at the prominent anterior cardinal angle. Dorsal and ventral margins nearly straight and converging towards the obtuse posterior end. The surface is smooth and ornamented with three, weak longitudinal costate ridges, proceeding gently towards the anterior end. This species can be distinguished from other species of *Costa* by the broadly rounded anterior margin, and the relatively weakly pronounced longitudinal ridges where the intercostal zones are smooth. The left valve is slightly larger than the right valve.

Sexual dimorphism: Males are longer than females.

Dimensions: Length = 1.14 mm, height = 0.55 mm, breadth = 0.20 mm (male left valve).
Material: 86 valves.
Age: Early Pliocene.
Occurrence: Peñon de Almayate, Mezquitilla, Valle Niza, southern Spain.

Ecology: Benthonic; shallow marine. Naticid drillholes occur in 10.4 % of the shells from the Peñon de Almayate (see Fig. 23: 2).

Genus HILTERMANNICYTHERE Bassiouni, 1970

Hiltermannicythere emaciata (Brady, 1866)
Plate 6, Fig. 10

1866 *Cythere emaciata,* Brady, p. 210.
1868 *Cythere emaciata* Brady.–Brady, p. 414, pl. 31, figs. 31–37, (non fig. 35).
1969 *Falunia emaciata* (Brady).–Uliczny, p. 95, pl. 8, figs. 3, 4; pl. 17, fig. 5.

Description: The carapace is quadrangular in lateral view. The dorsal and ventral margins are almost straight. The valve-surface is reticulate, with longitudinal ridges interrupted by fine reticulations.

Dimensions: Length = 0.89 mm, height 0.45 mm, breadth = 0.20 mm (figured right valve).
Material: One valve.
Age: Early Pliocene to Recent.
Distribution:
Pliocene: Spain (Almayate), Greece (Kefallinia).

Remarks: This species has also been reported from the Holocene of Shetland, Peterhead, Ormeshead, Hebrides, Aberdeenshire, Northumberland, Durham, Roundstone, Baltimore and Galway (Brady, 1868). It is a present-day inhabitant of British waters (Graham Coles, personal communication).

Ecology: Benthonic; marine.

Hiltermannicythere quadridentata (Baird, 1850)
Plate 6, Fig. 5.

1850 *Cythere quadridentata,* Baird, p. 173, pl. 21, fig. 2.
1868 *Cythere quadridentata* Baird.– Brady, p. 413, pl. 31, figs. 19–22. (*non* figs. 23–27).
1969 *Falunia quadridentata* (Baird), Uliczny, p. 97, pl. 8, fig. 5; pl. 17, fig. 6.
1972 *Falunia (Hiltermannicythere) quadridentata* (Baird), Sissingh, p. 106, pl. 7, fig. 16.

Description: The carapace is subquadrangular in lateral view. The anterior margin is broadly rounded with 14 marginal denticulations. The posterior end is bluntly triangular with four prominent spines. The dorsal margin is almost straight, the ventral margin slightly convex. The valve-surface is reticulate, with superimposed longitudinal ridges. The median and ventral ridges are almost parallel and unite at the broadly rounded anterior ridge. The intercoastal areas are pitted. A right hinge is shown in Plate 6, Fig. 5.

Remarks: The present specimens differ from those figured by Neale (1974) as *Celtia quadridentata* in the greater strength of the ornament, but is otherwise similar.

Dimensions: Length = 0.95 mm, height = 0.48 mm, breadth = 0.20 mm (figured right valve).
Material: 75 valves.
Age: Early Pliocene to Recent.
Distribution:
Pliocene: Spain (Almayate), Karpathos, Kefallinia, Crete.

Outside the Mediterranean, this species occurs in the coastal zones of Northumberland and Durham, Ormeshead, Oban, Shetland Islands and the Hebrides. Brady (1868) recorded this species from the "Glacial" of Scotland.

Ecology: Shallow marine; coastal zones. Brady (1868, p. 414) found it to be rare in deep water and gave depths between 45–80 m on the coasts of Northumberland and Durham.

Hiltermannicythere retifastigata (Jones, 1856)
Plate 6, Figs. 6, 7

*1856 *Cythere retifastigata,* Jones, p. 36, pl. 3, fig. 7.
1894 *Cythere rubra,* Müller, p. 372, pl. 28, figs. 21, 26.
1969 *Falunia retifastigata* (Jones), Uliczny, p. 98, pl. 5, fig. 9.
1972 *Falunia (Hiltermannicythere) retifastigata* (Jones), Sissingh, p. 106, pl. 5, figs. 17, 18.

Description: The carapace is elongate in lateral view. The anterior margin is evenly rounded, the posterior margin is tapered. The valve surface is ornamented with three, weak longitudinal ridges; the intercoastal areas are reticulated and pitted. The central posterior and posteroventral surfaces bear denticulations.

Dimensions: Length = 0.95 mm, height = 0.52 mm, breadth = 0.22 mm (left valve).
Material: 90 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic, Ionian, Aegean Sea, Tunisian Coast.
Pleistocene: Rhodes, Crete.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar, Las Palmares, Valle Niza), Greece (Kefallinia, Karpathos, Rhodes, Crete).

Remarks: This species has been reported from the "Suffolk Crag" (= Pliocene) of England. It is one of the more widely distributed species in the Spanish Pliocene.

Ecology: Marine. One adult specimen in the present collection from Almayate has a naticid drillhole (see Fig. 25: 7).

Hiltermannicythere rugosa (Costa, 1853)
Plate 7, Fig. 4

*1853 *Cythere rugosa,* Costa, p. 184, pl. 16, fig. 12.
1969 *Falunia rugosa* (Costa), Uliczny, p. 100, pl. 8, figs. 6, 7, pl. 17, figs. 7, 8.
1972 *Falunia (Hiltermannicythere) rugosa* (Costa), Sissingh, p. 106, pl. 7, fig, 19.
1979 *Hiltermannicythere rugosa* (Costa), Bassiouni, p. 138, pl. 17, figs. 13–15.

Description: The carapace is subrectangular in lateral view. The anterior margin is evenly rounded with marginal denticulations. The posterior margin is obtuse with four marginal spines. The dorsal margin is almost straight, the ventral margin sinuous. The valve-surface is reticulate and ornamented with faint longitudinal ridges. The anterocentral region has a network reticulational pattern. The shell is heavily calcified.

Dimensions: Length = 0.63 mm, height = 0.31 mm, breadth = 0.12 mm (figured right valve).
Material: One valve.
Age: Early Pliocene to Holocene.
Distribution:
Holocene: Italy.
Pleistocene: Greece.
Pliocene: Spain (Rio Guadalminar), Greece (Kefallinia, Crete), Turkey.

Hiltermannicythethere sphaerulolineata (Jones, 1856)
Plate 23, Figs. 6, 7

*1856 *Cythere sphaerulolineata,* Jones, p. 36, pl. 3, fig. 6.
1972 *Falunia (Falunia) sphaerulolineata* (Jones), Sissingh, p. 104, pl. 7, fig. 13.

Description: The carapace is pear-shaped, subrectangular in lateral view. The anterior margin is broadly rounded with marginal tubercles. The posterior margin is truncate and upturned dorsally. The dorsal margin is straight. The ventral margin is sinuous. The valve-surface is pitted and ornamented with weakly developed longitudinal ridges. The living individuals from Torre del Mar are more fragile than those from the Early Pliocene of Rio Guadalminar.

Dimensions: Length = 0.48–0.79 mm, height = 0.25–0.43 mm, breadth = 0.13–0.18 mm (left valves).
Material: 13 valves.
Age: Late Miocene to Recent.
Distribution:
Recent: Spain (Torre del Mar).
Pleistocene: Rhodes.
Pliocene: Spain (Rio Guadalminar, Mezquitilla), Rhodes, Crete.
Miocene: France (Rhône Basin).

Remarks: Jones (1856) recorded the species from the Pliocene Suffolk Crag, England.

Ecology: Shallow marine, near-shore environment. At Torre del Mar this species was collected living at depths of 10 to 12 m.

Hiltermannicythere stellata (Capeder, 1902)
Plate 7, Fig. 3.

1902 *Cytheridea stellata*, Capeder, p. 17, pl. 1, figs. 32a, 32b.
1967 *Falunia stellata stellata* (Capeder), Ruggieri, p. 358, pl. 37, fig. 1, text-figs. 10, 11.

Description: The carapace is subrectangular in lateral view. The anterior margin is broadly rounded and provided with antero-ventral denticulations in its central zone. The posterior margin is truncate, with a short caudal process ornamented with four terminally located denticles. The dorsal margin is almost straight, the ventral margin slightly sinuous. The valve-surface is pitted and ornamented with central-posterior, short, ridges, and a main longitudinal ventral ridge.

Dimensions: Length = 0.58 mm, height = 0.36 mm, breadth = 0.13 mm (figured left valve).
Material: One valve.
Age: Late Miocene to Early Pliocene.
Distribution:
Pliocene: Spain (Rio Guadalminar).
Miocene: Italy (Scrivia, S. Leo).

Hiltermannicythere turbida (Müller, 1894)
Plate 6, Figs. 8, 9

1894 *Cythereis turbida*, Müller, p. 371, pl. 28, figs. 22, 27.
1969 *Falunia turbida* (Müller), Uliczny, p. 101, pl. 9, fig. 1; pl. 17, fig. 9.
1972 *Falunia (Hiltermannicythere) turbida* (Müller), Uffenorde, p. 73, figs. 26, 27; pl. 7, fig. 10; pl. 8, fig. 1.
1975 *Hiltermannicythere turbida* (Müller), Bonaduce, Ciampo, and Masoli, p. 49, pl. 24, figs. 7–9.
1976 *Hiltermannicythere turbida* (Müller), Breman, p. 58, pl. 7, fig. 107.

Remarks: Uffenorde's (1972, p. 75) description makes it apparent that this species is highly polymorphic. The restricted material available in this study does not add anything new to Uffenorde's observations.

Dimensions: Length = 0.75 mm, height = 0.35 mm, breadth = 0.13 mm (right valve).
Material: Four valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Along the Tunisian coast, Bay of Naples, Adriatic Sea, Limski Channel.
Pliocene: Spain (Almayate, Mezquitilla, Limonar), Greece.
This species has also been reported from the Bay of Biscay.

Ecology: Benthonic; shallow marine (neritic, brackish-water environment). Lives on and among seaweed and algae. Said to prefer medium sand, frequent on very sandy pelite. Recorded depths range from 4–35 m in the Limski Channel (Uffenorde, 1972), down to 170 m; optimally 27–125 m, by Bonaduce *et al.* (1975, p. 50). Bonaduce *et al.* (1975, p. 50) observed the species to be very common in the Bay of Naples; it is very rare in the present collection from southern Spain.

Tribe *PTERYGOCYTHEREIDINI* Puri, 1957
Genus *PTERYGOCYTHEREIS* Blake, 1933

Pterygocythereis jonesii (Baird, 1850)
Plate 4, fig. 3

1850 *Cythereis jonesii*, Baird, p. 175, pl. 20, fig. 1.
1868 *Cythere jonesii* (Baird), Brady, p. 418, pl. 30, figs. 13–16.
1928 *Cythereis jonesi* Baird.– Sars, p. 196, pl. 91.
1950 *Pterygocythereis jonesii* (Baird) *ceratoptera* (Bosquet), Ruggieri, p. 26, pl. 1, fig. 10.
1972 *Pterygocythereis (Pterygocythereis) jonesii* (Baird), Sissingh, p. 111, pl. 8, fig. 2.
1972 *Pterygocythereis jonesii* (Baird), Uffenorde, p. 75, pl. 12, fig. 6.
1975 *Pterygocythereis jonesi* (Baird), Bonaduce, Ciampo, and Masoli, p. 54, pl. 29, figs. 1–11.
1976 *Pterygocythereis (Pterygocythereis) jonesii* (Baird), Breman, p. 59, pl. 8, fig. 109.
1978 *Pterygocythereis jonesii* (Baird), Atersuch in: Stereo-Atlas 5 (2): 9–16.
1981 *Pterygocythereis jonesii* (Baird), Mostafawi, p. 149, pl. 7, figs. 4–5.
1985 *Pterygocythereis jonesii* (Baird), Stambolidis, p. 207, pl. 4, figs. 8–9.

Description: The carapace is compressed anteriorly, arrow-shaped in dorsal view, subquadrangular in lateral view. The anterior margin is broadly rounded. The posterior margin is obtusely rounded, denticulated and spinose. The dorsal margin is almost straight, with dorsal ridge-spines. The ventral margin is sinuous. The left valve has an alar prolongation in the ventrolateral region. The shell surface is smooth and ornamented with spines and tubercles mainly in the antero-central regions. The eye tubercle is prominent.

Dimensions: Length = 1.03 mm, height = 0.56 mm, breadth = 0.26 mm (figured left valve).
Material: 3 valves.
Age: Early Pliocene to Recent.

Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Limski Channel, Aegean Sea, Evros-Delta, Cyprus, Levant.
Pleistocene: Algeria, Italy, Rhodes.
Pliocene: Algeria, Spain (Cerro de San Antón), Italy, Rhodes, Karpathos, Crete.

Remarks: This species has a broad geographical distribution outside the Mediterranean. Baird (1850) reported it from the Holocene (sub-Recent) of Great Britain. Sars (1928) collected the species alive in the Christiana Fjord, and on the south and west coasts of Norway.

Ecology: Shallow marine. Bonaduce *et al.* (1975) recorded the depth range in the Adriatic Sea, with the optimum between 80 and 170 m., and to be common on medium and fine sand, very sandy pelite and sandy silt, but rare on silt and silty pelite. Brady (1868) mentioned a depth range of 3.5 to 110 metres off the British Isles. Sars (1928) gave depths in the Christiana Fjord of 55 to 90 m on muddy bottoms. Elofson (1941, p. 302) reported depth-ranges in the Gullmarfjord of between 14 to 70 m, Väderöarna 130 m, Koster 25 to 200 m, Oslofjord 55 to 90 m and Skagerrak between 35 to 150 m.

Ptergocythereis siveteri Athersuch, 1978
Plate 4, Fig. 2

1894 *Cythereis jonesii,* (Baird), Müller, p. 375, pl. 29, figs. 23, 25; pl. 31, figs. 23, 24.
1972 *Pterygocythereis (Pterygocythereis) ceratoptera* (Bosquet), Sissingh, p. 111, pl. 8, fig. 1.
1975 *Pterygocythereis ceratoptera* (Bosquet), Bonaduce, Ciampo, and Masoli, p. 53, pl. 30, figs. 1–9.
1978 *Pterygocythereis siveteri* Athersuch in: Stereo-Atlas 5 (1): 1–8.

Description: The carapace is obtusely rectangular in lateral view, and arrow-shaped in dorsal view. The anterior end is broadly rounded with a single row of prominent spines. The posterior margin is angular, bearing six spines along the posteroventral corner. The alar prolongation on the valve-surface is wing-shaped and extended ventrolaterally. The surface is smooth. This species differs from *P. jonesii* by the V-shaped uppermost adductor muscle scar (Athersuch, 1978). The taxonomic status of *Pterygocythere* and *Pterygocythereis* has recently been reviewed by Babinot (1980) and Reyment (1984).

Dimensions: Length = 0.98 mm, height = 0.55 mm, breadth = 0.28 mm (left valve).
Material: 10 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Aegean Sea, Cyprus.
Pleistocene: Italy, Rhodes.
Pliocene: Spain (Almayate, Mezquitilla, Limonar), Italy, Rhodes.
Miocene: Gavdos, Crete.

Remarks: This species occurs living off Madeira, NW Scotland, North Sea, and in the Bay of Biscay, as well as in Holocene sediments off the Isle of Man.

Ecology: Benthonic; shallow marine (neritic), to fairly deep marine (infralittoral, circumlittoral, eurybathic). Optimally 80–170 m Bonaduce *et al.* (1975, p. 54). Lives on seaweed and algae (Müller, 1894). Stated to prefer fine sand and to be rare on silt (Bonaduce *et al.,* 1975). The Spanish occurrences derive from a shallow-water habitat.

Genus *LIXOURIA* Uliczny, 1969

Lixouria aquila Ruggieri, 1972
Plate 4, Fig. 1

1972 *Lixouria aquila,* Ruggieri, p. 102, text-figs. 3, 4, 6, 7.

Description: The carapace is ovate to subtriangular in lateral view. The anterior margin is obliquely and broadly rounded. The posterior margin is sharply rounded. The dorsal margin is straight, the ventral margin slightly sinuous. The anterior and posterior margins bear minute spines. The valves have a short prominent alar process. The valve-surface is smooth.

Dimensions: Length = 0.85 mm, height = 0.52 mm, breadth = 0.32 mm (figured left valve).
Material: 7 valves.
Age: Early Pliocene to Middle Pliocene.
Distribution:
Pliocene: Spain, (Almayate, Mezquitilla), Italy (Piacenza).

Ecology: Shallow marine. Naticid drill-holes occur in three valves out of five from Almayate, (see Fig. 24: 4). The ecological significance of gastropod predation in relation to depth is discussed in the section on predation (see p. 28).

Tribe *ECHINOCYTHERIDINI* Hazel, 1967
Genus *ECHINOCYTHEREIS* Puri, 1954

Echinocythereis scabra (von Muenster, 1830)
Plate 4, Figs. 5–10

*1830 *Cythere scabra,* von Muenster, p. 63.
1838 *Cytherina scabra* (von Muenster), Roemer, p. 516, pl. 6, fig. 9.
1866a *Cythere scabra* von Muenster.– Brady, p. 380, pl. 61, fig. 8, a–d.
1969 *Echinocythereis scabra* (von Muenster), Uliczny, p. 105.
1972 *Echinocythereis (Echinocythereis) scabra* (von Muenster), Sissingh, p. 102.
1973 *Echinocythereis scabra* (von Muenster), Moos, p. 29, pl. 1, figs. 1–12; pl. 2, figs. 1–2.
1981 *Echinocythereis scabra* (von Muenster), Uffenorde, p. 155, pl. 6, figs. 2–5.

Description: The carapace is subquadrate to subovate in lateral view. The dorsal margin is almost straight, the ventral margin sinuous and slightly convex in outline. The anterior end is broadly rounded, the posterior end obliquely rounded and projected mid-posteriorly. The valve-surface is ornamented with numerous small papillae which may or may not be arranged in concentric patterns. Details of the hinge are given in Plate 4, Figs. 9, 10.

Remarks: Moos (1973) revised *Echinocythereis* in the NW German Oligocene and in so doing, selected a neotype for *E. scabra.* Moos paid particular attention to the occurrence of a range of ornamental morphs in the species; for example, the appearance of individuals displaying a background pattern of reticulations among the papillae.

Reyment (1985) has given a detailed evolutionary analysis of the evolutionary significance of polymorphism in Eocene *Echinocythereis.*

Dimensions: Length = 1.05 mm, height = 0.55 mm, breadth = 0.25 mm (left valve).
Material: More than 400 valves.
Age: Eocene to Recent.
Distribution:
Recent and Holocene: Crete.
Pleistocene: Rhodes.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Valle Niza), Greece, Karpathos, Rhodes.
Miocene: Crete.

Remarks: E. scabra has been reported from the Upper Oligocene of Germany (Astrup) and from the Miocene of France (Bordeaux).

Ecology: Benthonic; deep marine (infra-neritic and bathyal) according to Van Morkhoven (1963, p. 171). However, in the present material from Almayate, predator drill-holes occur in 12.5 % of the specimens (see Fig. 22: 6) thus indicating a relatively shallow endobionthic environment. Fossil occurrences of this and other species of *Echinocythereis,* often seem to be linked to sediments of shallow-water origin.

Echinocythereis sp.
Plate 4, Fig. 4

Description: The shape is subovate to subrectangular in lateral view, with a broadly rounded anterior margin with prominent small spines; the shell is compressed in the anterior part. The dorsal margin is straight; the posterior margin has a rounded caudal process and is finely denticulate. The valve is tumid in the central region and reticulated with ovate circles. The valve-surface is smooth in the peripherical anterior part. This form could well be an instar of *Echinocythereis scabra.*

Dimensions: Length = 0.80 mm, height = 0.45 mm, breadth = 0.20 mm (left valve).
Material: 8 valves.
Age: Early Pliocene.
Occurrence: Peñon de Almayate, Mezquitilla, southern Spain.

Genus *HENRYHOWELLA* Puri, 1957

Henryhowella asperrima (Reuss, 1850)
Plate 5, Figs. 1, 2

1850 *Cypridina asperrima,* Reuss, p. 74, pl. 10, figs. 5a–b.
1962 *Henryhowella asperrima* (Reuss), Ruggieri, p. 18, pl. 1, figs. 16–19.
1969 *Henryhowella asperrima* (Reuss), Uliczny, p. 102, pl. 17, fig. 10.
1972 *Henryhowella asperrima asperrima* (Reuss), Sissingh, p. 107.
1976 *Henryhowella asperrima asperrima* (Reuss), Breman, p. 59, pl. 8, fig. 3.
1981 *Henryhowella asperrima* (Reuss), Uffenorde, p. 148, pl. 2, figs. 14–15, 17–19.

Description: The carapace is subovate to subrectangular in lateral view. The anterior margin is broadly rounded, the posterior margin subangular. The dorsal margin is straight, the ventral margin is slightly convex. The valve-surface has three flexed, longitudinal plications, and it is covered with numerous short and blunt spines superimposed on the reticulations. The spines are concentrically arranged around the subcentral tubercle.

Remarks: According to Ruggieri (1962, p. 19), this species displays a wide range of variation in both ornament and shape and there are two adult morphs: (a) a small form, and (b) a large form, could be distinguished. Uffenorde (1981, p. 148) was, however, unable to substantiate such a relationship in his Oligocene material; he did, however, record a certain change in shape from Upper Oligocene to Upper Miocene, which could have evolutionary significance.

Dimensions: Length = 0.72 mm, height = 0.38 mm, breadth = 0.14 mm (left valve).
Material: 8 valves.
Age: Late Eocene to Recent.
Distribution:
Holocene: Adriatic Sea.
Pleistocene: Rhodes.
Pliocene: Spain (Almayate), S-E France, Karpathos, Kefallinia, Rhodes, Crete.
Miocene: Sicily (Enna), Gavdos, Crete.

Remarks: This species has been reported from the Eocene and Lower Pliocene of Central America (Ruggieri, 1962, p. 20).

Ecology: Benthonic; shallow marine (infra-neritic, infra-littoral, circalittoral) and deep marine (bathyal, abyssal). No soft parts have yet been described.

Subfamily *BUNTONIINAE* Apostolescu, 1961
Genus *BUNTONIA* Howe, 1935
Subgenus *BUNTONIA* Howe, 1935

Buntonia (Buntonia) sublatissima dertonensis Ruggieri, 1954
Plate 13, Fig. 10

1954 *Buntonia sublatissima dertonensis,* Ruggieri, p. 565, figs. 25–26, 32, 33.
1972 *Buntonia (Buntonia) sublatissima dertonensis* Ruggieri.– Sissingh, p. 95, pl. 6, fig. 6.
1981 *Buntonia (Buntonia) sublatissima dertonensis* Ruggieri.– Uffenorde, p. 149, pl. 10, fig. 12.

Description: The carapace is pear-shaped. The anterior margin is broadly rounded. The dorsal margin is straight. The valve is tumid in the postero-ventral region. The surface is reticulated and provided with weak longitudinal ridges. The figured carapace is heavily calcified. The morphological criteria used for distinguishing this subspecies are doubtful (cf. Uffenorde, 1981, p. 149) and could well be an example of ecophenotypy, whereby the polymorphic condition is continuous in expression (cf. Carbonel & Pujos, 1982).

Dimensions: Length = 0.54 mm, height = 0.35 mm, breadth = 0.13 mm (figured left valve).
Material: two valves.
Age: Late Miocene to Early Pliocene.
Distribution:
Pliocene: Spain (Almayate).
Miocene: Italy (Romagna), Gavdos, Crete.

Remarks: This species has also been reported from the Upper Miocene of Germany. The rarity of *Buntonia* s. str. in our collection is rather surprising, considering its importance further to the east (e.g. Sicily).

Subgenus *RECTOBUNTONIA* Sissingh, 1972

Buntonia (Rectobuntonia) subulata Ruggieri, 1954
Plate 11, Fig. 2

1954 *Buntonia subulata,* Ruggieri, p. 568, figs. 34–37.
1972 *Buntonia (Rectobuntonia) subulata subulata* Ruggieri.– Sissingh, p. 97, pl. 6, fig. 89.
1976 *Buntonia subulata* Ruggieri.– Bonaduce, Pugliese, and Minichelli, p. 429, text-fig. 1, figs. 1a–g. Text-fig. 2, figs. 1–3.
1981 *Buntonia (Rectobuntonia) subulata subulata* Ruggieri.– Mostafawi, p. 152, pl. 7, figs. 6–7.
1982 *Buntonia subulata subulata* Ruggieri.– Carbonnel, p. 24, pl. 3, fig. 25.

Description: The carapace is ovate subrectangular in lateral view. The anterior margin is broadly rounded, the posterior margin sharply rounded, narrow, and upturned dorsally. The dorsal margin is slightly arched, the ventral margin sinuous. The valve-surface is faintly ornamented with concentric ribs which are best developed mainly in the anterior and posteroventral parts of the shell. The shell is heavily calcified.

Dimensions: Length = 0.52 mm, height = 0.32 mm, breadth = 0.15 mm (figured left valve).
Material: One left valve.
Age: Middle Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples.
Pleistocene: Italy, Rhodes.
Pliocene: Spain (Valle Niza), S-E France, Crete, Rhodes.
Miocene: Italy (Rimini), Crete.

Ecology: Shallow marine, near-shore species; Bonaduce *et al.* (1975) reported the species to be rare in the Bay of Naples at depths ranging between 25 to 90 m and to be most abundant between 65 to 90 m.

Tribe *LEGUMINOCYTHERINI* Howe, 1961
Genus *RUGGIERIA* Keij, 1957

Ruggieria, tetraptera (Seguenza, 1880)
Plate 6, Figs. 11–15; Plate 7, Fig. 1

*1880 *Cythere tetraptera,* Seguenza, p. 125, pl. 12, figs. 9, 9a.
1962 *Ruggieria tetraptera tetraptera* (Seguenza), Ruggieri, p. 47, pl. 5, figs. 11–13.
1964 *Ruggieria tetraptera tetraptera* (Seguenza), Dieci & Russo, p. 68, pl. 11, fig. 6.
1967 *Ruggieria tetraptera* (Seguenza), Ruggieri, p. 361, figs. 17–20.
1968 *Ruggieria tetraptera* (Seguenza), Uliczny, p. 110, pl. 9, figs. 5, 6; pl. 18, figs. 3, 4.
1972 *Ruggieria (Ruggieria) tetraptera tetraptera* (Seguenza), Sissingh, p. 112.

Description: The carapace is elongate subrectangular in lateral view. The anterior margin is irregularly rounded with marginal denticulations. The posterior has an extended upwardly directed caudal process with prominent denticles. The valve has an alar prolongation which ends with two spines. The valve-surface is smooth but with a superimposed median ridge and a short, weak ridge which runs parallel to the alar prolongation. A left hinge is illustrated in Plate, 6, Fig. 14.

Remarks: According to Ruggieri (1962, p. 47), *R. tetraptera* is very variable, especially with respect to the development of the median ridge. Comparing the appearance of our material with that figured by the above authors (synonymy), it seems that this species could well be highly polymorphic in different parts of the Mediterranean. The specimens from Almayate have a more prominent anterodorsal margin and a longer posterocaudal process than the Italian material.

Dimensions: Length = 1.03 mm, height = 0.55 mm, breadth = 0.28 mm (Male left valve).
Length = 0.98 mm, height = 0.48 mm, breadth = 0.21 mm (female left valve).
Material: More than 200 valves.
Age: Late Miocene to Early Pleistocene.
Distribution:
Pleistocene: Rhodes, Crete.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar, Las Palmares, Rio Guadalminar, Valle Niza), Italy (Romagna, Castell'Arquato), Greece (Kefallinia, Karpathos, Rhodes, Crete).
Miocene: Italy (Benestare), Malta, Greece (Gavdos, Crete).

Ecology: Shallow marine; Naticid drill-holes occur in 7.6 % of the Almayate material (see Fig. 24: 8), thus indicating a relatively shallow endobionthic environment. Russo & Bossio (1976) found the species in the Miocene of Malta in blue clay and greensands, indicating infra-littoral sediments.

Ruggieria tetraptera angustata (Seguenza, 1880)
Plate 7, Fig. 2

*1880 *Cythere tetraptera* var. *angustata,* Seguenza, p. 193.
*1880 *Cythere tetraptera* var. *dentata,* Seguenza, p. 193.
1960 *Ruggieria palpebralis,* Ruggieri, p. 4, pl. 1, figs. 3–5, pl. 2, figs. 13.
1962 *Ruggieria tetraptera angustata* (Seguenza), Ruggieri, p. 47, pl. 5, fig. 10.

Remarks: This is a subspecies of *Ruggeria tetraptera,* characterized by the presence of the accessory longitudinal ventral ridge.

Dimensions: Length = 1.00 mm, height = 0.52 mm, breadth = 0.28 mm (figured left valve).
Material: One valve, presumably a male.
Age: Early Miocene to Early Pliocene.
Distribution:
Pliocene: Spain (Rio Guadalminar), Italy, Sicily.
Miocene: Sicily.

Ecology: Presumed marine.

Tribe *BASSLERITINI* Puri, 1973
Genus *BASSLERITES* Howe, 1937

Basslerites berchoni (Brady, 1869)
Plate 7, Fig. 8

*1869 *Cythere berchoni,* Brady, p. 117, pl. 14, figs. 3–4.
1894 *Cythereis teres* (Brady), Müller, p. 379, pl. 29, figs. 6, 15.
1950 *Basslerites berchoni* (Brady), Ruggieri, p. 42, text-fig. 26.
1972 *Basslerites berchoni* (Brady), Sissingh, p. 122.
1981 *Basslerites berchoni* (Brady), Mostafawi, p. 152, pl. 4, figs. 13–14.
1982 *Basslerites berchoni* (Brady), Carbonnel, p. 23, pl. 3, fig. 3.

Remarks: The form referred here differs from the holotype by being larger. It is the only species of *Basslerites* s. str. occurring in our collection. *B. berchoni* occurs along the Atlantic coast of Britain.

Dimensions: Length = 0.62 mm, height = 0.34 mm, breadth = 0.20 mm (right valve).
Material: Two valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Aegean Sea, Egypt (Port Said).
Pleistocene: Italy (Calabria, Crotone), Rhodes.

Pliocene: Spain (Mezquitilla), SE France, Greece (Kos).

Ecology: Shallow marine. Lives on *Posidonia* (Müller, 1894). It has been found in salinities between 27–38 ‰ (Yassini, 1969, Barbeito-Gonzalez, 1971, Uffenorde, 1972).

FAMILY HEMICYTHERIDAE Puri, 1953
Subfamily *HEMICYTHERINAE* Puri, 1953
Tribe *HEMICYTHERINI* Puri, 1953
Genus *GRAPTOCYTHERE* Ruggieri, 1972

Graptocythere hscripta (Capeder, 1900)
Plate 8, Figs. 4–6

1900 *Cythere h-scripta,* Capeder, p. 61, pl. 1, fig. 1.
1953 *Hemicythere polyptica* (Reuss), Ruggieri, p. 92, pl. 6, fig. 61.
1969 *Pachycaudites h-scripta* (Capeder), Uliczny, p. 57, pl. 3, figs. 8, 9; pl. 15, fig. 2.
1972 *Graptocythere h-scripta* (Capeder), Ruggieri, p. 93, fig. 1.

Description: The carapace is subtriangular to subrectangular in lateral view, the anterior margin is well rounded, the dorsal margin weakly arched and the ventral margin convex. The posterior margin is almost irregularly concave, with a short, sharp posterodorsal edge, and a broad caudal process projected posteroventrally. The valve-surface is pitted and ornamented with broad, longitudinal ridges running from around the central region of the valve.

Remarks: The ornamentation of the present forms does not correspond well with the *Hemicythere polyptica* (Reuss) described by Ruggieri (1953, p. 92), although it agrees perfectly with the description of *P. hscripta* (Capeder) given by Uliczny (1969, p. 57), apart from minor variation shown by the ribs in the posterocentral region of the carapace. *P. ? hscripta* (Capeder) figured by Sissingh (1972, p. 125) is different in shape and ornament and is probably the same form as *Graptocythere* aff. *G. hscripta* (Capeder) figured by Bonaduce *et al.* (1975, p. 47, p. 17, fig. 17).

Dimensions: Length = 0.78 mm, height = 0.48 mm, breadth = 0.18 mm (left valve).
Material: 62 valves.
Age: Middle Miocene to Pliocene.
Distribution:
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Valle Niza), Italy, Kefallinia.
Miocene: Italy (Romagna).

This species was originally described from the Middle Miocene of the Vienna Basin (Reuss, 1850). It is one of the more widely distributed species in the Spanish Pliocene.

Ecology: Presumed shallow marine. Naticid drillholes occur frequently, amounting to 29.7 % of the specimens from Almayate (see Fig. 22: 2).

Genus *HETEROCYTHEREIS* Elofson, 1941
The collection contain only one species of *Heterocythereis* s. str.

Heterocythereis albomaculata (Baird, 1838)
Plate 8, Fig. 3; Plate 19, Fig. 4

1838 *Cythere albomaculata,* Baird, p. 142, pl. 5, fig. 23.
1973 *Heterocythereis albomaculata* (Baird), Sissingh, p. 37, pl. 1, fig. 8.
1975 *Heterocythereis albomaculata* (Baird), Bonaduce, Ciampo, and Masoli, p. 46, pl. 18, figs. 11, 12; pl. 21, figs. 8–11.

Remarks: The caudal process is well developed. The valve-surface is finely pitted, with light reticulae on the dorsal, anteromarginal and ventral ridges.

Dimensions: Length = 0.89 mm, height = 0.50 mm, breadth = 0.18 mm (right valve).
Material: 15 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Tarifa (this study), Along the African and eastern Mediterranean coasts and the Adriatic Sea.
Pleistocene: Italy (Santa Maria di Catanzaro).
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Las Palmares).

This species has a broad geographical distribution outside the Mediterranean and occurs in Great Britain, Ireland, Bay of Biscay, Skagerrak (Elofson, 1941) and probably off Madeira and Cabo Verde. Moyes (1965) recorded it from the Upper Miocene and Pliocene of the Aquitaine Basin.

Ecology: Shallow marine (epi-neritic, littoral infralittoral). Brackish-water euryhaline environment. Associated with vegetation. (sand and medium sand in the Adriatic Sea) according to Bonaduce *et al.* (1975). Elofson (1941, p. 293) recorded it form depths of between 5–30 m. Yassini (1969) found it in the Bay of Arcachon at depths of 3–8 m and in the Gulf of Gascony down to 28 m. *H. albomaculata* was collected at Tarifa and Rio Jara near to the place where the creek enters the sea.

Tribe AURILINI Puri, 1973
Genus MUTILUS Neviani, 1928

Mutilus elegantulus Ruggieri & Sylvester–Bradley, 1975
Plate 8, Figs. 7–9

*1878 *Cythere retiformis,* Terquem, p. 116, pl. 13, figs. 16a–d.
1956 *Mutilus (Mutilus) retiformis* (Terquem), Ruggieri, p. 169, figs. 2, 3.
1973 *Mutilus retiformis* (Terquem), Ruggieri & Sylvester–Bradley in: Stereo-Atlas 1 (2): 109–116.
1975 *Mutilus elegantulus,* Ruggieri & Sylvester–Bradley in: Stereo-Atlas 2 (4): 295.
1982 *Mutilus retiformis* (Terquem), Carbonnel, p. 43, pl. 6, fig. 9.

Description: The carapace is subquadrate, in lateral view, the anterior end is broadly rounded, the posterior truncate with a more or less well-developed posteroventral caudal prolongation. The lateral surface is coarsely reticulate with wide, deep polygonal pits. A left hinge is shown in Plate 8, Fig. 7.

Dimensions: Length = 0.79 mm, height = 0.47 mm, breadth = 0.17 mm (right valve).
Material: More than 300 valves.
Age: Early Pliocene to Early Pleistocene.
According to Pokorný (1958, p. 268) *M. retiformis* ranges from Pliocene to Recent.
Distribution:
Pleistocene: Greece (Rhodes).
Pliocene: Algeria, Spain (Almayate, Mezquitilla, Cerro de San Antón, Las Palmares, Valle Niza, Ampurdan), Sicily, Crete, Rhodes.

Ecology: Shallow-waters, Marine. Naticid drillholes occur in 2.5 % of the shells from Almayate (see Fig. 22: 3).

Genus AURILA Pokorný, 1955

Aurila cimbaeformis (Seguenza, 1882)
Plate 8, Figs. 10–13

*1882 *Cythere cimbaeformis,* Seguenza, p. 22, pl. 1, figs. 6a–d.
1950 *Hemicythere cimbaeformis* (Seguenza), Ruggieri, p. 38, pl. 1, fig. 2; text-fig. 22.
1969 *Mutilus cimbaeformis* (Seguenza), Uliczny, p. 52, pl. 14, fig. 7.
1973 *Mutilus cimbaeformis* (Seguenza), Doruk in: Stereo-Atlas 1 (22): 121–124.
1975 *Aurila cymbaeformis* (Seguenza), Bonaduce, Ciampo, and Masoli, p. 43, pl. 17, fig. 15.

Remarks: The carapace is ear-shaped to subquadrangular in lateral view, the anterior is broadly rounded, the posterior end obliquely truncated. The characteristic feature of this species is the ornament.

It is perhaps worthwhile keeping in mind that the ornamental characteristics used by Uliczny (1969, p. 52) for justifying the separation of his *Mutilus praeapulania* from the present species are of doubtful taxonomic significance, and have been identified as morphological variants at the infra-specific level by Hartmann (1982) in a Recent species of the genus from Australia. See also Ducasse (1981). The statistical analysis of 11 carapace characters shows that all the five samples studied from Almayate (see Aranki & Reyment, in press), are significantly different. The males are somewhat more elongated than the females.

Dimensions: Length = 0.71 mm, height = 0.48 mm, breadth = 0.20 mm (left valve).
Material: More than 2000 valves.
Age: Early Pliocene to ? Recent.
Distribution:
Holocene: Adriatic Sea, Italy.
Pleistocene: Italy, Greece, Cyprus, Turkey.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar, Valle Niza, Las Palmares, Rio Guadalminar), Italy, Greece, Cyprus, Turkey.

Ecology: Benthonic; presumed shallow marine (neritic and littoral). Predator holes in the Almayate material occur in 7.4 % of the specimens (see Fig. 22: 5).

Aurila convexa (Baird, 1850)
Plate 9, Figs. 1–6; Plate 17, Fig. 8

1850 *Cythere convexa,* Baird, p. 134, pl. 21, fig. 3.
1894 *Cythereis convexa* (Baird), Müller, p. 366, pl. 28, figs. 14, 19; pl 30, figs. 49–51; pl. 35, figs. 6, 13, 19.
1969 *Aurila convexa convexa* (Baird), Uliczny, p. 21, pl. 11, figs. 1, 2.
1971 *Aurila convexa* (Baird), Barbeito-Gonzalez, p. 277, pl. 11, figs. 1c–3c, pl. 46, figs. 9, 10.
1972 *Aurila convexa* (Baird), Uffenorde, p. 77, pl. 8, fig. 4.
1973 *Mutilus convexus* (Baird), Doruk in: Stereo-Atlas 1 (2): 129–136.
1975 *Aurila convexa* (Baird), Bonaduce, Ciampo, and Masoli, p. 43, pl. 21, figs. 1–7.
1982 *Aurila convexa* (Baird), Carbonnel, p. 19, pl. 2, figs. 1–11, 14.

Description: The carapace is ear-shaped in lateral view, the dorsal margin is convex, the ventral margin sinuous. The anterior end is broadly rounded, and the posterior end obliquely truncate. The posteroventral margin bears denticles. The valves are ornamented with small, reticulated pits, with opaque areas showing a consistent pattern. The surface ornamentation of this species shows considerable polymorphism, a characteristic property of the *Aurila – Mutilus* group. (cf. Hartmann (1982), Ducasse (1981), Carbonnel (1982). A right hinge is illustrated in Plate 9, Fig. 6.

Remarks: Carbonnel (1982, p. 19) recorded polymorphism in the reticular pattern of this species. Keyser (1982) has considered the sensory organs of *A. convexa,* a species known to have three kinds of pores. Whatley (1983) expressed the opinion that *A. convexa* is parthenogenetic outside the eastern Mediterranean, but without providing evidence for this view. The material studied here from the Pliocene of the western Mediterranean displays evidence of sexual dimorphism in the shell proportions.

Dimensions: Length = 0.75 mm, height = 0.50 mm, breadth = 0.20 mm (left valve).
Material: More than 12000 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea.
Pleistocene: Spain, Italy, Greece, Crete, Turkey.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar, Las Palmares, Valle Niza, Rio Guadalminar), Italy, Greece, Crete, Turkey.
Miocene: Italy, Cyprus, Italy.

A convexa occurs in the Atlantic and along the coast of Northern Europe. It was collected at Tarifa near the Strait of Gibraltar, and at Roscoff, on the west coast of France. It is the most abundantly occurring species in the collection.

Ecology: Shallow marine (tidal, neritic and littoral). Lives on *"Posidonies cymodoceés",* and tolerates salinities in excess of 26 ‰ (Müller, 1894). Reported from calcareous algae and sand schill by Yassini (1969, p. 43), see also Whatley & Wall (1975). Naticid drill-holes occur in 4.3 % of the specimens from Almayate (see Fig. 22: 1), and 4.2 % at Cerro de San Antón. The species was reported from depths down to 122 m in the Adriatic Sea by Bonaduce *et al.* (1975, p. 43), although they claim it to be more abundant between 50 and 70 m. Yassini (1969, p. 44) collected *A. convexa* from the lower intertidal zone of Arcachon (France), and noted that it lives in salinities ranging from 26 ‰ to 34 ‰. Bodergat (1983) recorded *A. convexa* in salinities of 38 ‰. On the Atlantic coast of France, off Roscoff, it is abundant at Dune de Rater, Pierre Noir and Primel at depths of between 17 and 20 m.

Subfamily THAEROCYTHERINAE Hazel, 1967
Tribe THAEROCYTHERINI Hazel, 1967
Genus HERMANITES Puri 1955

Hermanites haidingeri (Reuss, 1850)
Plate 9, Figs. 7–9

1850 *Cypridina haidingeri,* Reuss, p. 78, pl. 10, fig. 13.
1953 *Cythereis haidingeri* (Reuss), Ruggieri, p. 76, pl. 2, figs. 12, 12c.
1962 *Hermanites haidingeri* (Reuss) *rectangularis* n. subsp. Ruggieri, p. 23, pl. 2, figs. 1–5, text-fig. 10.
1962 *Hermanites haidingeri minor* n. subsp. Ruggieri, p. 25, pl. 2, figs. 6–10.
1964 *Hermanites haidingeri* (Reuss), Dieci, and Russo, p. 71, pl. 12, fig. 3.
1972 *Hermanites haidingeri haidingeri* (Reuss), Sissingh, p. 123.

Description: The carapace is subrectangular to "horse-head-shaped" in lateral view and arrow-shaped in ventral view. The anterior end is broadly rounded with marginal denticulations, the posterior end is subacute, truncated and with a caudal extension converging downwards; it is provided with prominent spines. The carapace has ventral and posterodorsal longitudinal ridges and a prominent subcentral tubercle. The ventral ridge corresponds to a deep internal furrow. The valve-surface is furnished with almost concentric reticulae of varying dimensions, starting from the subcentral tubercle. A left hinge is shown in Plate 9, Fig. 9.

Dimensions: Length = 0.88 mm, height = 0.48 mm, breadth = 0.21 mm (left valve).
Material: 56 valves and carapaces.
Age: Early Oligocene to Early Pleistocene.
Distribution:
Pleistocene: Italy (Castell'Arquato, Vallebiaja, Cosenza, Palermo).
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón), Italy (Castell'Arquato, Vallebiaja and Cosenza), Greece (Karpathos, Crete).
Miocene: France, Sicily (Enna), Greece (Gavdos, Crete).

This species has also been reported from the Oligocene and Miocene of Austria.

Ecology: Presumed shallow marine (epineritic environments). Predator drill-holes occur in 14,3 % of the material collected from Almayate (see Fig. 21: 6).

Subfamily BRADLEYINI Benson, 1972
Genus BRADLEYA Hornibrook, 1952

"Bradleya" pliocenica? (Seguenza, 1880)
Plate 8, Figs. 1, 2

*1880 *Cythereis pliocenica,* Seguenza, p. 192.
1962 *Bradleya pliocenica* (Seguenza), Ruggieri, p. 21, pl. 1, fig. 22.

Remarks: I have only two damaged juveniles valves at my disposal. The reticulation and the structure of the ridges suggests that this species could well be a juvenile of *"Bradleya" pliocenica.* The valves are strongly calcified. Plate 8, Fig. 2 illustrates interesting features of the primary pattern in the posterior zone of a left valve, and the secondary reticulation. A possible generic location of the species that might be worth considering is *Heinia* (see Van den Bold, 1985).

Material: Two damaged left valves.
Age: Early Pliocene.
Occurrence: Spain (Peñon de Almayate).

Dimensions: Length = 0.78 mm, height = 0.48 mm, breadth = 0.20 mm (figured right valve, a larval shell).
Material: 180 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Limski Channel, Malta, Levant.
Pleistocene: Rhodes.
Pliocene: Spain (Almayate, Mezquitilla), Greece (Karpathos, Rhodes, Kefallinia, Crete).
Miocene: France.

This species has also been reported from the Indopacific Ocean, Manila, New Zealand and West Australia.

Ecology: Shallow marine (epi-neritic). Breman (1976, p. 37) refers to depths ranging from 12 to 120 m, but usually not deeper than 30 m. Lives among calcaraeous algae (Müller, 1894, p. 377). Predator drill-holes occur in 4.4 % of the shells from Almayate (see Fig. 24: 6).

Genus QUADRACYTHERE Hornibrook, 1952
Subgenus TENEDOCYTHERE Sissingh, 1972

Quadracythere (Tenedocythere) prava (Baird, 1850)
Plate 9, Fig. 12

1850 *Cythere prava,* Baird, p. 256, pl. 18, figs. 13–15.
1868 *Cythere dissimilis,* Brady, p. 222, pl. 15, figs. 12, 13.
1894 *Cythereis prava* (Baird), Müller, p. 376, pl. 29, figs. 22, 27; pl. 31, figs. 31, 32, 34; pl. 36, figs. 31, 32.
1969 *Quadracythere prava prava* (Baird), Uliczny, p. 69.
1971 *Cythereis polygonata* Rome.–Barbeito–Gonzalez, p. 281, pl. 14, figs. 1b–3b; pl. 46, fig. 36.
1972 *Quadracythere prava* (Baird), Uffenorde, p. 76, pl. 8, fig. 3.
1972 *Quadracythere (Tenedocythere) prava* (Baird), Sissingh, p. 126, pl. 19, fig. 4.
1975 *Tenedocythere prava* (Baird), Bonaduce, Ciampo, and Masoli, p. 46, pl. 23, figs. 1–4; pl. 28, fig. 13.
1976 *Quadracythere (Tenedocythere) prava* (Baird), Breman, p. 63, pl. 9, fig. 126.

Remarks: The carapace is subquadrate to subrectangular in lateral view. The anterior margin is broadly rounded, the posterior margin is elongated to form a short posteroventral caudal process. The valve-surface is ornamented with prominent dorsomarginal and ventromarginal ribs. I have only juveniles in the present collection, a remarkable situation with possible ethological significance in that this species may be one of the migratory ones in which adults move to a different environment to that inhabited by larvae.

Quadracythere (Tenedocythere) salebrosa (Uliczny, 1969)
Plate 9, Figs. 10, 11

1969 *Quadracythere prava salebrosa,* Uliczny, p. 70, pl. 4, figs. 3, 4.
1972 *Quadracythere (Tenedocythere) salebrosa* Uliczny. – Sissingh, p. 127, pl. 10, fig. 5.
1982 *Quadracythere salebrosa* Uliczny.–Carbonnel, p. 48, pl. 6, figs. 1, 2.

Remarks: This species differs from *Q. (Tenedocythere) prava* (Baird, 1850) in the presence of the longitudinal ridges between the posterodorsal and ventrolateral ridges.

Dimensions: Length = 0.91 mm, height = 0.55 mm, breadth = 0.25 mm (left valve).
Material: More than 300 valves.
Age: Early Pliocene to late Pliocene.
Distribution:
Pliocene: Algeria, Spain (Almayate, Mezquitilla, Cerro de San Antón, Valle Niza, Ampurdan). France, Crete.

Ecology: Presumed to be shallow marine. Predator drill-holes occur frequently at Almayate being found in 11.1 % of the shells in the present collection (see Fig. 22: 4).

Subfamily UROCYTHEREIDINAE Hartmann and Puri, 1974
Genus UROCYTHEREIS Ruggieri, 1950

Urocythereis favosa (Roemer, 1838)
Plate 9, Fig. 13; Plate 19, Figs. 8, 9

1838 *Cytherina favosa,* Roemer, p. 516, pl. 6, fig. 7.
1969 *Urocythereis favosa favosa* (Roemer), Uliczny, p. 61.
1972 *Urocythereis favosa favosa* (Roemer), Sissingh, p. 127.
1974 *Urocythereis favosa* (Roemer), Doruk in: Stereo-Atlas 2 (1): 33–44.

Description: The carapace is elongate-ovate or rectangular in lateral view. The anterior end is regularly rounded, the posterior end dorsally concave and convex ventrally. The dorsal margin is almost straight, the ventral margin is slightly concave. The valves are heavily calcified. The inner lamella is moderately wide with numerous marginal pore canals. The valve-surface is pitted and coarsely reticulate, there may be smoother fields in the reticular pattern (Plate 19, Fig. 9).

Remarks: This species is very variable, both in external and internal characteristics, which has probably seduced many authors into giving it many names. According to Doruk (1974), earlier Pliocene forms have bigger fossae than later Recent forms, but intermediates occur throughout. The posterior element of the left hinge in Pliocene forms may be with or without a central "tubercle" of variable length. This characteristic varies individually, and in recent forms the central tubercle is not developed (Doruk, 1974).

The juveniles show more variation than the adults, in both the external and internal characteristics. The juveniles have a more extended anterior, and a relatively broader posterior than adults. *U. favosa* seems to have lived continuously in the Almayate area since the Pliocene as shown by the present work. As far as can be judged from the material at my disposal, there could be differences in ornamental details and shape between the Miocene and Recent specimens from the same vicinity; however, the influence of polymorphic effects is a complicating factor which would require a detailed quantitative analysis to answer.

We note that Barbeito-Gonzalez (1971, p. 279–280) referred to his material as a "subspecies", without formal name-designations. He described a smooth morph and a pitted morph.

Dimensions: Length = 1.02 mm, height = 0.58 mm. breadth = 0.20 mm (left valve).
Length = 0.31–0.65 mm, height = 0.21–0.36 mm, breadth = 0.10–0.16 mm (juveniles).
Material: 65 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar; this study), North Aegean Sea, South and West coast of Turkey.
Pleistocene: Italy, Rhodes.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar, Las Palmares, Valle Niza), France, Italy, Greece Kefallinia, Karpathos, Rhodes), Cyprus, Turkey.
Miocene: Italy.

Ecology: Shallow marine (neritic, littoral). At Torre del Mar this species was collected at depths ranging from 10 to 12 m. Predator drill-holes occur only in the Pliocene larval shells (22.2 % frequency at Almayate), (see Fig. 24:5).

Urocythereis labyrinthica Uliczny, 1969
Plate 9, Figs. 14–16

1969 *Urocythereis labyrinthica labyrinthica,* Uliczny, p. 63, pl. 4, fig. 6; pl. 15, fig. 5.
1969 *Urocythereis labyrinthica aperta,* Uliczny, p. 64, pl. 15, figs. 6, 7.
1974 *Urocythereis labyrinthica* Uliczny.–Doruk in: Stereo-Atlas 2 (1): 49–52.

Remarks: The labyrinthic ornament is characteristic of this species (see Plate 9, Figs. 14–15). Uliczny (1969, p. 64) described *U. labyrinthica aperta* as a subspecies of *U. labyrinthica labyrinthica* on the basis of size and shape differences of the "labyrinths." Doruk (1974) found that the width and the extent of labyrinths are variable and the variation is continuous, he therefore, suggested that there is no subspecific differentiation between the two forms. I found the same features in the present material and I therefore, concur with Doruk by considering these two forms as one species. The possibility of polymorphism should be investigated as a source of the observed variation.

Dimensions: Length = 1.08 mm, height = 0.54 mm, breadth = 0.23 mm (left valve).
Material: 52 valves.
Age: Early Pliocene to Early Pleistocene.
Distribution:
Pleistocene: Italy (Calabria), Greece (Rhodes).
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar), Greece (Kefallinia, Ionian Islands).

Ecology: Presumed shallow marine. Naticid drill-holes occur in 6.8 % of the shells from Almayate (see Plate 9, Fig. 16).

Urocythereis margaritifera (Müller, 1894)
Plate 19, Figs. 5–7

1894 *Cythereis margaritifera,* Müller, p. 368, pl. 32, figs. 26, 29, 32, 35–37.
1953 *Hemicythere (Urocythereis) margaritifera* (Müller), Ruggieri, p. 94, pl. 1, fig. 6.
1969 *Urocythereis margaritifera margaritifera* (Müller), Uliczny, p. 65, pl. 15, fig. 8.
1972 *Urocythereis margaritifera margaritifera* (Müller), Sissingh, p. 128, pl. 10, fig. 8.

Remarks: The surface ornament is characterized by irregularly shaped pits (Plate 19, Fig. 6), which seem to be a constant feature in this species.

Dimensions: Length = 0.80 mm, height = 0.39 mm, breadth = 0.20 mm (figured right valve).
Material: Five Recent valves plus three damaged Pliocene right valves.
Age: Early Oligocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Bay of Naples, Adriatic Sea.
Pleistocene: Rhodes.
Pliocene: Spain (Almayate, Rio Guadalminar), Greece (Karpathos, Rhodes, Kefallinia, Crete).

This species has also been reported from the Oligocene of Hungary.

Ecology: Shallow marine (neritic, littoral). At Torre del Mar this species was collected at a depth of 12 m.

Subfamily ORIONINAE Puri, 1973
Genus CAUDITES Coryell and Fields, 1937

Caudites calceolatus (Costa, 1853)
Plate 10, Fig. 1

*1853 *Cytherina calceolatus,* Costa, p. 185, pl. 16, fig. 14.
1968 *Caudites calceolatus* (Costa), Masoli, p. 26, pl. 2, fig. 14; pl. 7, figs. 99, 100.
1969 *Caudites calceolatus* (Costa), Uliczny, p. 49, pl. 14, fig. 6.
1972 *Caudites calceolatus* (Costa), Sissingh, p. 123.
1975 *Caudites calceolatus* (Costa), Bonaduce, Ciampo, and Masoli, p. 47, pl. 26, figs. 10–13.
1976 *Caudites calceolatus* (Costa), Breman, p. 64.
1982 *Caudites calceolatus* (Costa), Carbonnel, p. 27, pl. 4, fig. 9.

Description: The carapace is small, elongate to subtriangular in outline, and laterally compressed. The anterior margin is broadly rounded, the dorsal margin weakly arched. The posterior is obliquely truncated and projected postero-ventrally. The ventral margin is straight and medianly concave. The valve-surface is ornamented with a longitudinal ridge which runs mainly in an anteroventral direction and which becomes sinuous posterodorsally, forming the highest point on the valve-surface. From that point it swings down to the posteroventral corner. Beyond the anterior margin depression, there are approximately four flat pits.

Dimensions: Length = 0.74 mm, height = 0.40 mm, breadth = 0.11 mm (left valve).
Material: 23 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Tunisian Coast, Adriatic Sea, Aegean Sea, Ionian Sea, Naxos.
Pleistocene: Rhodes.
Pliocene: Algeria, Spain (Almayate, Mezquitilla, Las Palmares), Italy, Greece (Kefallinia, Karpathos, Rhodes, Crete).
Miocene: Spain (Ampurdan), Greece (Gavdos, Crete).

Ecology: Shallow marine (littoral, shallow infra-littoral) (Breman, 1976). In warmer waters it is mainly epineritic (Van Morkhoven, 1963). A naticid drill-hole occurs in one shell from Almayate.

Genus PACHYCAUDITES Uliczny, 1969

Pachycaudites ungeri (Reuss, 1850)
Plate 10, Figs. 2, 3

1850 *Cypridina ungeri,* Reuss, p. 79, pl. 11, fig. 11.
1962 *Caudites ungeri* (Reuss), Ruggieri, p. 42, pl. 5. figs. 1–5.
1969 *Pachycaudites ungeri* (Reuss), Uliczny, p. 59, pl. 15, fig. 3.
1972 *Pachycaudites ungeri ungeri* (Reuss), Sissingh, p. 125, pl. 10, fig. 2.

Description: The carapace is large and subtriangular to subrectangular in lateral view. The anterior margin is well rounded; the dorsal margin is weakly arched and posteriorly extended by the acutely projected posteroventrally caudal process. The surface is ornamented with four longitudinal ridges; the median ridges are joined to the subcentral tubercle, and only the posterodorsal area is reticulate. A right hinge is shown in Plate 10, Fig. 2.

Dimensions: Length = 0.95 mm, height = 0.55 mm, breadth = 0.20 mm (right valve).
Material: 45 valves.

Age: Middle Miocene to Early Pleistocene.
Distribution:
Pleistocene: Crete.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón), Greece (Karpathos, Crete).
Miocene: Italy, Crete.

Reuss (1850) described the species from the Middle Miocene of the Vienna Basin.

Ecology: Presumed shallow marine. This is a euryhaline species that seems to have inhabited littoral and shallow infralittoral environments. Predator drill-holes occur in 8.3 % of the valves from Almayate (see Fig. 24: 3).

FAMILY CYTHERETTIDAE Triebel, 1972
Subfamily *CYTHERETTINAE* Triebel, 1952
Genus *CYTHERETTA* G.W. Müller, 1894

Cytheretta adriatica Ruggieri, 1952
Plate 7, Figs. 5–7

1950 *Cytheretta jurinei* (Münster), Ruggieri, p. 11, fig. 11, text-fig. 3.
1952 *Cytheretta adriatica,* Ruggieri, p. 36.
1970 *Cytheretta adriatica* Ruggieri.– Barbeito-Gonzalez, p. 285, pl. 17, figs. 1b, 2b, 3b.
1972 *Cytheretta (Cytheretta) adriatica* Ruggieri.– Sissingh, p. 129.
1975 *Cytheretta adriatica* Ruggieri.– Bonaduce, Ciampo, and Masoli, p. 54, pl. 32, figs. 7–12.
1976 *Cytheretta adriatica* Ruggieri.– Breman, p. 64, pl. 9, fig. 127.
1977 *Cytheretta adriatica* Ruggieri.– Athersuch in: Stereo-Atlas 4 (1): 69–78.

Remarks: The males, which are larger than females, have faint longitudinal ridges, and a more marked depression in the posteroventral region. The strength of the costation is variable. A right hinge is figured in Plate 7, Fig. 7.

Dimensions: Length = 1.14 mm, height = 0.58 mm, breadth = 0.25 mm (right valve).
Material: 176 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Tunisian Coast, Italy (Porto Corsini, Rimini), Adriatic Sea, Naxos, Cyprus.
Pleistocene: Italy (Imola), Crete.
Pliocene: Spain (Mezquitilla, Cerro de San Antón), Italy (Piemonte, Vallebiaja, Cosenza), Greece (Crete, Karpathos).

Ecology: Shallow marine, near-shore, Bonaduce *et al.* (1975) recorded depths above 85 m in the Adriatic Sea and depths not exceeding 20 m off the Italian Adriatic coast on medium sand and very sandy pelite. Athersuch (1976) collected the species alive off Cyprus at depths of 10 to 20 m, and in a salinity of 39 ‰. The species is abundant at Mezquitilla in the lower and upper samples; predator drill-holes occur in 17.1 % of the specimens from Mezquitilla (see Fig. 21: 5).

Genus *FLEXUS* Neviani, 1929

Flexus triebeli (Ruggieri, 1962)
Plate 10, Figs. 6–8

1962 *Eucytheretta triebeli,* Ruggieri, p. 49, pl. 5, figs. 8, 9.
1964 *Flexus triebeli* (Ruggieri), Dieci and Russo, p. 75, pl. 11, fig. 1.
1972 *Cytheretta (Flexus) triebeli* (Ruggieri), Sissingh, p. 131.
1981 *Flexus* aff. *triebeli* (Ruggieri), Uffenorde, p. 154, pl. 8, fig. 16.

Description: The carapace is elongate-ovate to cylindrical in shape. The anterior margin is broadly rounded. The posterior is curved upward and it usually bears three weak marginal spines. This species is strongly ornamented being characterized by the presence of three longitudinal costae. The present specimens correspond closely to the figures of *E. triebeli* Ruggieri (1962).

Dimensions: Length = 0.82 mm, height = 0.48 mm, breadth = 0.18 mm (left valve).
Material: More than 155 valves.
Age: Late Miocene to Early Pleistocene.
Distribution:
Pleistocene: Italy, Sicily (Enna).
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar, Las Palmares, Valle Niza, Rio Guadalminar), Italy, Sicily (Enna), Greece (Karpathos).
Miocene: Italy (Calabria), Vienna Basin.

This species occurs in the Upper Miocene of Cuxhaven Germany (Uffenorde, 1981).

Ecology: Shallow marine. Predator drill holes occur on 3.4 % of the shells from Almayate (see Fig. 25: 5).

Genus *PROTOCYTHERETTA* Puri, 1958

Protocytheretta obtusa Ruggieri, 1962
Plate 10, Figs. 4, 5

1962 *Protocytheretta obtusa,* Ruggieri, p. 48, pl. 6, figs. 1, 1a, 1b, 2, 2a.
1964 *Protocytheretta obtusa* Ruggieri.– Dieci and Russo, p. 75, pl. 11, fig. 10.
1972 *Protocytheretta obtusa* Ruggieri.– Sissingh, p. 131, pl. 10, fig. 10.

Remarks: The carapace is subrectangular in lateral view, the posterior end is laterally compressed. The valve-surface is ornamented with three prominent longitudinal ridges, is covered with pits, punctae and concave, circular punctae.

Dimensions: Length = 0.71 mm, height = 0.35 mm, breadth = 0.15 mm (left valve).
Material: 45 valves
Age: Middle Miocene to Late Pliocene.
Distribution:
Pliocene: Spain (Almayate, Mezquitilla), Karpathos, Crete.
Miocene: Sicily (Benestare).

Ecology: Shallow marine. Predator drill-holes occur on 23.7 % of valves at Almayate (see Fig. 25: 6).

Genus *LOCULICYTHERETTA* Ruggieri, 1954

Loculicytheretta pavonia (Brady, 1866)
Plate 23, Fig. 5

1866 *Cythere pavonia,* Brady, p. 378, pl. 61, figs. 2a–2d.
1954 *Loculicytheretta pavonia* (Brady), Ruggieri, p. 571, text-figs. 40, 40a, 40b, 41, 41a.
1971 *Loculicytheretta pavonia* (Brady), Barbeito-Gonzalez, p. 285, pl. 17, figs. 1c, 2c, 3c, 4c.
1973 *Loculicytheretta pavonia* (Brady), Doruk in: Stereo-Atlas 1 (4): 237–244.
1976 *Loculicytheretta pavonia* (Brady), Athersuch, and Bonaduce, p. 350, pl. 1, figs. 1–4; pl. 2, figs. 1–10; pl. 3, figs. 1–6.

Description: I have only males in the present collection from Torre del Mar, an unusual situation for which no ready explanation is available. The carapace is elongate subrectangular in lateral view. The anterior margin is evenly rounded; the posterior margin is subacute and projected anterodorsally. The dorsal margin is almost straight, the ventral margin slightly sinuous. The valve-surface has three strongly developed longitudinal ridges, and occasionally two weak ridges. The intercoastal areas are punctate with various sizes of punctae. The valve is heavily calcified.

Dimensions: Length = 0.58 mm, height = 0.28 mm, breadth = 0.13 mm (figured right valve).
Material: 10 male valves.
Age: Eocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar, Alicante), Tunisia, Libya, Greece, Cyprus (Dhavlos bay), Levant.
Pleistocene: Italy (Tuscany), Turkey.
Pliocene: Italy (Tuscany), Turkey.

Van Morkhoven (1963) recorded this species from Alicante (Recent), and from W. Africa (sub-Recent). Szczechura reported the species from the Miocene of North Africa (see Athersuch & Bonaduce, 1976, p. 350), and Oertli (1973) recorded it from the Eocene of N. Africa.

Ecology: Shallow marine environment. At Torre del Mar this species was collected from a depth of 12 m. Brady (1866) found it among "sponge-sand", deposits.

Family MICROCYTHERIDAE Klie, 1938
Genus *MICROCYTHERE* G.W. Müller, 1894

Microcythere inflexa Müller, 1894
Plate 16, Figs. 9, 10

1894 *Microcythere inflexa,* Müller, p. 328, pl. 24, figs. 30–32, 40–42, 48, 50.
1972 *Microcythere inflexa* Müller.– Uffenorde, p. 97, pl. 3, fig. 11.
1975 *Microcythere inflexa* Müller.– Bonaduce, Ciampo, and Masoli, p. 59.

Description: The carapace is elongate ovate, subrectanuglar in lateral view. The anterior margin is evenly rounded. The posterior margin is obtusely rounded. The dorsal margin is convexly arched, the ventral margin slightly sinuous, running almost parallel with the dorsal margin. The valve-surface is smoothly pitted and concentrically striated, mainly in the anterior region. The valves are thin-shelled and sometimes pellucid.

Dimensions: Length = 0.32 mm, height = 0.15 mm, breadth = 0.05 mm (figured carapace).
Age: Miocene ? to Recent.
Distribution:
Recent: Spain (Torre del Mar), Bay of Naples, Limski Channel, Adriatic Sea.

This species was recorded by van den Bold (1946, p. 26) from the Miocene of Central America, a claim seemingly requiring further documentation.

Ecology: Shallow marine. Müller (1894) found it to live between *Peysonellia* and to be rare in the Bay of Naples. Bonaduce *et al.* (1975) noted that the distribution of this species in the Adriatic Sea does not show any obvious correlation with depth. Its optimum seems to correspond to a depth-range of 75 to 95 m and it is present on all types of bottom. At Torre del Mar, it was collected alive from a depth of 5 m (a turbulent and wave-wracked environment), it belongs to the interstitial fauna.

Hundreds of shells of *Microcythere* were obtained from Torre del Mar. This genus was more abundant in July of 1985, when it was collected from depths of 4 to 12 m. In June of 1984, it was collected only from a depth of 5 m.

Microcythere levis Müller, 1894
Plate 16, Fig. 8

1894 *Microcythere levis,* Müller, 329, pl. 24, figs. 25, 26, 53, 58.

Remarks: A species of *Microcythere* with the characteristics of *M. levis,* but differing in its smaller size.

Dimensions: Length = 0.28 mm, height = 0.14 mm, breadth = 0.05 mm (figured carapace).
Age: Recent.
Distribution:
Recent: Spain (Torre del Mar), Bay of Naples, Adriatic Sea.

Ecology: Shallow marine. Lives on calcareous algae, rare in the Bay of Naples (Müller, 1894). At Torre del Mar it was collected alive from depths of 4 to 12 m from sandy sediment. Bonaduce *et al.* (1975, p. 59) suggested that the distribution of this species is correlated neither with depth nor substrate. This species has yet to be reported from fossil strata. It inhabits the interstitial environment.

Microcythere obliqua, Müller, 1894
Plate 16, Fig. 7

1894 *Microcythere obliqua, Müller, 329, pl. 24, figs. 4–8, 45, 49.*
1972 Microcythere obliqua Müller.– Uffenorde, p. 97, pl. 3, figs. 7, 8.

Remarks: A species of *Microcythere* which is elongate-ovate in outline, with a convex dorsal margin, and an obliquely rounded posterior margin.

Dimensions: Length = 0.26 mm, height = 0.11 mm, breadth 0.04 mm (figured carapace).
Age: Recent.
Distribution:
Recent: Spain (Torre del Mar), Bay of Naples, Limski Channel, Adriatic Sea.

Ecology: Shallow marine. Müller (1894) found the species between living *Posidonia,* and detritus, and to be rare. Bonaduce *et al.* (1975, p. 59) found it rare in the Adriatic Sea at depths between 50 to 225 m. At Torre del Mar, it was collected alive from depths of 4 to 12 m from coarse sand; it inhabits the interstitial environment.

Family LOXOCONCHIDAE Sars, 1925
Genus *HIRSCHMANNIA* Elofson, 1941

Hirschmannia sp.
Plate 12, Fig. 5

Remarks: I have only one complete carapace of this species which resembles *Hirschmannia* sp. Bonaduce, Ciampo, and Masoli, 1975.

Material: One carapace (lost after study).
Age: Early Pliocene.
Occurrence: Spain (Cerro de San Antón).

Subfamily *LOXOCONCHINAE* Sars, 1925
Genus *LOXOCONCHA* Sars, 1866

The species referred to *Loxoconcha* are abundantly represented in our fossil and recent material.

Loxoconcha agilis Ruggieri, 1967
Plate 11, Fig. 3

1967 *Loxoconcha agilis,* Ruggieri, p. 377, pl. 37, fig. 6, text-figs. 42–46.
1985 *Loxoconcha agilis* Ruggieri.– Stambolidis, p. 218, pl. 6, figs. 3–5.

Description: The carapace is typically rhomboidal in lateral view, with a caudal process projected above mid-height. The valve-surface is pitted and ornamented with variable concentic rows.

Remarks: Ruggieri (1967, p. 378) mentioned that this species is similar to the Recent *L. granulata* Sars 1866 from Britain. Bonaduce *et al.* (1975, p. 102) found a species close to *L. agilis* in general appearance but a little shorter and less acuminate than those described by Ruggieri (1967). *L. agilis* has been found in the Bay of Naples and cited as *Loxoconcha* n. sp. A (Puri, Bonaduce & Malloy, 1964).

Dimensions: Length = 0.54 mm, height = 0.33 mm, breadth = 0.13 mm (right valve).
Material: 68 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Aegean Sea.
Pleistocene: Turkey.
Pliocene: Spain (Almayate, Mezquitilla), Turkey.
Miocene: Italy.

Doruk (1979, p. 172) recorded *L. agilis* from the Pleistocene and Pliocene of Turkey.

Ecology: Shallow marine. Predator drill-holes occur in 7.6 % of the shells from Almayate (see Fig. 24: 2). There are no previous records of gastropod predation on *Loxoconcha.*

Loxoconcha concentrica Bonaduce, Ciampo, and Masoli, 1975
Plate 12, Fig. 9

1975 *Loxoconcha concentrica,* Bonaduce, Ciampo, and Masoli, p. 105, pl. 60, figs. 8–12.

Remarks: The description of Bonaduce *et al.* (1975), corresponds well with the material referred here, the only difference being the larger size of this single left valve. A case could possibly be made for including this species in *Kuiperiana,* but this cannot be decided on the basis of the available material.

Dimensions: Length = 0.42 mm, height = 0.27 mm, breadth = 0.12 mm (figured left valve).
Material: One valve.
Age: Early Pliocene to Recent.
Distribution:
Recent: Bay of Naples, Adriatic Sea.
Pliocene: Spain (Cerro de San Antón).

Ecology: Marine; Bonaduce *et al.* (1975) recorded *L. concentrica* at depths exceeding 70 m in the Adriatic Sea and stated it to be most abundant over a depth range of 125 – 170 m.

Loxoconcha elliptica Brady, 1868
Plate 20, Figs. 6–8; Plate 21, Figs. 1–6

1868 *Loxoconcha elliptica,* Brady, p. 435, pl. 27, figs. 38, 39, 45–48; pl. 40, fig. 3.
1958 *Loxoconcha elliptica* Brady.– Hartmann, p. 228.
1975 *Loxoconcha elliptica* Brady.– Bonaduce, Ciampo, and Masoli, p. 106, pl. 63, figs. 14; pl. 67, fig. 10.
1976 *Loxoconcha elliptica* Brady.– Breman, p. 65.
1976 *Loxoconcha elliptica* Brady.– Athersuch & Whittaker in: Stereo-Atlas 3 (2): 99–106.
1985 *Loxoconcha elliptica* Brady.– Stambolidis, p. 220, pl. 6, figs. 11–12.

Description: The carapace is elongate ovate, subrhomboidal in lateral view. The anterior margin is broadly rounded, the posterior margin obliquely rounded. The dorsal margin is arched, the ventral margin sinuous. The valve-surface is smoothly punctate. Plate 20, fig. 6 and Plate 21, Figs. 1 and 2 show some of the extremities. Right (Plate, 20, Fig. 8; Plate 21, Fig. 3) and left (Plate 21, Fig. 5) hinges are shown for comparison. The muscle scars of a left and right valves are also figured (Plate 21, Figs. 4 and 6).

Dimensions: Length = 0.66 mm, height = 0.39 mm, breadth = 0.14 mm (left valve).
Material: More than 600 valves.
Age: Pliocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar, Los Barrios near Guadacorte, Estepona, Las Cuches), Mallorca, Algiers, Tunisian Coast, French Coast, Adriatic Sea.

Remarks: This species occurs in the Pleistocene of Great Britain. It has also been reported from the North Sea (Elofson, 1941, p. 324). Schornikow (1969) reported it from the Black Sea, Sea of Azov, and the Caspian Sea. It has also been recorded from the Pliocene of Azerbaijan.

Ecology: Fresh-water, brackish water, and marine environments. Bonaduce *et al.* (1975) found this species along the southernmost part of the Apulia Coast at depths not exceeding 20 m in the areas influenced by fresh-water out-flow (cf. the locality Los Barrios p. 19). Whittaker (1981, p. 294), noted that *L. elliptica* is euryhaline and able to tolerate all ranges of salinity from 0–35 ‰, and to be a successful colonizer with well marked seasonal patterns of distribution and age-structure; it also appears to be eurythermal. Its ontogenetic cycle continues through the winter months in Christchurch Harbour, south coast of England (Whittaker, 1981).

At Los Barrios this species is very numerous where it occurs in stagnant mud. The lagoon is brackish, and cut off from the Mediterranean today; it also contains living foraminifers (including *Elphidium* sp.) which suggests that isolation from the ocean is of very recent date, possibly the outcome of a recent local crustal elevation. This hypothesis is supported by the fact that predator drill-holes occur in 0.8 % of the shells from Los Barrios (see Fig. 23: 5). *L. elliptica* is rare at Las Cuches, Estepona and Torre del Mar. At Torre del Mar it was collected from depths of 5 and 12 m from a fine sandy substrate.

Loxoconcha obliquata Seguenza, 1879
Plate 11, Fig. 8

*1879 *Loxoconcha obliquata,* Seguenza, p. 126, pl. 12, fig. 10.
1963 *Loxoconcha obliquata* Seguenza.– Ruggieri, p. 11, pl. 1, figs. 9–10, text-fig. 4.

Remarks: The carapace is typically rhomboidal in lateral view and more extended than *L. rhomboidea* (Fischer). The valve-surface is ornamented with fine rows of punctae. Ruggieri (1963) made a neotype of this species from his material at Benestare. It is one of the few entirely fossil *Loxoconcha* species of the present collection.

Dimensions: Length = 0.62 mm, height = 0.40 mm, breadth = 0.15 mm (left valve).
Material: More than 400 valves.
Age: Early Pliocene to Early Pleistocene.
Distribution:
Pleistocene: Italy (Benestare).
Pliocene: Spain (Almayate, Mezquitilla, Valle Niza).

Ecology: Benthonic; shallow marine. Naticid drill-holes occur in 4.9 % of the shells from Almayate (see Fig. 24: 1).

Loxoconcha rhomboidea (Fischer, 1855)
Plate 11, Figs. 6, 7; Plate 20, Figs. 2–5

*1855 *Cythere rhomboidea,* Fischer, p. 656.
1975 *Loxoconcha rhomboidea* (Fischer), Bonaduce, Ciampo, and Masoli, p. 109, pl. 59, figs. 8–12, text-fig. 43.
1976 *Loxoconcha rhomboidea* (Fischer), Athersuch and Whittaker in: Stereo-Atlas 3 (2): 81–90.

Description: The carapace is rhomboidal, subovate in lateral view. The anterior margin is evenly rounded, the posterior margin is obliquely truncated above mid-height. The dorsal margin is strongly arched, the ventral margin sinuous, with a prominent posterior "keel" i.e. a strongly compressed marginal area in both valves. The valve-surface is ornamented with rather variably developed concentric rows of punctae. The hinge is illustrated in Plate 11, Fig. 7. There are differences in shape brought about by variability in the length-height relationship (cf. Plate 11, Fig. 6 and Plate 20, Fig. 2).

Remarks: Bonaduce *et al.* (1975, p. 110) considered *L. rhomboidea, L. bairdi* Müller and *L. exagona* B.C and M. to constitute a homogeneous distributional group, without drawing out the implications of this assumption. This interesting problem needs to be taken up further.

Dimensions: Length = 0.65 mm, height = 0.45 mm, breadth = 0.18 mm (left valve).
Material: More than 600 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), N African Coast, Adriatic, Aegean.
Pleistocene: Rhodes, Crete.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Las Palmares), Greece (Karpathos, Rhodes, Crete).
Miocene: Crete.

This species has also been reported from the Holocene of the Netherlands. It occurs along the Baltic Sea and in the Kattegat, between Denmark and Sweden, and the coasts of Europe from N Norway to Madeira and the Canary Islands, off NW Africa.

Ecology: Benthonic; shallow marine (neritic and littoral): from near-shore to 125 m, most common around 70 m and frequent on medium and fine sand, present on very sandy pelite, sandy pelite and sandy silt in the Adriatic Sea (Bonaduce *et al.*, 1975). Yassini (1969, p. 109) recorded it at depths between 1–10 m in salinities more than 26 ‰. Temp. 6–27°C. Euryhaline (7–36 %) and eurythermal. Bodergat (1983) recorded this species in salinities up to 38 ‰ and found it among "*Posidonies cymodoceés*". At Torre del Mar it is rare, and was collected from depths of 5 and 12 m from sandy sediments. At the Peñon de Almayate *L. rhomboidea* is abundant; predator drill-holes occur in 9.1 % of the shells (see Fig. 23: 4). As already noted, this evidence of gastropod predation on *Loxoconcha* is remarkable.

Loxoconcha tumida Brady, 1869
Plate 10, Figs. 12, 13; Plate 11, Figs. 4, 5

1869 *Loxoconcha tumida,* Brady, p. 48, pl. 8, figs. 11, 12.
1952 *Loxoconcha tumida* Brady.– Ruggieri, p. 17, pl. 4, figs. 2–6.
1971 *Loxoconcha ovulata* (Costa), Barbeito-Gonzalez, p. 307, pl. 32, figs. 1b–4b.
1072 *Loxoconcha ovulata* (Costa) = *Loxoconcha tumida* Brady.– Uffenorde, p. 85, pl. 9, fig. 4.
1972 *Loxoconcha tumida* Brady.– Sissingh, p. 134.
1975 *Loxoconcha tumida* Brady.– Bonaduce, Ciampo, and Masoli, p. 110, pl. 60, figs. 1–7.
1976 *Loxoconcha tumida* Brady.– Breman, p. 66, pl. 9, fig. 130.
1979 *Loxoconcha ovulata* (Costa), Athersuch in: Stereo-Atlas 6 (2): 141–150.
1982 *Loxoconcha tumida* Brady.– Carbonnel, p. 40, pl. 5, fig. 4.

Description: The carapace is ovate or elongate, the anterior is rounded and the posterior upwardly rounded. The valve-surface is coarsely sculptured with polygonal pits of variable shape arranged in approximately concentric rows, with the grade of coarseness increasing outwards. A left hinge is shown in Plate 10, Fig. 13.

Remarks: Ascoli (Athersuch, 1979) considered *Loxoconcha ovulata* (Costa) to be conspecific with *L.*

tumida Brady, so he used *L. ovulata* (Costa) as the valid name. Since then, the usage of the names has been divided. Athersuch (1979 in the Stereo-Atlas 6(2):149) suggested that Ascoli should have considered that the name is a *nomen dubium* and referred the case to the Commission on Zool. Nomenclature. Athersuch did not figure the lectotype in the Costa collection, so the valid name seems to be *L. tumida,* but if he did designate a *figured* specimen as lectotype, his choice would stand. This has yet to be decided.

Dimensions: Length = 0.61 mm, height = 0.41 mm, breadth = 0.18 mm (right valve).
Material: More than 600 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Mediterranean Sea in general.
Pleistocene: Italy, Rhodes.
Pliocene: Algeria, Spain (Almayate, Mezquitilla, Cerro de San Antón, Limonar, Valle Niza, Rio Guadalminar, Ampurdan), Greece (Karpathos, Rhodes, Crete).
Miocene: SE France, Crete.

Ecology: Benthonic; shallow marine (neritic, littoral), optimum depth is 20–70 m, but occurs down to 125 m. Stated to prefer medium and fine sand, but also occurs on sandy silt (Bonaduce *et al.,* 1975). Predator drill-holes occur on 8.3 % of the shells in Almayate (see Fig. 23: 6).

Loxoconcha turbida Müller, 1912
Plate 20, Fig. 1

1894 *Loxoconcha levis.* Müller, p. 344, pl. 27, figs. 8, 19, 22; pl. 28, figs. 4, 8.
1912 *Loxoconcha turbida,* Müller, p. 308 (new name).
1952 *Loxoconcha turbida* Müller.– Ruggieri, p. 73, pl. 4, fig. 1.
1972 *Loxoconcha turbida* Müller.– Sissingh, p. 135.
1975 *Loxoconcha turbida* Müller.– Bonaduce, Ciampo, and Masoli, p. 111, pl. 66, figs. 1–3.
1976 *Loxoconcha turbida* Müller.– Breman, p. 67, pl. 9, fig. 132.
1979 *Loxoconcha turbida* Müller.– Yassini, p. 388, pl. 6, figs. 5, 7–8.

Description: The carapace is ovate subrhomboidal in lateral view. The anterior margin is broadly rounded. The posterior margin is provided with an obtuse caudal process, projected mid-posteriorly. The valve surface is smoothly pitted, mainly in the central region.

Dimensions: Length = 0.60 mm, height = 0.38 mm, breadth = 0.15 mm (figured carapace).
Material: 6 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Monaco, Bay of Naples, Adriatic Sea.
Pleistocene: Italy (Castell'Arquato), Rhodes.
Pliocene: Algeria, Spain (Limonar) Italy, Rhodes.

Ecology: Shallow marine (littoral), Müller (1894) found it to be rare in the Bay of Naples, and to live on sandy substrates between seaweed, algae, and detritus. Bonaduce *et al.* (1975) noted that this species is widely distributed in the Adriatic Sea at depths of less than 170 m. The maximum recorded frequencies were observed at depths not exceeding 20 m, at which the salinity is about 35 ‰. At Torre del Mar it is rare, and was collected from a depth of 12 m on a fine sandy bottom. One carapace was found in Limonar sample 3.

Loxoconcha variesculpta Ruggieri, 1962
Plate 10, Figs. 9, 10

1962 *Loxoconcha variesculpta,* Ruggieri, p. 58, pl. 7, figs. 12, 13, text-fig. 13.
1972 *Loxoconcha variesculpta* Ruggieri.– Sissingh, p. 135.

Notes: The carapace is subrhomboidal, elliptical in lateral view. The dorsal margin is almost straight. The valve-surface is covered with irregular pits. Another possibility for the generic assignation of this species is *Sagmatocythere* as the general habitus of the carapace is not typical of *Loxoconcha.* More material is necessary for deciding this question.

Dimensions: Length = 0.53 mm, height = 0.24 mm, breadth = 0.12 mm (figured left valve).
Material: Two valves.
Age: Middle Miocene to Early Pliocene.
Distribution:
Pliocene: Spain (Almayate).
Miocene: Sicily (Enna), Crete.

Loxoconcha versicolor Müller, 1894
Plate 10, Fig. 11

1894 *Loxoconcha versicolor,* Müller, p. 346, pl. 27, fig. 4; pl. 28, figs. 5, 10.
1972 *Loxoconcha versicolor* Müller.– Sissingh, p. 135.
1975 *Loxoconcha versicolor* Müller.– Bonaduce, Ciampo, and Masoli, p. 111, pl. 65, figs. 1–8.
1976 *Loxoconcha versicolor* Müller.– Breman, p. 67, pl. 9, fig. 131.

Remarks: The carapace is subrectangular in lateral view. It has a semi-alar prolongation. The valve-surface is richly ornate and reticulated with polygonal pits. This form, and *L. variesculpta,* are the rarest species of *Loxoconcha* in the present material. Also here, an assignation to the genus *Sagmatocythere* might be worth considering.

Dimensions: Length = 0.45 mm, height = 0.22 mm, breadth = 0.13 mm (left valve).
Material: 4 damaged valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Mediterranean Sea (ubiquitous).
Pleistocene: Rhodes.
Pliocene: Spain (Almayate, Mezquitilla), Karpathos.

Ecology: Benthonic; shallow marine. Bonaduce *et al.* (1975, p. 111) refer to an optimum depth range of 70 and 170 m. Lives on detritus. Stated to prefer very sandy pelite. At Monaco it was found at depths of 20 and 70 m (Ruggieri, 1964, p. 521).

Family PARACYTHERIDEIDAE Puri, 1957
Subfamily PARACYTHERIDEA G. W. Müller, 1894
Genus PARACYTHERIDEA G. W. Müller, 1894

Paracytheridea depressa Müller, 1894
Plate 13, Fig. 1

1894 *Paracytheridea depressa,* Müller, p. 341, pl. 29, fig. 4.
1962 *Paracytheridea bovettensis* (Seguenza), Ruggieri, p. 14, pl. 1, figs. 11, 11a.
1972 *Paracytheridea triquetra bovettensis* (Seguenza), Sissingh, p. 136.

Description: The carapace is elongate in lateral view and somewhat alate; it is strongly flattened ventrally. In dorsal view, it is shaped like an arrowhead. The dorsal margin is straight to concave. The posterior end has a distinct caudal, and spine-like process projected subdorsally. Posteriorly, the valves are much compressed. The valve-surface is ornamented with ridges and intercostal reticulae.

Remarks: Numerous species of *Paracytheridea* have been described under the generic name of *Cytheropteron.* The present species has been identified by many authors as *P. bovettensis* (Seguenza, 1880). Bonaduce *et al.* (1975, p. 90) considered *P. bovettensis* an invalid species, and concluded that *P. depressa* Müller 1894, *should be revived* but limited to Müller's Fig. 4 of Pl. 29, which specimen should be considered the type species. The present specimens are conspecific with Müller's (1894, pl. 29, fig. 4); I adhere to the position adopted by Bonaduce *et al.* (1975).

Dimensions: Length = 0.55–0.70 mm, height = 0.25–0.35 mm, breadth = 0.15–0.20 mm (left valves).
Material: 52 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic, Aegean Sea.
Pleistocene: Italy (in Carrubare near Reggio Calabria), Greece (Rhodes, Crete).
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Las Palmares, Valle Niza, Ampurdan), Italy, Greece (Karpathos, Rhodes, Crete).
Miocene: Crete.

Ecology: Shallow marine (epi-neritic). Lives on seaweed and calcareous algae (Müller, 1894). Stated to prefer medium sand (Bonaduce *et al.,* 1975).

Family CYTHERURIDAE G. W. Müller, 1894
Subfamily CYTHERURINAE G. W. Müller, 1894
Genus EUCYTHERURA G. W. Müller, 1894

Eucytherura complexa (Brady, 1866)
Plate 13, Fig. 9

1866 *Cythere complexa,* Brady, p. 210.
1894 *Eucytherura complexa* Brady.–Müller, p. 306, pl. 20, figs. 13, 17; pl. 21, fig. 3.
1969 *Eucytherura complexa* (Brady), Yassini, p. 97.
1972 *Eucytherura complexa* (Brady), Sissingh, p. 140, pl. 12, fig. 10.
1975 *Eucytherura complexa* (Brady), Bonaduce, Ciampo, and Masoli, p. 85, pl. 48, figs. 8–14.

Description: The left valve referred here is parallelogram-shaped in lateral view, with a subdorsal caudal process. The valve-surface is strongly reticulate and pitted, with a subcentral tubercle (?) of uncertain anatomical significance. The valve is heavily calcified.

Dimensions: Length = 0.39 mm, height = 0.25 mm, breadth = 0.13 mm (figured left valve).
Material: One left valve.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Tyrrhenian Sea, Adriatic Sea.
Pleistocene: Rhodes.
Pliocene: Spain (Almayate), Rhodes, Crete.
Miocene: Italy (Romagna).

This species was reported from the Late Miocene of Romagna (Ruggieri, 1962). It was originally described from the Hebrides, Great Britain.

Ecology: Shallow to fairly deep marine, occurs at depths greater than 50 m. The species has been reported living at depths in excess of 1000 m (Van Morkhoven, 1963, p. 355). The present specimen could therefore have been transported after death. Lives on calcareous algae and algal detritus (Müller, 1894). Stated to prefer sand and very sandy pelite (Bonaduce *et al.*, 1975).

Genus PSEUDOCYTHERURA Dubowsky, 1939

Pseudocytherura calcarata (Seguenza, 1880)
Plate 13, Fig. 8

*1880 *Cytheropteron calcaratum*, Seguenza, p. 365, pl. 17, fig. 53.
1952 *Paracytheridea (Paracytheropteron) calcarata* (Seguenza), Ruggieri, p. 79, pl. 6, figs. 1–3; pl. 7, fig. 7.
1969 *Pseudocytherura calcarata* (Seguenza), Yassini, p. 99.
1972 *Pseudocytherura calcarata* (Seguenza), Sissingh, p. 144, pl. 12, fig. 11.
1975 *Pseudocytherura calcarata* (Seguenza), Bonaduce, Ciampo, and Masoli, p. 90, pl. 50, figs. 7–12.

Description: The carapace is subrectangular in lateral view. The characteristic feature of this species is the polygonal reticulation. Comparison of the figured species with recent forms, suggests that they are more reticulate than the fossil representative, although this observation needs to be confirmed by more material than is available at present.

Material: Four valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Adriatic Sea.
Pleistocene: Italy (Reggio Calabria), Rhodes.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón), Italy (Castell'Arquato), Greece (Crete, Karpathos, Rhodes).

Ecology: Shallow marine (infra-littoral). Lives on various types of bottom. Stated to prefer coarse sand (Bonaduce *et al.*, 1975).

Genus SEMICYTHERURA Wagner, 1957

Semicytherura acuticostata (Sars, 1866)
Plate 13, Fig. 2

1866 *Cytherura acuticostata*, Sars, p. 210, pl. 98, fig. 1.
1894 *Cytherura ventricosa*, Müller, p. 292, pl. 18, figs. 5, 15; pl. 19, fig. 11.
1952 *Cytherura acuticostata* Sars.–Ruggieri, p. 84, pl. 5, figs. 6, 7.
1969 *Semicytherura acuticostata* (Sars), Yassini, p. 84.
1971 *Semicytherura* cf. *acuticostata*, Barbeito–Gonzalez, p. 290, pl. 21, figs. 1c, 2c.
1972 *Semicytherura acuticostata* (Sars), Sissingh, p. 144, pl. 12, fig. 2.
1975 *Semicytherura acuticostata* (Sars), Bonaduce, Ciampo, and Masoli, p. 69, pl. 40, figs. 1–5.
1976 *Semicytherura acuticostata ventricosa* (Müller), Breman, p. 69, pl. 10, fig. 153.

Description: The carapace is subquadrangular in lateral view. The anterior margin is broadly rounded, the posterior margin obliquely truncate with a caudal process directed upwards from the upper third of the posterior. The dorsal margin forms an arch, which is somewhat medianly depressed. The ventral margin is almost straight and is overlapped posteroventrally by an acute wing. The valve-surface is ornamented with longitudinal ridges.

Remarks: Ruggieri (1953, p. 120) considered *Cytherura acuticostata* to be synonymous with *Cytherura ventricosa.* Uffenorde (1972, p. 89) thought the living Mediterranean population could possibly be regarded as a subspecies, *S. a. ventricosa* (Müller), but without specifying his reasons. Uffenorde (1972) noted what could be seasonally controlled polymorphism in this species, basing his suggestion on observations on another species of the genus made by Szezechura (1971).

Dimensions: Length = 0.44 mm, height = 0.22 mm, breadth = 0.19 mm (figured right valve).

Material: Two valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Capri Messina, Monaco, Tunisian Coast, Aegean Sea, Adriatic Sea.
Pleistocene: Italy (sediments of Rio Riorzo near Castell'Arquato and Carrubare near Reggio Calabria), Rhodes, Crete.
Pliocene: Spain (Almayate, Mezquitilla), Greece (Karpathos, Rhodes, Crete).

This species also occurs in the North Sea and the Baltic, Norway, Great Britain and Ireland, and in the Pleistocene of England and Ireland.

Ecology: Shallow marine and deep marine (eurybathyal, turbulent coastal water), at depths ranging to almost 200 m (optimally 70–125 m in the Adriatic Sea (Bonaduce *et al.*, 1975). Müller (1894, p. 292) reported it to be rare in the Bay of Naples and to live on calcareous algae. Bonaduce *et al.* (1975,

p. 69) found the species to be frequent in the Adriatic Sea and to prefer medium sand. In the present collection it is rare.

Semicytherura alifera (Ruggieri, 1959)
Plate 13, Fig. 6

1894 *Cytherura alata,* Müller, p. 288, pl. 18, figs. 1, 7, 8; pl. 19, fig. 9.
1953 *Cytherura alata* Müller.–Ruggieri, p. 121, pl. 5, figs. 48, 50.
*1959 *Semicytherura alifera,* Ruggieri, p. 204 (new name).
1971 *Semicytherura alifera* (Ruggieri), Barbeito – Gonzalez, p. 292, pl. 22, figs. 1a, 2a, 3a.
1975 *Semicytherura alifera* (Ruggieri), Bonaduce, Ciampo, and Masoli, p. 70, pl. 44, figs. 3–9.
1976 *Semicytherura alifera* (Ruggieri), Breman, p. 69, pl. 10, fig. 155.

Description: The carapace is subrectangular in lateral view. The anterior margin is irregularly rounded and the posterior margin has a subacutely pointed caudal process projected from the upper fourth of the posterior margin, and directed obliquely upwards. The dorsal and ventral margins are almost parallel. The ventral margin is overlapped posteroventrally by an acute wing. The valve-surface is reticulate and lined with fine ribs.

Remarks: Ruggieri (1953, p. 122) mentioned that this species had not yet been encountered in the fossil state so the present record is of significance for establishing its geological history.

Dimensions: Length = 0.48 mm, height = 0.25 mm, breadth = 0.13 mm (figured right valve).
Material: Two valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Naxos.
Pliocene: Spain (Almayate).

Ecology: Shallow marine. Lives mainly on algal detritus, but also calcareous algae (Müller, 1894). Rare in the Adriatic Sea and restricted to depths not exceeding 125 m. Stated to prefer medium and fine sand (Bonaduce *et al.,* 1975, p. 70).

Semicytherura costata (Müller, 1894)
Plate 21, Figs. 7, 8

1894 *Cytherura costata,* Müller, p. 295, pl. 8, figs. 11, 15; pl. 32, fig. 33.
1971 *Semicytherura costata* (Müller), Barbeito–Gonzalez, p. 296, pl. 24, figs. 1e, 2e.
1972 *Semicytherura costata* (Müller), Sissingh, p. 144.
1975 *Semicytherura costata* (Müller), Bonaduce, Ciampo, and Masoli, p. 71, pl. 44, fig. 13.

Description: The carapace is elongate, subrectangular in lateral view. The anterior margin is evenly rounded, the posterior margin obtusely rounded. The dorsal margin is broadly arched, the ventral margin slightly concave. The valve-surface is ornamented with longitudinal ridges, and reticulated with a polygonal network. The peripheral areas of the polygons are punctate. The valves are thin-shelled. The copulatory organ is diagnostic for this species (see Plate 21, Fig. 8, also Müller, 1894, Pl. 32, fig. 33).

Dimensions: Length = 0.45 mm, height = 0.17 mm, breadth = 0.10 mm (right valve).
Material: Three valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Bay of Naples, Adriatic Sea.
Pleistocene: Rhodes.
Pliocene: Rhodes.

Ecology: Shallow marine. Müller (1894) found it to live between calcareous algae, and to be rare in the Bay of Naples. Bonaduce *et al.* (1975) found it occasionally along the Apulia Coast. At Torre del Mar, where it is also rare, it was collected alive from a depth of 12 m, from a fine sandy bottom.

Semicytherura cribriformis (Müller, 1894)
Plate 21, Fig. 9

1894 *Cytherura cribriformis,* Müller, p. 295, pl. 17, figs. 1, 6; pl. 19, fig. 10.

Remarks: This species differs from *Semicytherura inversa* by being faintly reticulated, and in having a less pronounced caudal process. The specimens in the present collection show a denser polygonal reticulation than the material figured by Müller (1894).

Bonaduce *et al.* (1975, p. 73) mentioned that *S. cribriformis* has not been found in the Adriatic Sea, but has been erroneously kept in synonymy with *S. inversa* by Müller (1912) and by most subsequent authors.

Dimensions: Length = 0.48 mm, height = 0.25 mm, breadth = 0.14 mm (figured right valve).
Material: 5 valves.
Age: Late Pliocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Bay of Naples, Crotone.
Pleistocene: Italy.
Pliocene: Spain (Valle Niza), Italy.

Ecology: Shallow marine. Müller (1894) found this species on living *Posidonia* and detritus. At Torre del Mar it is rare, and was collected at a depth of 12 m. At Valle Niza it is also rare.

Semicytherura incongruens (Müller, 1894)
Plate 22, Figs. 3–5

1894 *Cytherura incongruens,* Müller, p. 296, pl. 17, figs. 2, 7, 8; pl. 19, fig. 7.
1953 *Cytherura incongruens* Müller.–Ruggieri, p. 118.
1968 *Semicytherura incongruens* (Müller), Masoli, p. 40, pl. 10, figs. 141–144.
1971 *Semicytherura incongruens* (Müller), Barbeito – Gonzalez, p. 297, pl. 25, figs. 1b, 2b.
1972 *Semicytherura incongruens* (Müller), Uffenorde, p. 90, pl. 10, fig. 6.
1974 *Semicytherura incongruens* (Müller), Doruk in: Stereo-Atlas 2 (2): 105–112.
1975 *Semicytherura incongruens* (Müller), Bonaduce, Ciampo, and Masoli, p. 72, pl. 40, figs. 12–15.

Description: The carapace is elongate-ovate in lateral view. The anterior margin is broadly rounded, and keeled anteriorly. The posterior margin is broad, and provided with an obtuse, upwardly projected caudal process. The valve-surface is reticulate, and punctate with longitudinal light costae running mainly ventrally. The extremities are shown in Plate 22, Figs. 3–5.

Dimensions: Length = 0.51 mm, height = 0.25 mm, breadth = 0.14 mm (left valve).
Material: 5 valves.
Age: Late Pliocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Monaco, Bay of Naples, Tunis, Adriatic Sea, Limski Channel, Aegean Sea.
Pleistocene: Italy, Turkey.
Pliocene: Turkey.

Ecology: Shallow marine. Müller (1894) found this form to live among seagrass and detritus in the Bay of Naples where it was rare. At Torre del Mar it is also rare, and was collected alive from depths of 8 and 12 m from fine sand. Bonaduce *et al.* (1975) found it to be the second most abundant species in the Adriatic Sea, occurring at depths not exceeding 125 m, with the maximum recorded number of specimens coming from depths between 20 and 50 m, with the optimum at 42 m. Ciliberto & Pugliese (1981, p. 75) reported it to be very common between 0 and 50 m in the Mediterranean.

Semicytherura inversa (Seguenza, 1880)
Plate 12, Fig. 10; Plate 13, Fig. 3

*1880 *Cytherura inversa,* Seguenza, p. 365, pl. 17, figs. 51a, 51b.
1953 *Cytherura inversa* Seguenza.–Ruggieri, p. 119.
1971 *Semicytherura inversa* (Seguenza), Barbeito – Gonzalez, p. 297, pl. 25, figs. 1a, 2a.
1972 *Semicytherura inversa* (Seguenza), Sissingh, p. 145, pl. 12, fig. 4.
1975 *Semicytherura inversa* (Seguenza), Bonaduce, Ciampo, and Masoli, p. 72, pl. 42, figs. 1–5.

Description: The carapace is ovate to subrectangular in lateral view. The dorsal margin is gently arched, with a postero-dorsal caudal process. The ventral margin is almost straight and is overlapped postero-ventrally by a marked alar projection. The valve-surface is reticulated upon which longitudinal riblets of variable strength are superimposed.

Dimensions: Length = 0.55 mm, height = 0.23 mm, breadth 0.16 mm (figured left valve).
Material: 4 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Aegean Sea, Adriatic Sea.
Pleistocene: Italy (Reggio Calabria), Rhodes.
Pliocene: Spain (Almayate, Mezquitilla), Italy (Reggio Calabria), Greece (Karpathos, Rhodes, Crete).

Ecology: Shallow marine, at depths not greater than 165 m, but optimally distributed between 70–80 m. Stated to prefer fine and medium sand (Bonaduce *et al.,* 1975).

Semicytherura sulcata (Müller, 1894)
Plate 22, Figs. 6–9; Plate 23, Figs. 1–4.

1894 *Cytherura sulcata,* Müller, p. 297, pl. 17, figs. 4, 10; pl. 19, fig. 19.
1952 *Cytherura sulcata* Müller.–Ruggieri, p. 82, pl. 5, figs. 1, 2.
1968 *Semicytherura sulcata* (Müller), Masoli, p. 45, pl. 10, figs. 156, 157.
1972 *Semicytherura sulcata* (Müller), Uffenorde, p. 93.
1974 *Semicytherura sulcata* (Müller), Doruk in: Stereo-Atlas 2 (2): 93–100.
1976 *Semicytherura sulcata* (Müller), Breman, p. 72, pl. 11, fig. 166.

Description: The carapace is elongate-ovate to subrectangular in lateral view. The anterior margin is broadly rounded. The posterior margin bears a subcentrally projected caudal process. The dorsal margin is slightly arched. The ventral margin is sinuous. The valve-surface is finely ribbed and punctate

(Plate 22, Fig. 9) to a variable degree passing to reticulation. The sexual dimorphism is strong; it is characterized by the males been more coarsely pitted than the females (cf. Plate 22, Figs. 6–8). This species is highly polymorphic in both ornament and shape. The ejaculatory and copulatory apparatus are shown in Plate 23, Fig. 2 and 3.

Dimensions:
Length = 0.51–0.58 mm, height = 0.24–0.28 mm, breadth = 0.13–0.14 mm (left valves).
Material: More than two hundred valves.
Age: Pleistocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Bay of Naples, Adriatic Sea, probably ubiquitous along the Mediterranean coasts.
Pleistocene: Italy (Imola), Turkey.

Ecology: Shallow marine (littoral) near-shore environment favouring a fine sandy substrate. Müller (1894) found the species to be rare in the Bay of Naples, and associated with the sea-grass *Posidonia.* Bonaduce *et al.* (1975, p. 81) found this species in the Adriatic Sea at depths not exceeding 120 m where the maximum number of specimens corresponds to depths of between 40 and 70 m. At Torre del Mar, this species was collected alive at depths of 8, 10 and 12 m with the greatest frequency at a depth of 12 m.

Semicytherura sp. 1
Plate 13, Fig. 5

Description: The carapace is subquadrangular in lateral view. The anterior margin is evenly rounded, the posterior margin obliquely truncated with a projected caudal process produced above the middle. In lateral view, the dorsal margin is gently arched and sinuous. The ventral margin is almost parallel with the dorsal margin. The alar lateral prolongation is almost smoothly rounded, overlapping the valve. The valve-surface is swollen from the centre of the valve to the postero-ventral corner with a smoothly rounded alar process. The surface is ornamented with longitudinal ribs, with a main pitted depression on the pronounced wing.

Dimensions: Length = 0.40 mm, height = 0.21 mm, breadth = 0.10 mm (figured carapace).
Material: 6 valves.
Age: Early Pliocene.
Occurrence: Spain (Peñon de Almayate).

Semicytherura sp. 2
Plate 13, Fig. 7

Description: The carapace is ovate to subrectangular in lateral view. The dorsal margin is gently convex, and the ventral margin sinuous. The anterior margin is evenly rounded; the posterior caudal process is projected just above the mid-height of the valve. This species is probably close to the material referred *Semicytherura* aff. *inversa* by Bonaduce, Ciampo, and Masoli (1975).

Dimensions: Length = 0.55 mm, height = 0.29 mm, breadth = 0.15 mm (figured left valve).
Material: Two valves.
Age: Early Pliocene.
Occurrence: Spain (Peñon de Almayate).

Semicytherura sp. 3.
Plate 22, Figs. 1–2.

Description: The carapace is elongate subquadrangular in lateral view. The anterior margin is broadly rounded. The posterior margin is obtusely truncate, and projected mid-posteriorly. The dorsal margin is almost straight, the ventral margin sinuous. The shell has a pronounced posteroventral ridge, which is provided with a small alar prolongation. The valve-surface is finely pitted, and is reticulated mainly anteriorly and posteriorly with weakly defined longitudinal costae. The inner lamella is wide anteriorly, the marginal pore canals are curved. The normal pore canals are simple.

Remarks: This species differs from *S. sella* (Sars, 1865) and *S. tela* Whittaker, 1980 by being much larger, and the absence of the costal ridges in the central region.

Dimensions:
Length = 0.46–0.56 mm, height = 0.23–0.26 mm, breadth = 0.09–0.13 mm.
Material: 6 valves.
Occurrence: Spain (Torre del Mar).
Age: Recent.

Ecology: Shallow marine. Living probably among fine encrusting algae (see Plate 22, fig. 2). At Torre del Mar, it was collected from depths of 10 and 12 m on a fine sandy substrate. It was probably living at the time of collection.

Subfamily CYTHEROPTERINAE Hanai, 1957
Genus CYTHEROPTERON Sars, 1866

Cytheropteron rotundatum Müller, 1894
Plate 13, Fig. 4

1894 *Cytheropteron rotundatum*, Müller, p. 301, pl. 20, figs. 4, 10; pl. 21, fig. 20.
1972 *Cytheropteron rotundatum* Müller.–Uffenorde, p. 95, figs. 34, 35, pl. 3, fig. 5.
1972 *Cytheropteron (Cytheropteron) rotundatum* Müller. – Sissingh, p. 139, pl. 11, fig. 7.
1975 *Cytheropteron rotundatum* Müller.–Bonaduce, Ciampo, and Masoli, p. 96, pl. 53, figs. 1–8.
1976 *Cytheropteron rotundatum* Müller.–Breman, p. 74, pl. 12, fig. 175.

Description: The carapace is subrhomboidal in lateral view. The anterior end is obliquely rounded below mid-height. The posterior has a well-developed bottleneck-shaped caudal process which is turned upwards. The dorsal margin is gently arched. The alae are triangular and posteriorly directed. The valves are inflated and bear three longitudinal ridges of which two connect the alar projection with the caudal process. The shell is heavily calcified.

Dimensions: Length = 0.43 mm, height = 0.24 mm, breadth = 0.13 mm (left valve).
Material: 4 valves.
Age: Early Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Malta, Adriatic Sea, Aegean Sea.
Pleistocene: Rhodes.
Pliocene: Spain (Almayate).
Miocene: France.

This species has also been reported from the Black Sea (Schornikow, 1969).

Ecology: Marine (infra-littoral). Lives on seaweed and algae (Müller, 1894). Uffenorde (1972, p. 95) recorded it at depths between 17–37 m in the Limski Channel and over a temperature range of 9–20°C and a salinity of >38 ‰. Bonaduce *et al.* (1975) suggested that this species seems to be present only at depths greater than 50 m. The abundance is said to increase with depth with an optimum between 170 and 210 m.

Cytheropteron sp.
Plate 13, Fig. 11

Description: A species of *Cytheropteron* s. str. with an evenly rounded anterior end and with a marginal "keel" situated mid-anteriorly. The posterior margin bears an obtuse caudal process. The alar prolongation is triangular and has a cavity in its upper part.

Remarks: This species may possibly be related to *C. apostoliensis* Sissingh (1972) and *C. punctatum* Brady (1868). The condition of the material at my disposal does not permit a further investigation of this species as it is present only by juveniles.

The ages of this form compared with *C. apostoliensis* and *C. punctatum* are as follows:

	Miocene	Pliocene	Pleistocene
Cytheropteron apostoliensis	+		
Cytheropteron punctatum			+
Cytheropteron sp.		+	

Material: Three valves.
Age: Early Pliocene.
Occurrence: Spain (Peñon de Almayate).

Family XESTOLEBERDIDAE Sars, 1928
Genus XESTOLEBERIS Sars, 1986

Xestoleberis communis Müller, 1894
Plate 14, Figs. 1–3

1894 *Xestoleberis communis*, Müller, p. 338, pl. 25, figs. 32, 33, 39; pl. 26, figs. 1, 6.
1971 *Xestoleberis communis* Müller. – Barbeito – Gonzalez, p. 317, pl. 39, figs. 1d–3d.
1976 *Xestoleberis communis* Müller.–Breman, p. 75, pl. 3, fig. 36.
1976 *Xestoleberis communis* Müller.–Athersuch, p. 296, pl. 9, figs. 1–4; pl. 10, figs. 1, 3–5; pl. 17, fig. 8, text-figs. 5b, 5d, 8c, 10b.

Description: The carapace is egg-shaped and widest behind the middle. The dorsal margin is convex, the ventral margin is sinuous. The anterior margin is rounded and narrower than the posterior margin which is broadly rounded. The carapace has distinctive central, dorsal and posterior opaque spots. The surface is smooth and the valves are thinly calcified. A left hinge is illustrated in Plate 14, Fig. 2.

Dimensions: Length = 0.65 mm, height = 0.45 mm, breadth = 0.20 mm (left valve).
Material: More than 1000 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Mediterranean Sea in general.
Pleistocene: Rhodes.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de

San Antón, Valle Niza, Rio Guadalminar), Tunis, Greece (Karpathos, Rhodes), Egypt.
Miocene: Crete.

Egology: Shallow marine. Near-shore species, very common and widespread in all regions in the Mediterranean. Stated to prefer medium sand (Bonaduce *et al.*, 1975). Predator drill-holes occur in 8.7 % of the shells from Almayate (see Fig. 25: 4) Müller (1894, p. 339) mentioned that this species is one of the most abundant ostracods in the Bay of Naples. At Almayate, I found it to be the most abundant species after the two species of *Aurila*. According to Bodergat (1983) it lives on "Posidonies cymodoceés" in recorded salinities of up to 38 ‰.

Xestoleberis dispar Müller, 1894
Plate 14, Fig. 4

1894 *Xestoleberis dispar,* Müller, p. 334, pl. 25, figs. 2, 3, 9, 35.
1975 *Xestoleberis dispar* Müller.–Bonaduce, Ciampo, and Masoli, p. 124, pl. 73, figs. 1–3.
1976 *Xestoleberis dispar* Müller.–Breman, p. 75, pl. 3, fig. 38.
1976 *Xestoleberis dispar* Müller.–Athersuch, p. 297, pl. 15, fig. 2, text-fig. 7f.

Description: The carapace is ovate-elongate, almost subtriangular in lateral view, with the characteristics of *Xestoleberis.* The anterior and posterior margins are broadly rounded. The dorsal margin is convex and the ventral margin concave.

Dimensions: Length = 0.55 mm, height = 0.32 mm, breadth = 0.13 mm (left valve).
Material: 150 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Aegean Sea.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón), SE France.

Ecology: Shallow marine, near-shore species. Lives on "Posidonies cymodoceés", calcaraeous algae and corals (Bodergat, 1983). Stated to prefer sandy pelite and sandy silt. Bonaduce *et al.* (1975, p. 124) reported this species to prefer depth-range of 15 to 125 m, but to be common at depths not exceeding 50 to 60 m. Bodergat (1983) noted it to occur in water with a salinity of up to 38 ‰. Predator drill-holes occur in 6.1 % of the material from Almayate (see Fig. 25: 1).

Drilling of *Xestoleberis* by predatory gastropods has not previously been recorded in the literature.

Xestoleberis fuscomaculata Müller, 1894
Plate 14, Figs. 6, 7

1894 *Xestoleberis fuscomaculata,* Müller, p. 337, pl. 25, figs. 41, 42; pl. 26, fig. 3.
1975 *Xestoleberis fuscomaculata* Müller.–Breman, p. 76, pl. 3, fig. 37.
1976 *Xestoleberis fuscomaculata* Müller.–Athersuch, p. 296, pl. 13, figs. 1–4; pl. 17, figs. 4, 6, 12, 14, 15; text-figs. 4a, c–g, j, 6e, 10a.

Description: The carapace is egg-shaped and widest behind the middle. The dorsal margin is convex, the ventral margin sinuous. The anterior margin is rounded and narrower than the posterior margin, which is broadly rounded. The valve-surface is smooth and dark-pigmented. The valves are thinly calcified.

Dimensions: Length = 0.62 mm, height = 0.32 mm, breadth = 0.15 mm (left valve).
Material: 60 valves.
Age: Early Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Aegean Sea, Cyprus.
Pliocene: Spain (Almayate, Mezquitilla).
Miocene: "Paratethys."

Ecology: Shallow marine and phytal zone. Living on and among seaweed and sponges (Müller, 1894). Athersuch (1976) found *X. fuscomaculata* at Dhekelia in Cyprus at a depth of 5 m and with in water salinity of up to 39 ‰.

Xestoleberis margaritea (Brady, 1866)
Plate 15, Fig. 2

1866 *Cytheridea margaritea,* Brady, p. 370, pl. 58, figs. 6a–d.
1953 *Xestoleberis margaritea* (Brady), Ruggieri, p. 123, pl. 5, figs. 41–44.
1972 *Xestoleberis* ex. gr. *margaritea* (Brady), Sissingh, p. 151.
1976 *Xestoleberis margaritea* (Brady), Athersuch, p. 294, pl. 11, figs. 1–3, text-fig. 9b.

Diagnosis: The carapace is egg-shaped with the characteristics of *Xestoleberis.* The anterior and posterior margins are evenly rounded. The dorsal margin is gently arched. The ventral margin is slightly sinuous, the valve-surface is smooth and with opaque spots, located in a manner which is diagnostic for this species.

Dimensions: Length = 0.49 mm, height = 0.30 mm, breadth = 0.18 mm (right valve).
Material: More than 270 valves.
Age: Late Miocene to Recent.

Distribution:
Recent and Holocene: Gulf of Monaco and Marseille, Italy, Ionian Sea, Levant.
Pleistocene: Italy, Rhodes.
Pliocene: Spain (Almayate, Mezquitilla), Italy, Karpathos, Rhodes.
Miocene: Crete.

This species has a broad geographical distribution, and has been reported worldwide, from the Indopacific Ocean, Panama, Western Australia, Oyster Harbour, and the Andaman Islands.

Ecology: Shallow marine. Lives on sponge-sand (Brady, 1866). Naticid drill-holes occur on 3 % of the shells from Almayate (see Fig. 25: 3).

Xestoleberis reymenti Ruggieri, 1967
Plate 14, Fig. 5.

1967 *Xestoleberis reymenti,* Ruggieri, p. 379, text-figs. 47–52.
1972 *Xestoleberis reymenti,* Ruggieri.–Sissingh, p. 151, pl. 4, fig. 11.

Remarks: The carapace is egg-shaped with the characteristics of *Xestoleberis.* The position of the muscle scars and the marginal and submarginal pore canals are diagnostic for this species. The present material shows the characteristically rounded anterior of *X. reymenti* (cf. Plate 14, Fig. 5 and Ruggieri, 1967, fig. 47).

Dimensions: Length = 0.58 mm, height = 0.38 mm, breadth = 0.15 mm (left valve).
Material: 20 valves.
Age: Late Miocene to Middle Pliocene.
Distribution:
Pliocene: Spain (Almayate, Mezquitilla), SE France.
Miocene: Gavdos, Crete. Italy (Casa, Gessi).

Xestoleberis ventricosa Müller, 1894
Plate 15, Fig. 1

1894 *Xestoleberis ventricosa,* Müller, p. 335, pl. 25, fig. 4, 5, 14, 34, 38.
1972 *Xestoleberis ventricosa* Müller.–Sissingh, p. 151, pl. 4, fig. 12.
1975 *Xestoleberis ventricosa* Müller.–Bonaduce, Ciampo, and Masoli, p. 125.
1976 *Xestoleberis ventricosa* Müller.–Athersuch, p. 297, pl. 3, figs. 2–4; pl. 17, figs. 10, 11; text-fig. 86.

Description: The carapace is ovate elongate and inflated posteroventrally. The anterior margin is broadly rounded, the posterior margin is narrower, evenly rounded, and inflated posteroventrally, a characteristic feature of this species. Müller (1894, p. 335) made special mention of the diagnostic significance of the posterior margin.

Dimensions: Length = 0.58 mm, height = 0.36 mm, breadth = 0.20 mm (right valve).
Material: More than 100 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Cyprus.
Pliocene: Spain (Almayate, Mezquitilla), Crete.
Miocene: Greece (Crete).

Ecology: Shallow marine. Lives on calcareous algae (Müller, 1894, p. 335) The figured right valve (Plate 15, Fig. 1) has calcareous algal fragments on it. Naticid drill-holes occur in 5.5 % of the material collected from Almayate (see Fig. 25: 2).

Family BYTHOCYTHERIDAE Sars, 1866
Genus BYTHOCYTHERE Sars, 1866

Bythocythere turgida Sars, 1866
Plate 15, Fig. 5

1866 *Bythocythere turgida,* Sars, p. 84
1928 *Bythocythere turgida* Sars.–Sars, p. 233, pl. 57.
1975 *Bythocythere turgida* Sars.–Bonaduce, Ciampo, and Masoli, p. 115, pl. 68, figs. 1–6.

Remarks: The dorsal margin is smoothly convex. The anteroventral region of the valve-surface has light reticulae. The posteroventral region is "wrinkled." Sars (1928, p. 234) considered sexual dimorphism in the carapace dimensions to be slight.

Dimensions: Length = 0.88 mm, height = 0.54 mm, breadth = 0.28 mm (figured right valve).
Material: 18 valves.
Age: Early Miocene to Recent.
Distribution:
Recent and Holocene: Adriatic.
Pliocene: Spain (Almayate, Mezquitilla, Las Palmares).

This species was originally described from the west coast of Norway, and has also been reported from the British Isles, Spitsbergen, Gulf of St. Lawrence, Skagerrak, and from the Miocene of France (Bordeaux).

Ecology: Shallow marine. (infra-neritic), and deep marine and seems to be eurybathyal. Thus it has been found at various depths down to over 800 m (cf. Breman, 1976, p. 38). Sars (1928) found it on muddy substrates at a depth of 18 m. Elofson (1941, p. 334) recorded it from the Skagerrak and in depths ranging from 20 to 140 m and in a salinity of up to 30 ‰. Bonaduce *et al.* (1975, p. 115) recorded *B. turgida* at depths ranging up from 27 m, with maximum abundances at 70 m and 210 m in the Adriatic Sea. The significance of this bimodality in vertical distribution requires further investigation.

Genus MONOCERATINA Roth, 1928

Monoceratina mediterranea Sissingh, 1972
Plate 15, Fig. 4

1953 *Monoceratina* sp., Ruggieri, p. 127, pl. 2, fig. 15.
1972 *Monoceratina mediterranea,* Sissingh, p. 152, pl. 12, figs. 13, 14.
1973 *Monoceratina mediterranea* Sissingh.–Ruggieri, p. 223, fig. 2.
1975 *Monoceratina mediterranea* Sissingh.–Bonaduce, Ciampo, and Masoli, p. 117, text-fig. 44.
1976 *Monoceratina mediterranea* Sissingh.–Minichelli, Pugliese, and Bonaduce, p. 473, pl. 1, figs. 5–7.

Description: The carapace is subrhomboidal in lateral view. The dorsal margin is somewhat sinuous, the ventral margin almost straight. The anterior margin is rounded. The posterior margin is slightly rounded ventrally, sloping upward to the distinct subdorsal caudal process. This species is characterized by a distinct subcentral sulcus, a large ventrolateral keel, and a low ridge along the dorsal margin. The shell is heavily calcified.

Dimensions: Length = 0.75 mm, height = 0.60 mm, breadth = 0.22 mm (left valve).
Material: 12 valves.
Age: Late Miocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, South Aegean Sea.
Pleistocene: Italy (in Rio Riorzo, near Castell'Arquato), Rhodes, Ionian Coast.
Pliocene: Spain (Almayate), Italy (in Rio Riorzo, near Castell'Arquato). Karpathos, Rhodes.
Miocene: Crete.

Ecology: Benthonic; marine, reported from depths of 140 to 375 m in the Gulf of Naples (Minichelli *et al.,* 1976). Bonaduce *et al.* (1975, p. 117) state that this species only occurs in waters deeper than 160 m, and that it prefers sandy pelite and silty substrates.

Genus PSEUDOCYTHERE Sars, 1866

Pseudocythere caudata Sars, 1866
Plate 15, Fig. 3

1866 *Pseudocythere caudata,* Sars, p. 88.
1880 *Pseudocythere caudata* Sars.–Brady, p. 144, pl. 1, figs. 6, a–d.
1894 *Pseudocythere caudata* Sars.–Müller, p. 285, pl. 16, figs. 5, 10, 30–36.
1928 *Pseudocythere caudata* Sars.–Sars, p. 239, pl. 109, fig. 2.
1975 *Pseudocythere caudata* Sars.–Bonaduce, Ciampo, and Masoli, p. 119, pl. 14, figs. 9, 10.

Description: The carapace is oval to subquadrangular in lateral view, with the typical caudal process of the genus. The dorsal margin is straight, the ventral margin sinuous. The anterior margin is broadly rounded, the posterior margin obliquely truncate and projected posterodorsally as an extended posteroventral ridge. Bonaduce *et al.* (1975, p. 119) in their description intimate that *P. caudata* displays polymorphism in shape.

Material: One valve.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Around the Mediterranean Sea.
Pliocene: Spain (Almayate).

This species was originally described from Norway, and has also been reported from the Recent and Holocene of the British Isles (Coles, pers. comm.), Fosse de Cap Breton, Bay of Biscay, Kerguelen, Scotland and Ireland.

Ecology: Benthonic; shallow to deep marine, 150 m to 210 m in the Adriatic. Yassini (1969, p. 116) observed *P. caudata* to be very rare in the Bay of Biscay. The species is euryhaline and eurythermal (Elofson, 1941), and lives over a depth range of 7–220 m. Yassini (1969) recorded his specimens from about 80 m. Bonaduce *et al.* (1983) reported this species from the Gulf of Aqaba in a near-shore environment. Müller (1894) reported *P. caudata* to live on calcareous algae. Bonaduce *et al.* (1975) found the species on various types of bottom, with the maximum number of specimens occurring on very sandy pelite, sandy pelite, and sandy silt.

Family PARADOXOSTOMATIDAE Brady and Norman, 1889
Genus PARADOXOSTOMA Fischer, 1855

Paradoxostoma simile Müller, 1894
Plate 17, Fig. 10

1894 *Paradoxostoma simile,* Müller, p. 318, pl. 22, fig. 30; pl. 27, figs. 2, 25, 27, 32.
1952 *Paradoxostoma simile* Müller.–Ruggieri, p. 91, pl. 8, fig. 7.

1968 *Paradoxostoma simile* Müller. – Masoli, p. 58, pl. 3, fig. 30; pl. 13, figs. 197–199.
1975 *Paradoxostoma simile* Müller. – Bonaduce, Ciampo, and Masoli, p. 120, pl. 71, figs. 10, 11.

Description: The carapace is elongate-ovate to subrhomboidal in lateral view. The anterior margin is narrowly rounded, the posterior margin subacute. The dorsal margin is convex, the ventral margin sinuous. The valve-surface is smooth to "polished" in aspect. The valves are thin and pellucid. The figured carapace is rather large for the species.

Dimensions: Length = 0.90 mm, height = 0.38 mm, breadth = 0.15 mm (figured carapace).
Material: 8 valves and carapaces.
Age: Recent.
Distribution:
Recent: Spain (Torre del Mar), Monaco, Bay of Naples, Adriatic Sea.

Ecology: Shallow marine. Müller (1894) found it to live mainly between seaweed and calcareous algae. Masoli (1968) found it at a depth of 20 m. Bonaduce *et. al.* (1975) noted it to be rare and to lack distributional connections with depth and substrate. At Torre del Mar it is rare where it was collected from a depth of 12 m (on sandy pelitic sediment).

Superfamily CYPRIDACEA Baird, 1845
Family MACROCYPRIDIDAE G.W. Müller, 1912
Genus MACROCYPRIS Brady, 1868

Macrocypris succinea Müller, 1894
Plate 15, Fig. 6

1894 *Macrocypris succinea,* Müller, p. 242, pl. 13, figs. 8–26, 28; pl. 38, fig. 34.
1972 *Macrocypris* sp. 2., Sissingh, p. 80, pl. 3, fig. 15.

Description: The carapace is elongate; the anterior margin is broadly rounded towards the tapered posterior, the posteroventral corner subacute. The dorsal margin is arched and the ventral margin slightly concave. The greatest height is at midlength. The valve-surface is almost smooth. The figure (Plate 15, Fig. 6) illustrates the internal aspect of a right valve.

Dimensions: Length = 1.36 mm, height = 0.53 mm, breadth = 0.28 mm (right valve).
Material: 20 valves.
Stratigraphical range: Early Pliocene to Recent.
Distribution:
Recent: Bay of Naples.
Pliocene: Spain (Almayate, Mezquitilla), Karpathos.

Remarks: This species occurs in the Pliocene of Pombal, Portugal (Nascimento, 1983).

Ecology: Benthonic; shallow marine (infraneritic, infralittoral) and deep marine (bathyal) according to Van Morkhoven (1963) and Breman (1976). It is a bottom dweller and lives on and among calcareous algae. Stated to prefer warm shallow environments (cf. Müller, 1894; Sars, 1928; Breman, 1976).

Family PONTOCYPRIDIDAE G.W. Müller, 1894
Genus PONTOCYPRIS Sars, 1866

Pontocypris acuminata (Müller, 1894)
Plate 15, Figs. 7, 8

1894 *Erythrocypris acuminata,* Müller, p. 259, pl. 11, figs. 5, 6, 40–42.
1971 *Pontocypris* aff. *acuminata* (Müller), Barbeito – Gonzalez, p. 268, pl. 6, figs. 1b, 2b.
1976 *Pontocypris acuminata* (Müller), Breman, p. 81, pl. 11, fig. 17.

Description: The carapace is subtriangular to elongate, acuminate; the anterior end is broadly rounded, the posterior strongly extended. The dorsal margin is arched and angled anterior of the middle, the ventral margin is sinuous. The valves are thinly calcified. The figured right valve is damaged in the posterior part. The material available seems to consist entirely of instars.

Dimensions: Length = 0.52 mm, height = 0.28 mm, breadth = 0.10 mm (right valve).
Material: 18 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Northern Coast of the Tyrrhenian Sea Bay of Naples, Aegean Sea.
Pliocene: Spain (Almayate, Mezquitilla, Cerro de San Antón, Valle Niza, Rio Guadalminar).
Ecology: Shallow marine (neritic). Active phytal swimmers. Müller (1894) found it to be rare in the Bay of Naples, and to live on calcareous algae and detritus.

Pontocypris mytiloides (Norman, 1862)
Plate 12, Fig. 11

*1862 *Cythere (Bairdia) mytiloides,* Norman, p. 50, pl. 3, figs. 1–3.
1894 *Erythrocypris serrata* G.W. Müller, p. 258, pl. 11, figs. 10, 11, 36–38.

Description: The carapace is subtriangular in lateral view. The anterior margin is evenly rounded, the posterior margin narrowly rounded, and tapered. The dorsal margin is almost straight. The valve-surface is smooth.

Dimensions: Length = 1.03 mm, height = 0.48 mm, breadth = 0.18 mm (figured left side).
Material: One carapace.
Age: Early Pliocene to Recent.
Recent: Bay of Naples, coast of France.
Pliocene: Spain (Cerro de San Antón).

Remarks: P. mytiloides has a broad geographical distribution outside the Mediterranean. Brady reported this species from the British Isles, and from the Pleistocene of Norway and Scotland (cf. Sars, 1928, p. 52).

It occurs along the Atlantic coast of France at Château du Taureau, Entre Duslen, Pighet, and Morgat (De Vos, 1957).

Ecology: Marine (Pokorný, 1958). Müller (1894) found this species between calcareous algae and detritus and to be rare in the Bay of Naples. Sars (1928) observed it to be abundant on sandy bottoms in the Laminarian regions of Korshavn and Risör in Norway.

Genus PROPONTOCYPRIS Sylvester–Bradley, 1947

Propontocypris intermedia (Brady, 1868)
Plate 12, Fig. 6

1868 *Pontocypris intermedia,* Brady, p. 220, pl. 14, figs. 1, 2.
1894 *Pontocypris intermedia,* G.W. Müller, p. 254, pl. 9, figs. 1, 22–25.
1975 *Propontocypris intermedia* (Brady), Bonaduce, Ciampo, and Masoli, p. 26, pl. 9, figs. 3, 4.

Remarks: The carapace is elongated subtriangular in lateral view. The anterior margin is evenly rounded; the posterior margin is subacute. The valve-surface is smooth.

Dimensions: Length = 0.76 mm, height = 0.34 mm, breadth = 0.10 mm (figured right side).
Material: 6 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Bay of Naples, Adriatic Sea, Tenedos.
Pliocene: Spain (Valle Niza).

Ecology: Shallow marine. Müller (1894) recorded this species living on calcareous algae, seaweed and detritus. Bonaduce *et al.* (1975) grouped it together with *Propontocypris pirifera.*

Propontocypris pirifera (Müller, 1894)
Plate 12, Fig. 8; Plate 17, Fig. 12

1894 *Pontocypris pirifera,* Müller, p. 247, pl. 10, figs. 1–3, 18–20, 22–24; pl. 38, fig. 52.
1969 *Propontocypris pirifera* (Müller), Yassini, p. 29, pl. 15.
1975 *Propontocypris pirifera* (Müller), Bonaduce, Ciampo, and Masoli, p. 26, pl. 9, figs. 5, 6.
1982 *Propontocypris pirifera* (Müller), Athersuch & Whittaker in: Stereo-Atlas 9 (1): 69–76.

Description: The carapace is subtriangular in lateral view. The anterior margin is evenly rounded, the posterior margin obtusely so. The dorsal margin is convex, the ventral margin sinuous. The valve surface is finely reticulate, and "hirsute". The figured juvenile specimen is poorly calcified (Plate 17, Fig. 12).

Dimensions: Length = 0.46 mm, height = 0.28 mm, breadth = 0.10 mm (left valve).
Material: 4 valves.
Age: Early Pliocene to Recent.
Distribution:
Recent and Holocene: Spain (Torre del Mar), Bay of Naples, Adriatic Sea.
Pliocene: Spain (Valle Niza, Mezquitilla).

Remarks: P. pirifera occur on the Atlantic coast of France at Chenal de l'Ile Verte, Le Beclem, Tysaoson and Château du Taureau (De Vos, 1957, p. 12).

Ecology: Shallow marine. Müller (1894) found this species living among *Posidonia* in the Bay of Naples, and between *Phylochaetopterus socialis* at Santa Lucia. Bonaduce *et al.* (1975) found it to be rare in the Adriatic Sea. At Torre del Mar it is rare and was collected alive from a depth of 12 m (sandy pelitic bottom). It is also rare at Valle Niza.

Family CANDONIDAE Kaufmann, 1900
Subfamily PARACYPRIDINAE Sars, 1923
Genus PARACYPRIS Sars, 1866

Paracypris aff. *polita* Sars, 1866
Plate 15, Figs. 9, 10

1866 *Paracypris polita,* Sars, p. 12.

Description: The carapace is elongate to subtriangular; the anterior margin is broadly rounded, the posterior margin is sharply rounded and subacute. The dorsal margin is arched, the ventral margin slightly sinuous. The valve-surface is smooth and shiny. The valves are heavily calcified. The left valve is larger than the right.

Remarks: This species is related to *Paracypris polita* Sars 1866, but differs in having a sharply rounded subacute posterior end. Most of the present specimens are damaged.

Dimensions: Length = 1.40 mm, height = 0.56 mm, breadth = 0.23 mm (left valve).
Material: Almost 140 valves.
Age: Early Pliocene.
Occurrence: Peñon de Almayate, Mezquitilla.

Ecology: Benthonic; shallow marine. *Paracypris polita* is a cosmopolitan species originally described from Norway. The species is probably inhabits the Mediterranean today (Brady & Norman, 1889).

Family CYPRIDIDAE Baird, 1845
Subfamily EUCYPRIDINAE Bronstein, 1947
Genus EUCYPRIS Vavra, 1891

Eucypris virens (Jurine, 1820)?
Plate 18, Figs. 9, 10

*1820 *Monoculus virens,* Jurine, p. 174, pl. 18, figs. 15, 16.
1902 *Cypris virens* (Jurine), Brady, p. 192, pl. 23, fig. 8.
1928 *Eucypris virens* (Jurine), Sars, p. 113, pl. 52.
1958 *Eucypris virens* (Jurine), Pokorný, p. 235, fig. 893.

Description: The carapace is elongate-ovate to subtriangular in lateral view. The anterior margin is broadly rounded, the posterior is narrowly rounded. The dorsal margin is convexly arched, and inclines sharply mid-dorsally. The ventral margin is sinuous. The valve-surface is smoothly punctate, and reticulate, with a peculiar scaly sculpturing. The valves are thinly calcified.

Remarks: The collection from Torre del Mar consist only of juveniles. The juveniles are easily distinguished from the adults by their peculiar sculpture, which is almost identical to that of *Cypris tessellata* Fischer, figured by Brady (1868, p. 366, pl. 23, figs. 39–45). I note that Sars (1928, p. 114) observed the same feature in his collection. It seems that this species is highly polymorphic, as far as can be ascertained from the literature and the present material. Sars (1928) did not find males in any of the collections he examined. This may mean that *E. virens* is parthenogenetic. Because later workers have not addressed themselves to this problem it would be incautious to draw conclusions from this material. Little is known of the proven distribution of parthenogenesis in ostracods – the only irrefutable evidence available at present for this type of reproduction is in non-marine species. However, there is another question: Sars (1928) recorded this problematical species from a freshwater environment, whereas Brady (1902) obtained it from a normal marine environment. Either the species is extremely euryhaline, which would appear improbable, or else there is a taxonomic confusion. Unfortunately, the material at my disposal does not permit a solution to this question.

Dimensions: Length = 0.64 mm, height = 0.38 mm, breadth = 0.13 mm (figured right valve).
Material: 5 valves.
Age: Tertiary to Recent.
Pokorný (1958) quotes a "Tertiary" age without further specification.
Distribution:
Recent: Spain (Torre del Mar).

E. virens has a broad geographical distribution and is known throughout Europe, North America, and Greenland.

Ecology: Sars (1928, p. 114) considered *E. virens* to be the commonest freshwater ostracod in Norway, being found abundantly in grassy ponds and swamps in early summer. At Torre del Mar; this species was collected from a depth of 12 m.

Bodegat (1983, p. 65, 88) recorded *Eucypris virens media* at Tour du Valat living on "Characées" in temporary tidal pools and in the open sea.

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PLATES

Lower Pliocene ostracods

Plate 1

1. *Cytherelloidea beckmanni* Barbeito–Gonzalez, 1971. Exterior view of a left valve. Early Pliocene. Almayate. PMSp391. × 100.

2. Same species. Dorsal view of carapace. PMSp392. × 100.

3. *Neonesidea corpulenta* Müller, 1894. Exterior view of a right valve. Early Pliocene. Almayate. PMSp393. × 100.

4. Same species. Interior view of a right valve. PMSp394. × 100.

5. *Neonesidea longevaginata* (Müller, 1894). Left side of carapace. Early Pliocene. Almayate. PMSp395. × 100.

6. Same species. Exterior view of a right valve. Early Pliocene. Mezquitilla. PMSp396. × 100.

7. *Neonesidea mediterranea* (Müller, 1894). Left side of carapace. Early Pliocene. Almayate. PMSp397. × 100.

8. Same species. Interior view of a right valve. PMSp398. × 100.

9. Same species. Left side of carapace. PMSp399. × 100.

10. *Neonesidea frequens* (Müller, 1894). Left side of carapace. Early Pliocene. Almayate. PMSp400. × 100.

11. Same species. Right side of carapace. PMSp401. × 100.

12. *Neonesidea formosa* (Brady, 1868). Exterior view of a left valve. Early Pliocene. Almayate. PMSp402. × 100.

13. Same species. Interior view of a right valve. PMSp403. × 100.

Plate 1

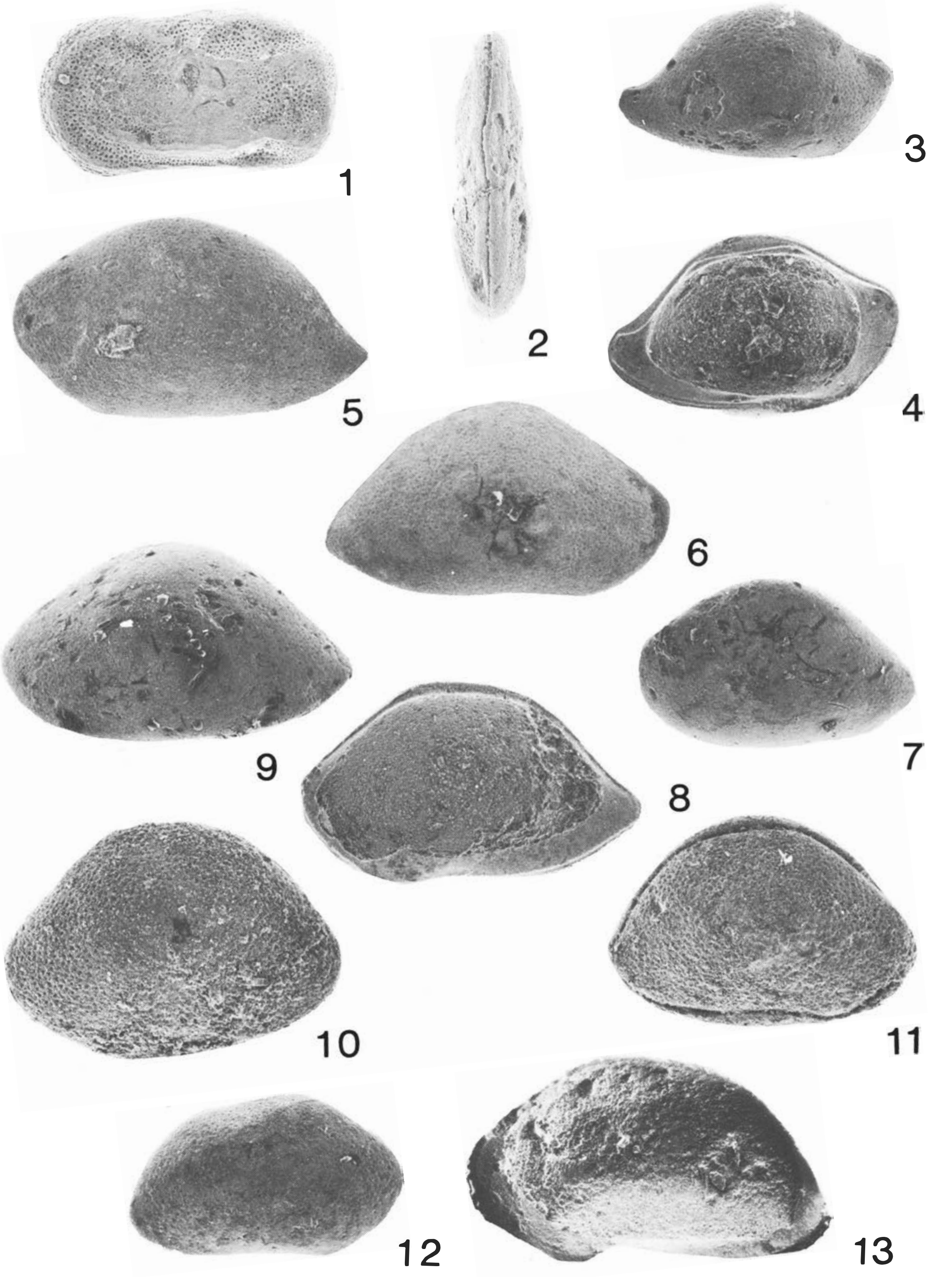

Plate 2

1. *Neonesidea formosa* (Brady, 1868). Interior view of a left valve. Early Pliocene. Almayate. PMSp404. × 200.

2. Same species. Exterior view of a left valve. PMSp405. × 200.

3. *Bythocypris bosquetiana* (Brady, 1866). Lateral view of a right valve. Early Pliocene. Almayate. PMSp406. × 200.

4. Same species. Interior view of a right valve. PMSp407. × 200.

5. Same species. Left side of a juvenile. PMSp408. × 200.

6. *Bythocypris lucida* (Seguenza, 1880). Exterior view of a right valve. Early Pliocene. Rio Guadalminar. PMSp409. × 100.

7. *Microcythere angulosa* (Seguenza, 1880). Left side of carapace. Early Pliocene. Almayate. PMSp410. × 200.

8. *Callistocythere littoralis* (Müller, 1894). Dorsal view of carapace. Early Pliocene. Almayate. PMSp411. × 200.

9. Same species. Left side of carapace. PMSp412. × 200.

10. Same species. Right side of carapace. PMSp413. × 200.

Plate 2

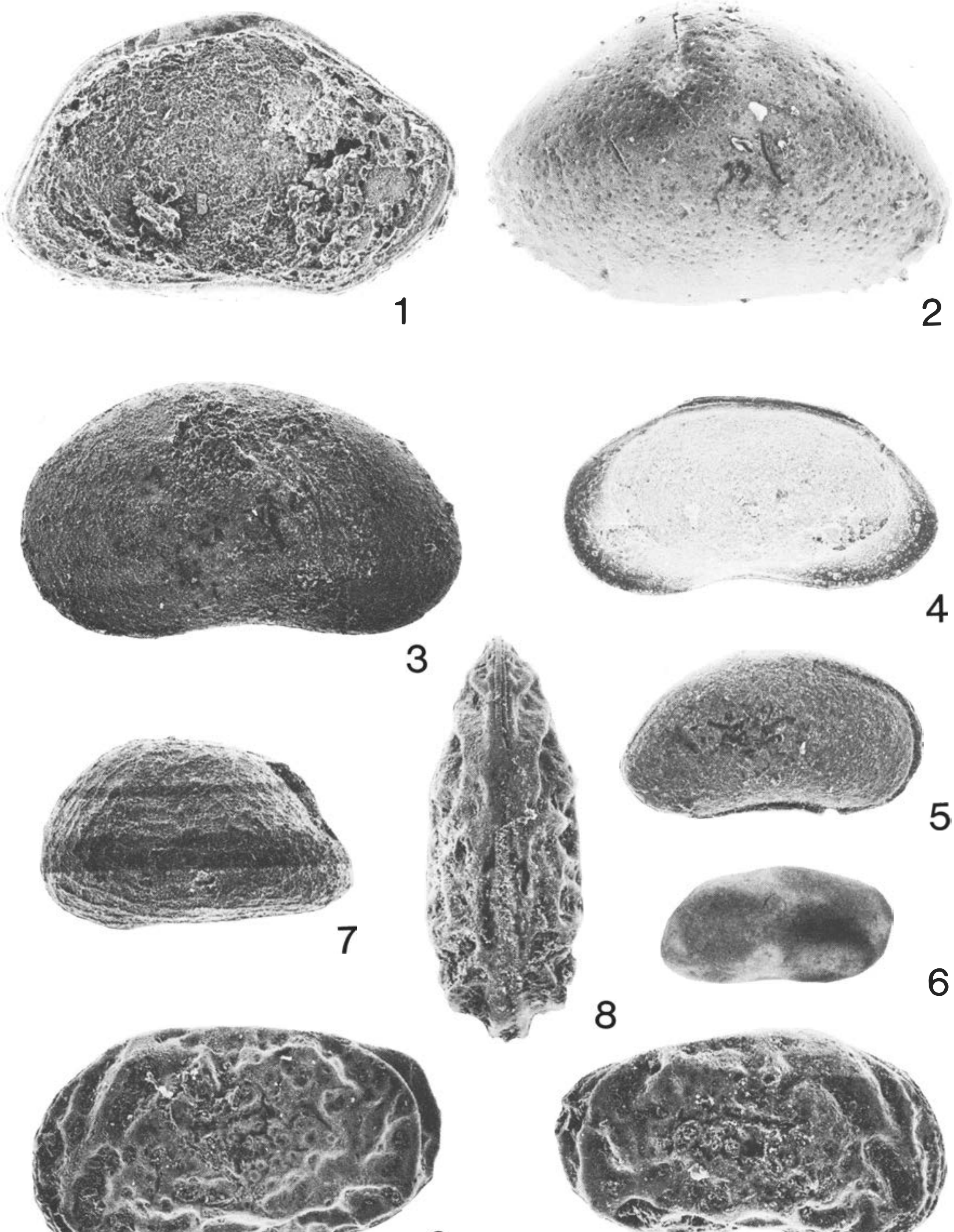

Plate 3

1. *Callistocythere lobiancoi* (Müller, 1912). Right side of carapace. Early Pliocene. Almayate. PMSp414. × 200.

2. *Callistocythere pallida* (Müller, 1894). Right side of carapace. Early Pliocene. Almayate. PMSp415. × 200.

3. *Callistocythere flavidofusca* (Ruggieri, 1950). Stereo-photographs of left side of a carapace. Early Pliocene. Almayate. PMSp416. × 200.

4. *Callistocythere rastrifera* (Ruggieri, 1953). Right side of carapace. Early Pliocene. Almayate. PMSp417. × 200.

5. *Bosquetina carinella* (Reuss, 1850). Exterior view of a left valve. Early Pliocene. Rio Guadalminar. PMSp418. × 100.

6. Same species. Right side of carapace. Early Pliocene. Almayate. PMSp419. × 100.

7. *Acanthocythereis ascoli* (Puri, 1963). Right side of carapace. Early Pliocene. Mezquitilla. PMSp420. × 110.

8. *Acanthocythereis hystrix* (Reuss, 1850). Right side of carapace. Early Pliocene. Almayate. PMSp421. × 100.

9. Same species. Interior view of a left valve. PMSp422. × 100.

10. Same species. Interior view of a right valve. PMSP423. × 100.

Plate 3

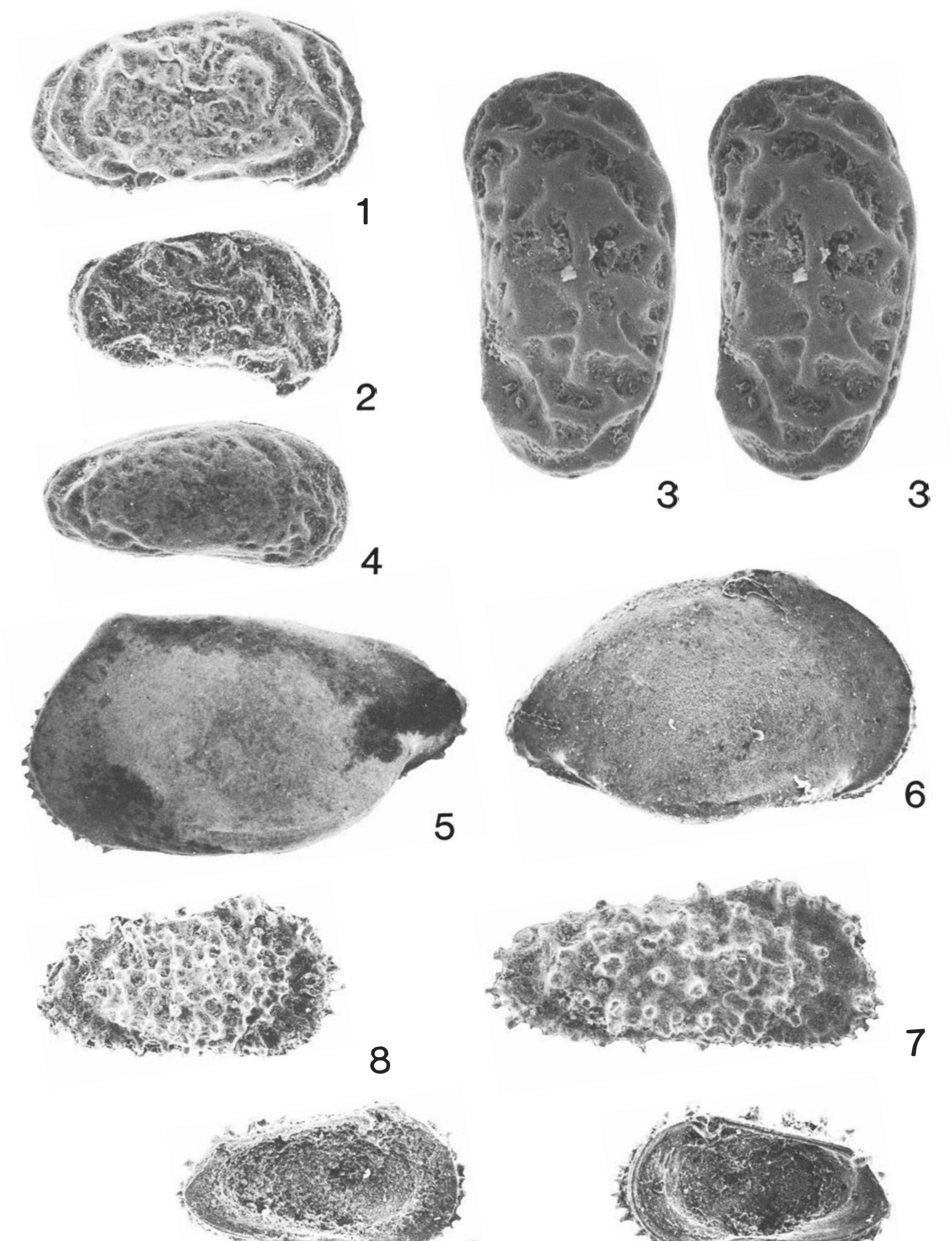

Plate 4

1. *Lixuoria aquila* Ruggieri, 1972. Exterior view of a left valve. Early Pliocene. Almayate. PMSp424. × 100.

2. *Pterygocythereis siveteri* Athersuch, 1978. Right side of carapace. Early Pliocene. Almayate. PMSp425. × 100.

3. *Pterygocythereis jonesii* (Baird, 1850). Exterior view of a left valve. Early Pliocene. Cerro de San Antón. PMSp426. × 100.

4. *Echinocythereis* sp. Exterior view of a left valve, probably a juvenile. Early Pliocene. Almayate. PMSp427. × 100.

5. *Echinocythereis scabra* (von Muenster, 1830). Exterior view of a left valve. Early Pliocene. Almayate. PMSP428. × 100.

6. Same species. Exterior view of a right valve. Right valve. PMSp429. × 100.

7. Same species. Ventral view of carapace. PMSp430. × 100.

8. Same species. Dorsal view of carapace. PMSp431. × 100.

9. Same species. Detail of the hinge. PMSp432. × 1000.

10. Same species. Detail of the hinge. PMSp433. × 1000.

Plate 4

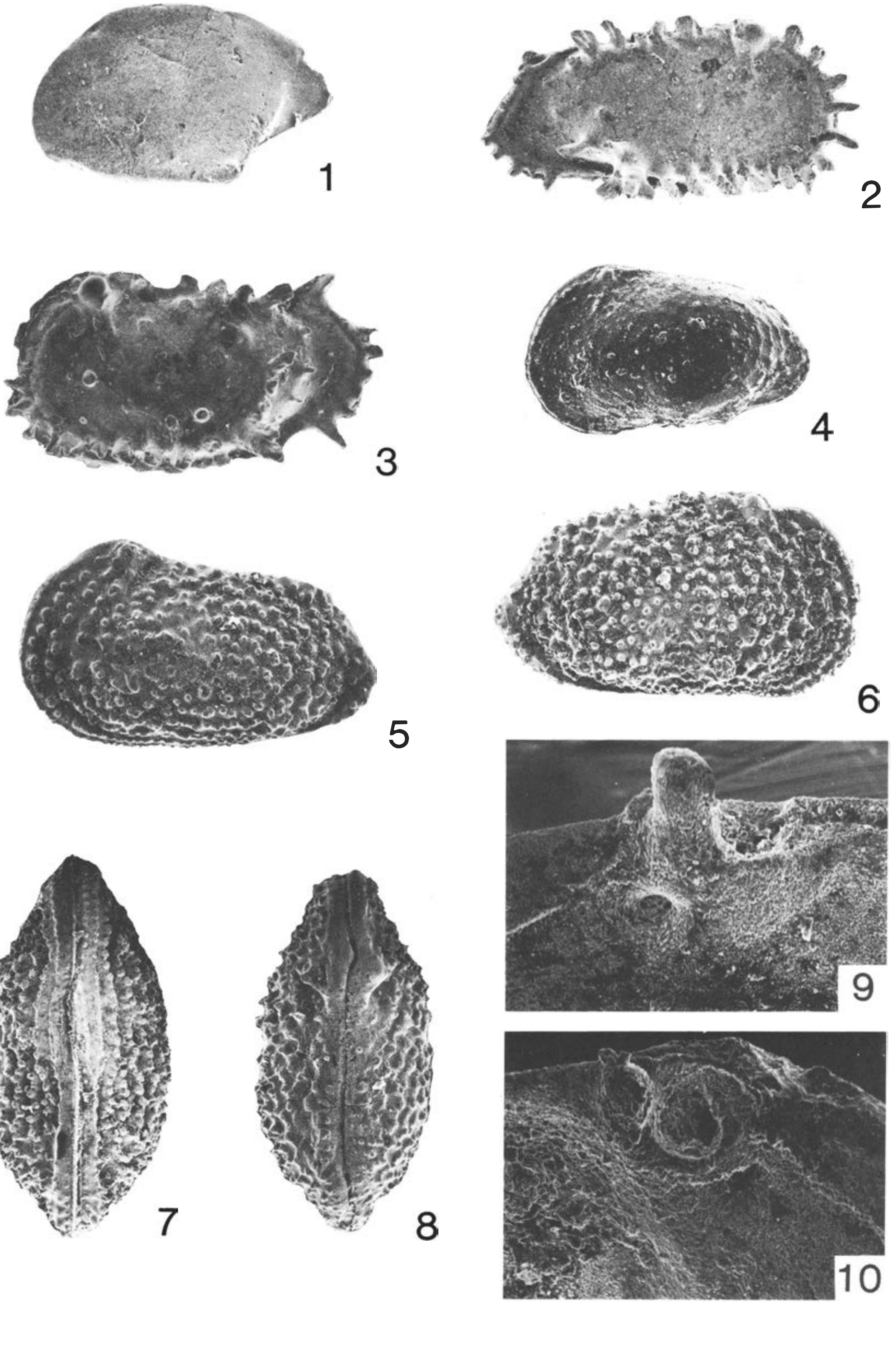

Plate 5

1. *Henryhowella asperrima* (Reuss, 1850). Left side of carapace. Early Pliocene. Almayate. PMSp434. × 100.

2. Same species. Right side of carapace. PMSp435. × 100.

3. *Carinocythereis carinata* (Roemer, 1838). Exterior view of a right valve. Early Pliocene. Almayate. PMSp436. × 100.

4. *Carinocythereis antiquata* (Baird, 1850). Exterior view of a left valve. Early Pliocene. Almayate. PMSp437. × 100.

5. Same species. Dorsal view of carapace. PMSp438. × 100.

6. Same species. Exterior view of a right valve. PMSp439. × 100.

7. *Carinocythereis carinata* (Roemer, 1838). Exterior view of a left valve. Early Pliocene. Almayate. PMSp440. × 100.

8. *Costa punctatissima* Ruggieri, 1961. Exterior view of a left valve. Early Pliocene. Almayate. PMSp441. × 100.

9. Same species. Dorsal view of carapace. PMSp442. × 100.

10. Same species. Exterior view of a right valve. PMSp443. × 100.

11. Same species. Interior view of a left valve. PMSp444. × 100.

12. *Costa batei* (Brady, 1866). Exterior view of a left valve. Early Pliocene. Almayate. PMSp445. × 100.

13. Same species. Right side of carapace. PMSp446. × 100.

14. Same species. Ventral view of carapace. PMSp447. × 100.

15. Same species. Interior view of a left female valve. PMSp448. × 100.

16. *Costa* aff. *batei.* Left view of carapace, with long caudal process. Early Pliocene. Almayate. PMSp. 449. × 100.

Plate 5

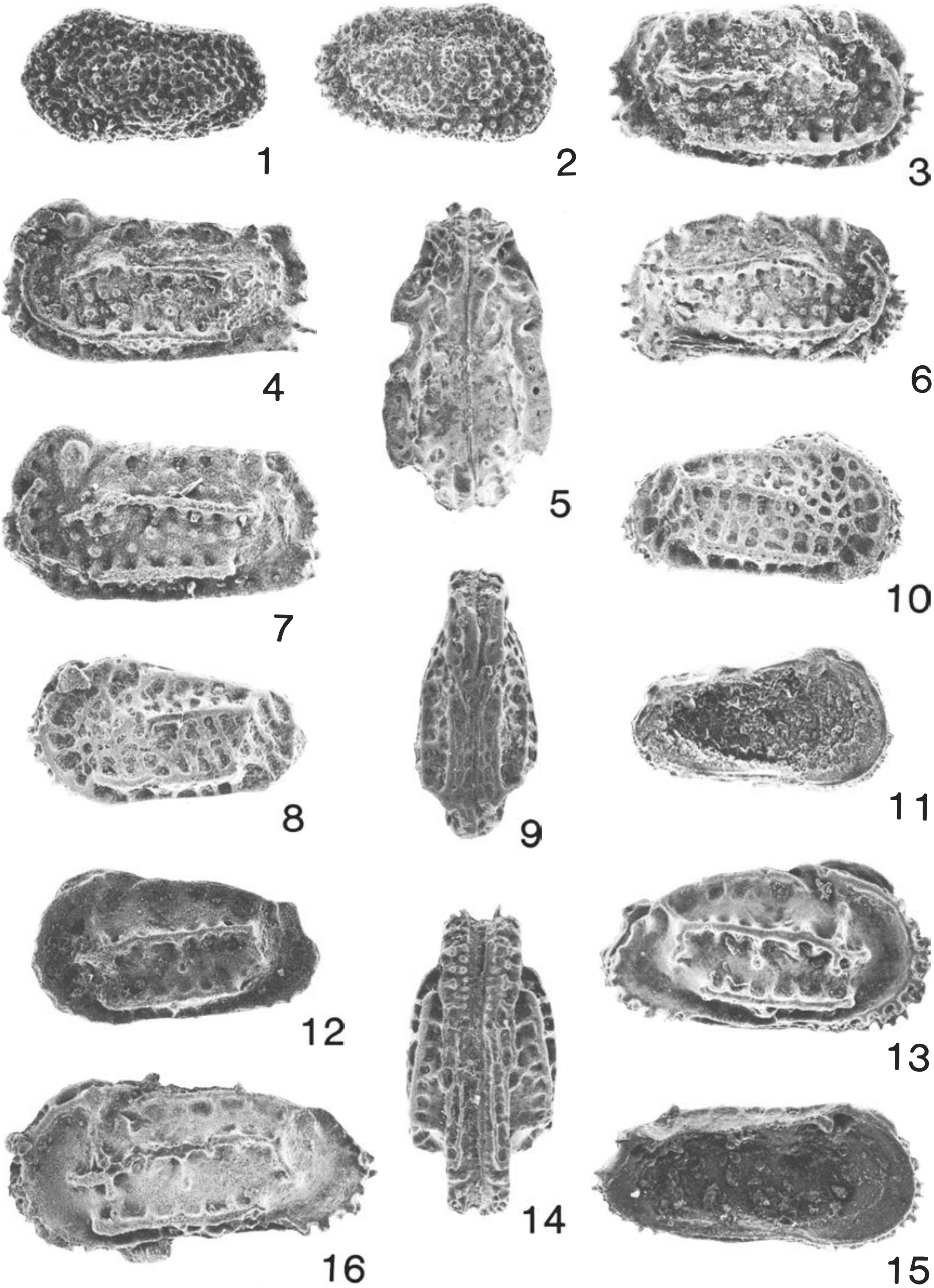

Plate 6

1. *Costa reymenti* sp. nov. Holotype Male, left valve. Drill-hole probably made by a naticid gastropod. Early Pliocene. Peñon de Almayate. PMSp450. × 100.

2. Same species. Paratype. Dorsal view of male carapace. PMSp451. × 100.

3. Same species. Paratype. Right side of female carapace. PMSp452. × 100.

4. *Costa edwardsii* (Roemer, 1838). Exterior view of a right valve. Early Pliocene. Almayate. PMSp453. × 100.

5. *Hiltermannicythere quadridentata* (Baird, 1850). Interior view of a right valve. Early Pliocene. Almayate. PMSp454. × 100.

6. *Hiltermannicythere retifastigata* (Jones, 1856). Left side of carapace. Early Pliocene. Almayate. PMSp455. × 100.

7. Same species. Right side of carapace. PMSp456. × 100.

8. *Hiltermannicythere turbida* (Müller, 1894). Right side of carapace. Early Pliocene. Cerro de San Antón. PMSp457. × 100.

9. Same species. Right side of carapace. Early Pliocene. Cerro de San Antón. PMSp458. × 100.

10. *Hiltermannicythere emaciata* (Brady, 1866). Exterior view of a right valve. Early Pliocene. Almayate. PMSp459. × 100.

11. *Ruggieria tetraptera* (Seguenza, 1880). Left side of carapace. Early Pliocene. Almayate. PMSp460. × 100.

12. Same species. Right side of female carapace. PMSp461. × 100.

13. Same species. Exterior view of a left male valve. PMSp462. × 100.

14. Same species. Interior view of a left male valve. PMSp463. × 100.

15. Same species. Dorsal view of male carapace. PMSp464. × 100.

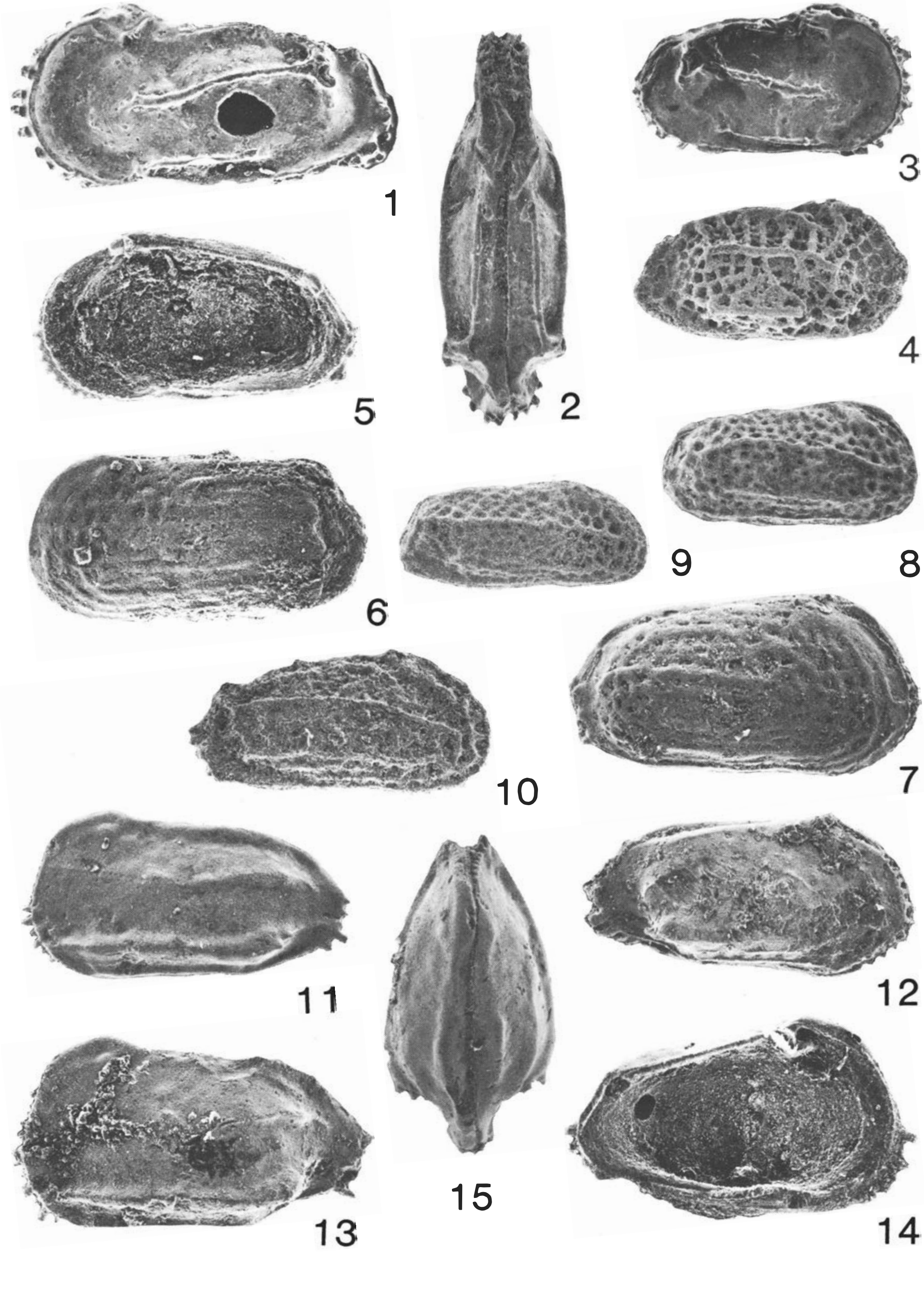
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Plate 7

1. *Ruggieria tetraptera* (Seguenza, 1880). Left side of female carapace, punctated variant. Early Pliocene. Rio Guadalminar. PMSp465. × 100.

2. *Ruggieria tetraptera angustata* (Seguenza, 1880). Exterior view of a left valve. Early Pliocene. Rio Guadalminar. PMSp466. × 100.

3. *Hiltermannicythere stellata* (Capeder, 1902). Exterior view of left valve. Early Pliocene. Rio Guadalminar. PMSp467. × 200.

4. *Hiltermannicythere rugosa* (Costa, 1853). Exterior view of a right valve. Early Pliocene. Rio Guadalminar. PMSp468. × 200.

5. *Cytheretta adriatica* Ruggieri, 1952. Left side of carapace. Early Pliocene. Mezquitilla. PMSp469. × 100.

6. Same species. Right side of carapace. PMSp470. × 100.

7. Same species. Interior view of a right valve. PMSp471. × 100.

8. *Basslerites berchoni* (Brady, 1869). Interior view of a right valve. Early Pliocene. Mezquitilla. PMSp472. × 165.

9. *Cistacythereis pokornyi* (Ruggieri, 1962). Left side of carapace. Early Pliocene. Mezquitilla. PMSp473. × 145.

10. *Cytherella vulgata* Ruggieri, 1962. Left side of carapace. Early Pliocene. Mezquitilla. PMSp474. × 130.

Plate 7

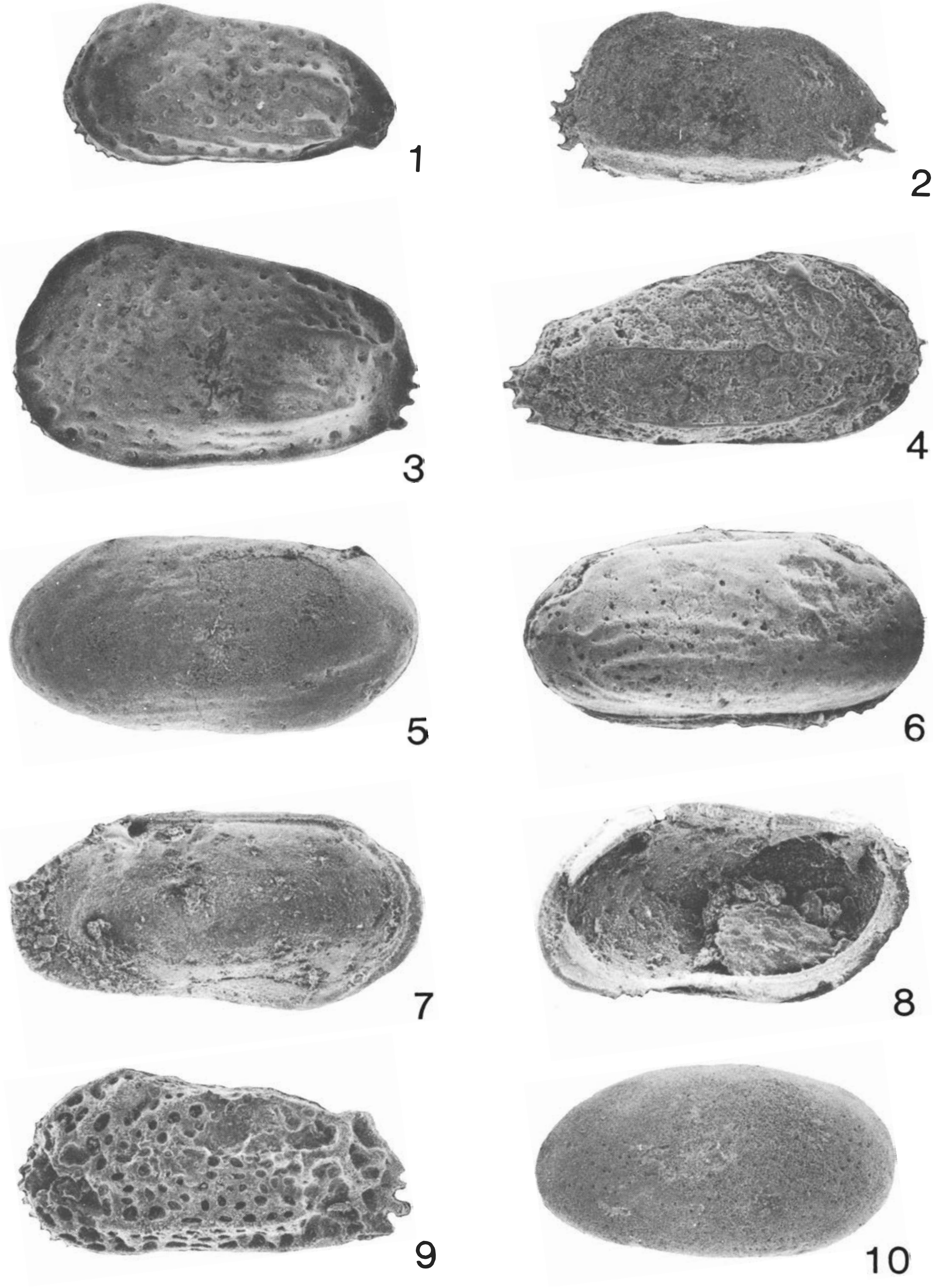

Plate 8

1. *"Bradleya" pliocenica?* (Seguenza, 1880). A left valve. Early Pliocene. Almayate. PMSp475. × 100.

2. Same individual. Detail of the posterior region, showing the smooth surface and denticulations. × 400.

3. *Heterocythereis albomaculata* (Baird, 1838). Right side of carapace. Early Pliocene. Almayate. PMSp476. × 100.

4. *Graptocythere hscripta* (Capeder, 1900). Left side of carapace. Early Pliocene. Almayate. PMSp477. × 100.

5. Same species. Ventral view of carapace. PMSp478. × 100.

6. Same species. Right side of carapace. PMSp479. × 100.

7. *Mutilus elegantulus* Ruggieri & Sylvester–Bradley, 1975. Interior view of a left valve. Early Pliocene. Almayate. PMSp480. × 100.

8. Same species. Dorsal view of carapace. PMSp481. × 100.

9. Same species. Exterior view of a right valve. PMSp482. × 100.

10. *Aurila cimbaeformis* (Seguenza, 1882). Exterior view of a left valve. Early Pliocene. Almayate. PMSp483. × 100.

11. Same species. Dorsal view of carapace. PMSp484. × 100.

12. Same species. Ventral view of carapace. PMSp485. × 100.

13. Same species. Exterior view of a right valve. PMSp486. × 100.

Plate 8

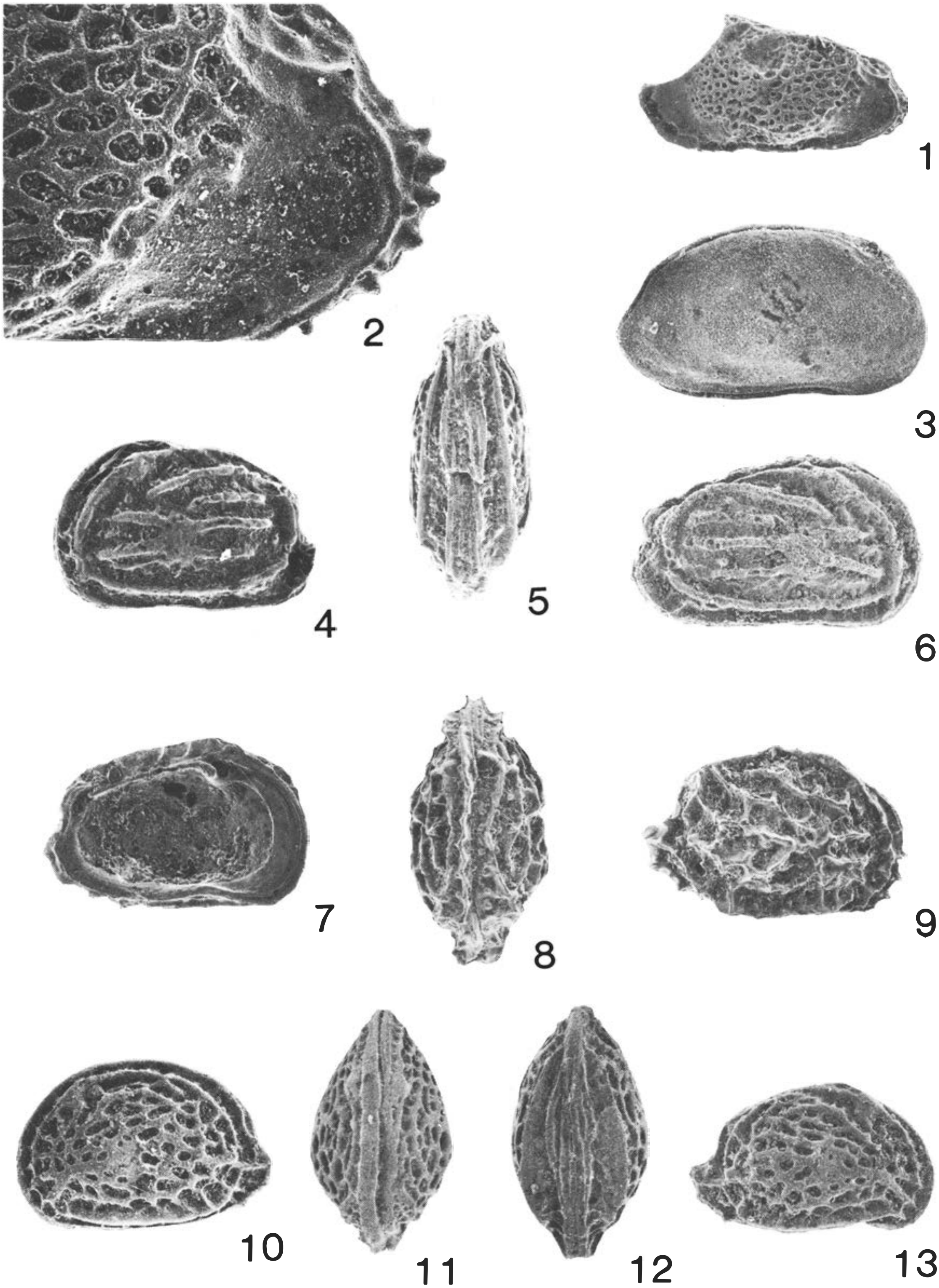

Plate 9

1. *Aurila convexa* (Baird, 1850). External view of a left valve. Early Pliocene. Almayate. PMSp487. × 100.

2. Same species. Dorsal view of carapace. PMSp488. × 100.

3. Same species. Ventral view of carapace. PMSp489. × 100.

4. Same species. External view of a right valve. PMSp490. × 100.

5. Same species. External view of a left valve. PMSp491. × 100.

6. Same species. Interior view of a right valve. PMSp492. × 100.

7. *Hermanites haidingeri* (Reuss, 1850). External view of a left valve. Early Pliocene. Almayate. PMSp493. × 100.

8. Same species. Dorsal view of carapace. PMSp494. × 100.

9. Same species. Interior view of a left valve. PMSp495. × 100.

10. *Quadracythere (Tenedocythere) salebrosa* (Uliczny, 1969). External view of a left valve. Early Pliocene. Almayate. PMSp496. × 100.

11. Same species. Exterior view of a right valve. Early Pliocene. Cerro de San Antón. PMSp497. × 100.

12. *Quadracythere (Tenedocythere) prava* (Baird, 1850). Right side of a juvenile individual. Early Pliocene. Almayate. PMSp498. × 100.

13. *Urocythereis favosa* (Roemer, 1838). Exterior view of a left valve. Early Pliocene. Almayate. PMSp499. × 100.

14. *Urocythereis labyrinthica* Uliczny, 1969. Exterior view of a left valve. Early Pliocene. Almayate. PMSp500. × 100.

15. Same species. Exterior view of a right valve. Early Pliocene. Limonar. PMSp501. × 100.

16. Same species. Interior view of a left valve, drill-hole probably made by a naticid gastropod. PMSp502. × 100.

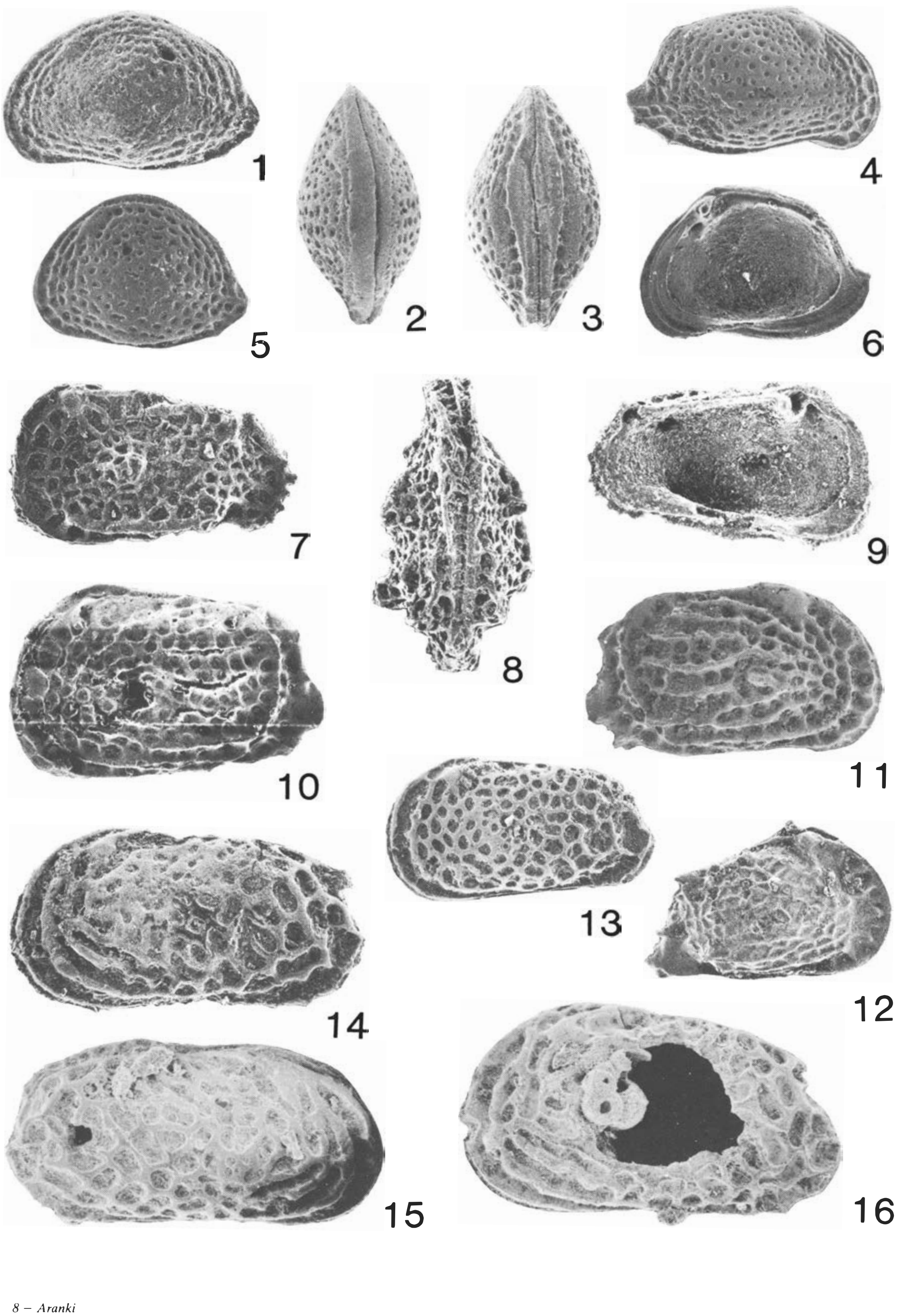
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Plate 10

1. *Caudites calceolatus* (Costa, 1853). Left side of carapace. Early Pliocene. Almayate. PMSp503. × 100.

2. *Pachycaudites ungeri* (Reuss, 1850). Interior view of a right valve. Early Pliocene. Almayate. PMSp504. × 100.

3. Same species. Right side of carapace. PMSp505. × 100.

4. *Protocytheretta obtusa* Ruggieri, 1962. Dorsal view of Carapace. Early Pliocene. Almayate. PMSp506. × 100.

5. Same species. Left side of carapace. PMSp507. × 100.

6. *Flexus triebeli* (Ruggieri, 1962). Right side of carapace. Early Pliocene. Almayate. PMSp508. × 100.

7. Same species. Ventral view of carapace. PMSp509. × 100.

8. Same species. Dorsal view of carapace. PMSp510. × 100.

9. *Loxoconcha variesculpta* Ruggieri, 1962. External view of a left valve. Early Pliocene. Almayate. PMSp511. × 200.

10. Same species. External view of a right valve. PMSp512. × 200.

11. *Loxoconcha versicolor* Müller, 1894. Right valve with a broken dorsal margin. Early Pliocene. Almayate. PMSp513. × 200.

12. *Loxoconcha tumida* Brady, 1869. Ventral view of carapace. Early Pliocene. Almayate. PMSp514. × 200.

13. Same species. Interior view of a left valve. PMSp515. × 200.

Plate 10

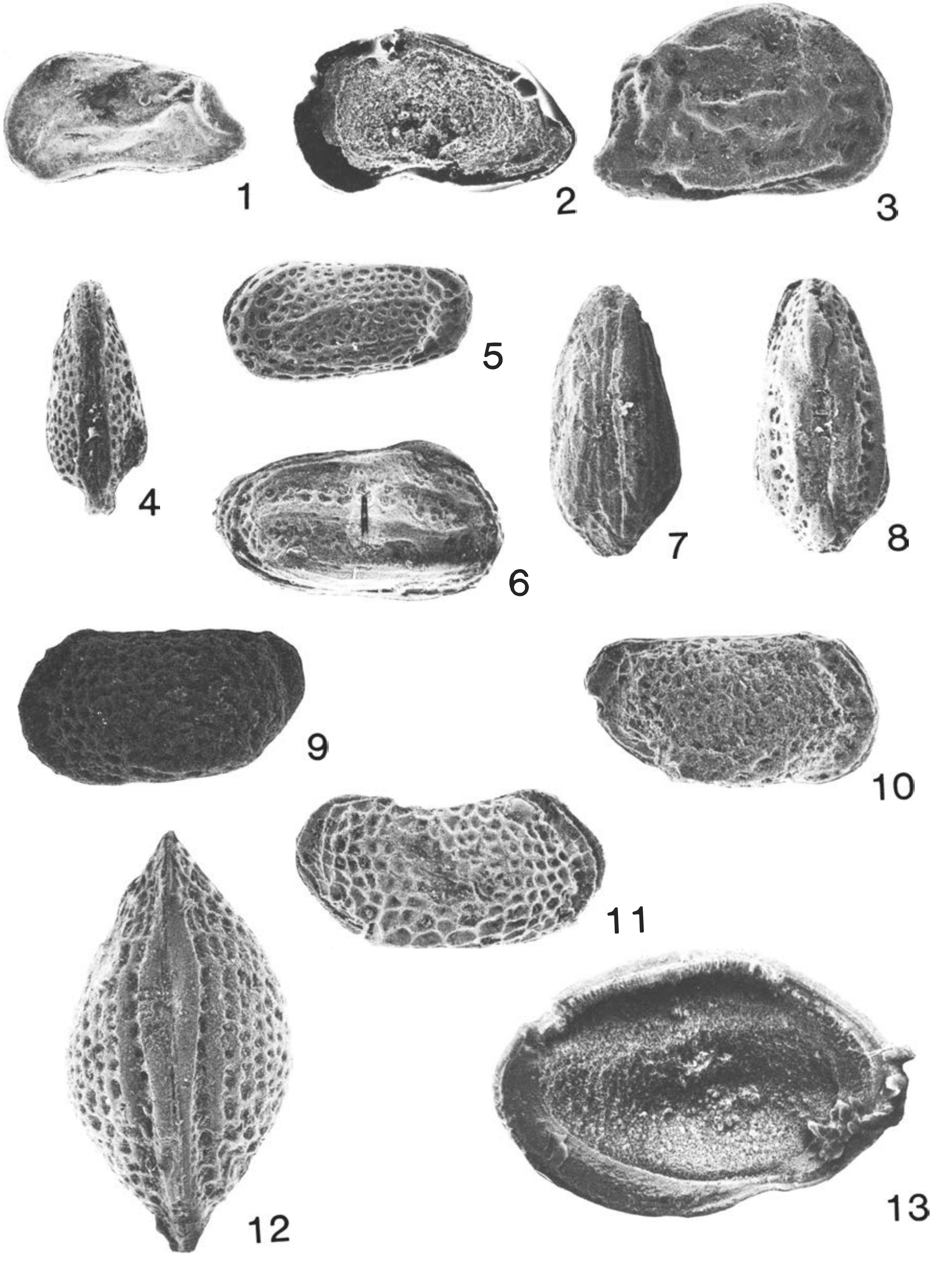


Plate 11

1. *Cytheromorpha* sp. External view of a left valve. Early Pliocene. Cerro de San Antón. PMSp516. × 200.

2. *Buntonia (Rectobuntonia) subulata* Ruggieri, 1954. External view of a left valve. Early Pliocene. Valle Niza. PMSp517. × 200.

3. *Loxoconcha agilis* Ruggieri, 1967. Right side of carapace. Early Pliocene. Almayate. PMSp518. × 200.

4. *Loxoconcha tumida* Brady, 1869. External view of a right valve. Early Pliocene. Almayate. PMSp519. × 200.

5. Same species. External view of a left valve. PMSp520. × 200.

6. *Loxoconcha rhomboidea* (Fischer, 1855). Right side of carapace. Early Pliocene. Almayate. PMSp521. × 200.

7. Same species. Interior view of a right valve. PMSp522. × 200.

8. *Loxoconcha obliquata* Seguenza, 1879. Right side of carapace. Early Pliocene. Almayate. PMSp523. × 200.

Plate 11

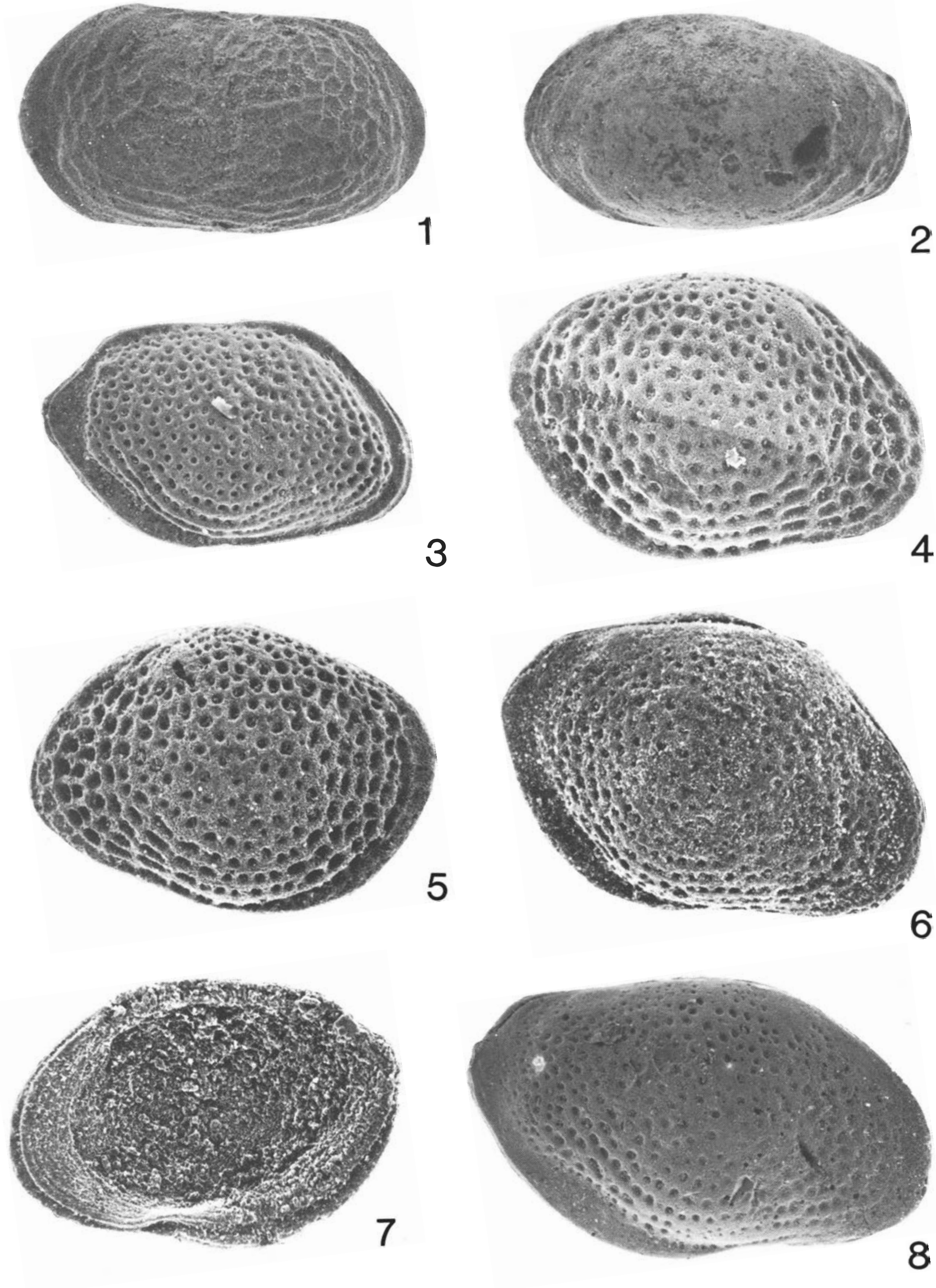


Plate 12

1. *Occultocythereis dohrni* Puri, 1963. Left side of carapace. Early Pliocene. Cerro de San Antón. PMSp524. × 200.

2. *Cytheridea neapolitana* Kollmann, 1960. Stereophotographs of a left valve. Early Pliocene. Cerro de San Antón. PMSp525. × 200.

3. Same species. Interior view of a right valve. PMSp526. × 100.

4. *Hemicytherideis elongata* (Brady, 1868). Left side of carapace. Early Pliocene. Cerro de San Antón. PMSp527. × 100.

5. *Hirschmannia* sp. Left side of carapace. Early Pliocene. Cerro de San Antón. PMSp528. × 100.

6. *Propontocypris intermedia* (Brady, 1868). Right side of carapace. Early Pliocene. Valle Niza. PMSp529. × 100.

7. *Bosquetina carinella* (Reuss, 1850). Exterior view of a left juvenile valve. Early Pliocene. Almayate. PMSp530. × 100.

8. *Propontocypris pirifera* (Müller, 1894). Left side of carapace. Early Pliocene. Cerro de San Antón. PMSp531. × 100.

9. *Loxoconcha concentrica* Bonaduce, Ciampo & Masoli, 1975. Left side of carapace. Early Pliocene. Cerro de San Antón. PMSp532. × 200.

10. *Semicytherura inversa* (Seguenza, 1880). Exterior view of a left valve. Early Pliocene. Mezquitilla. PMSp533. × 200.

11. *Pontocypris mytiloides* (Norman, 1862). Left side of carapace. Early Pliocene. Cerro de San Antón. PMSp534. × 100.

12. *Carinocythereis carinata* (Roemer, 1838). Exterior view of a left juvenile carapace. Early Pliocene. Cerro de San Antón. PMSp535. × 200.

Plate 12

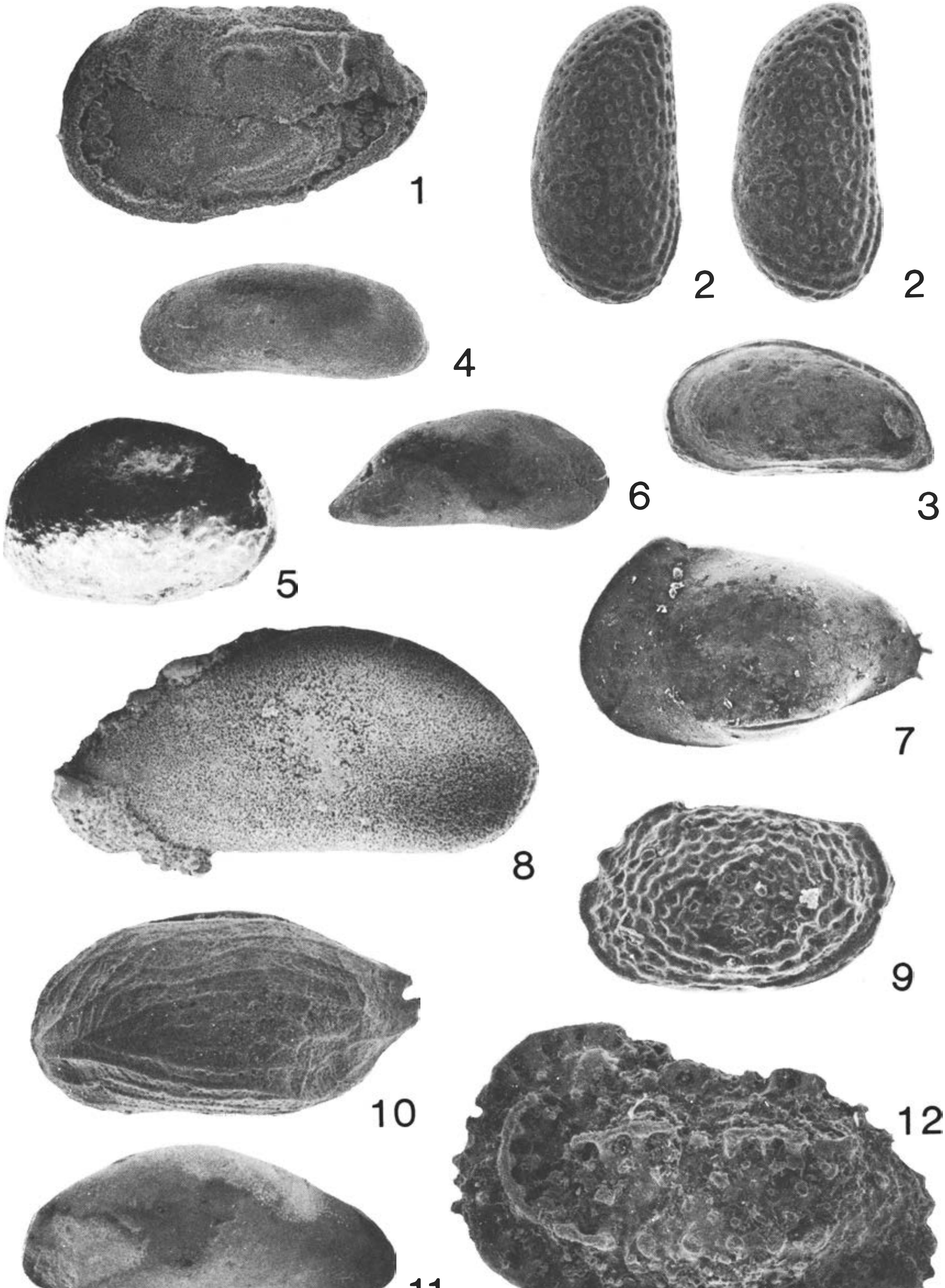


Plate 13

1. *Paracytheridea depressa* Müller, 1894. Exterior view of a left valve. Early Pliocene. Almayate. PMSp536. × 200.

2. *Semicytherura acuticostata* (Sars, 1866). Exterior view of a right valve. Early Pliocene. Almayate. PMSp537. × 200.

3. *Semicytherura inversa* (Seguenza, 1880). External view of a left valve. Early Pliocene. Almayate. PMSp538. × 200.

4. *Cytheropteron rotundatum* Müller, 1894. Ventral view of a juvenile individual. Early Pliocene. Almayate. PMSp539. × 200.

5. *Semicytherura* sp. 1. Right side of carapace. Early Pliocene. Almayate. PMSp540. × 200.

6. *Semicytherura alifera* (Ruggieri, 1959). Exterior view of a right valve. Early Pliocene. Almayate. PMSp541. × 200.

7. *Semicytherura* sp. 2. External view of a left valve. Early Pliocene. Almayate. PMSp542. × 200.

8. *Pseudocytherura calcarata* (Seguenza, 1880). Exterior view of a left valve. Early Pliocene. Cerro de San Antón. PMSp543. × 100.

9. *Eucytherura complexa* (Brady, 1866). Exterior view of a left valve. Early Pliocene. Almayate. PMSp544. × 100.

10. *Buntonia (Buntonia) sublatissima dertonensis* Ruggieri, 1954. Left side of carapace. Early Pliocene. Almayate. PMSp545. × 200.

11. *Cytheropteron* sp. Left valve of a juvenile individual. Early Pliocene. Almayate. PMSp546. × 400.

Plate 13

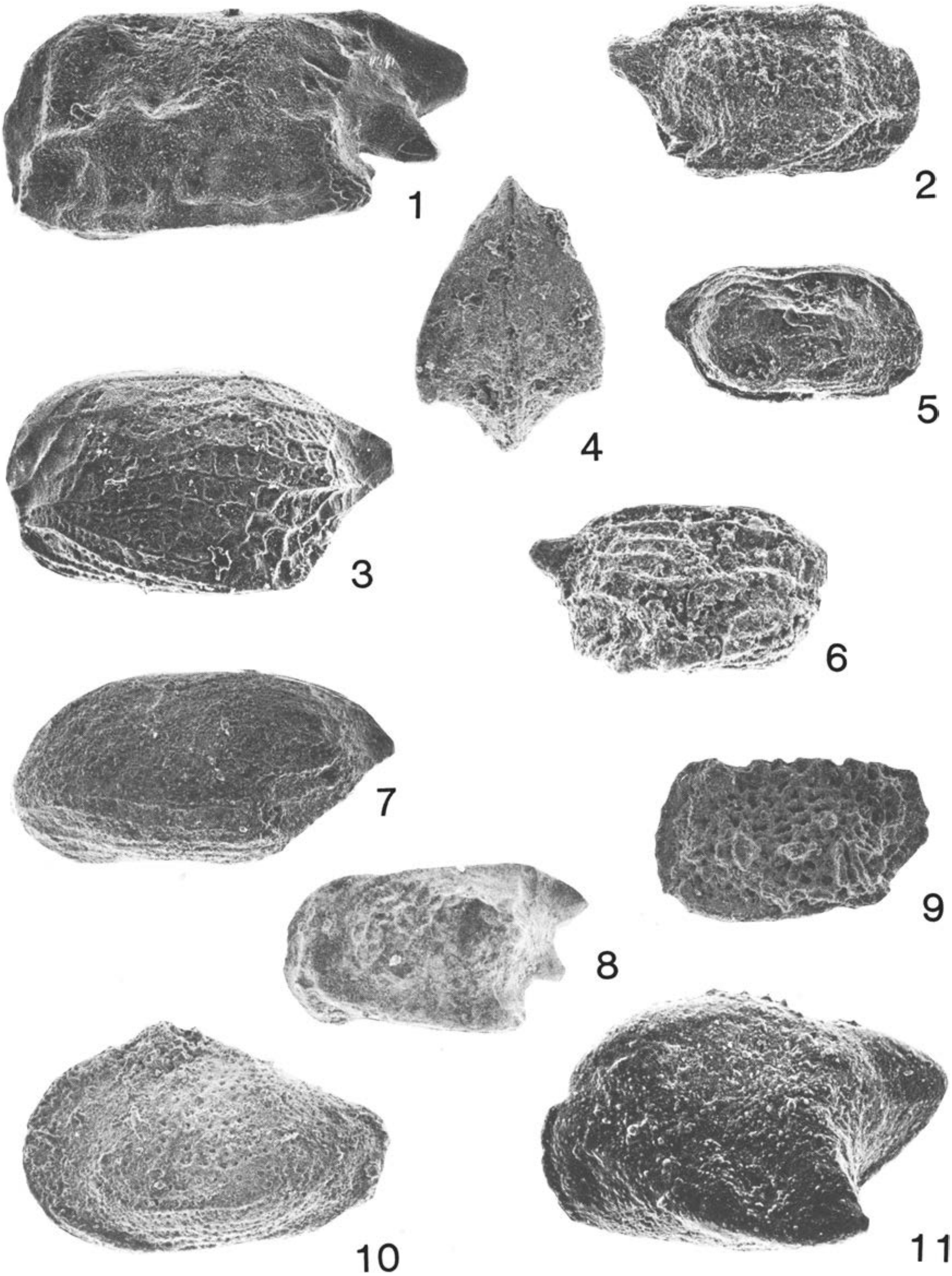


Plate 14

1. *Xestoleberis communis* Müller, 1894. Right side of carapace. Early Pliocene. Almayate. PMSp547. × 200.

2. Same species. Interior view of a left valve. PMSp548. × 200.

3. Same species. Ventral view of carapace. PMSp549. × 200.

4. *Xestoleberis dispar* Müller, 1894. Right side of carapace. Early Pliocene. Almayate. PMSp550. × 200.

5. *Xestoleberis reymenti* Ruggieri, 1967. Exterior view of a right valve. Early Pliocene. Almayate. PMSp551. × 200.

6. *Xestoleberis fuscomaculata* Müller, 1894. Left side of carapace. Early Pliocene. Almayate. PMSp552. × 200.

7. Same spacies. Dorsal view of carapace. PMSp553. × 200.

Plate 14

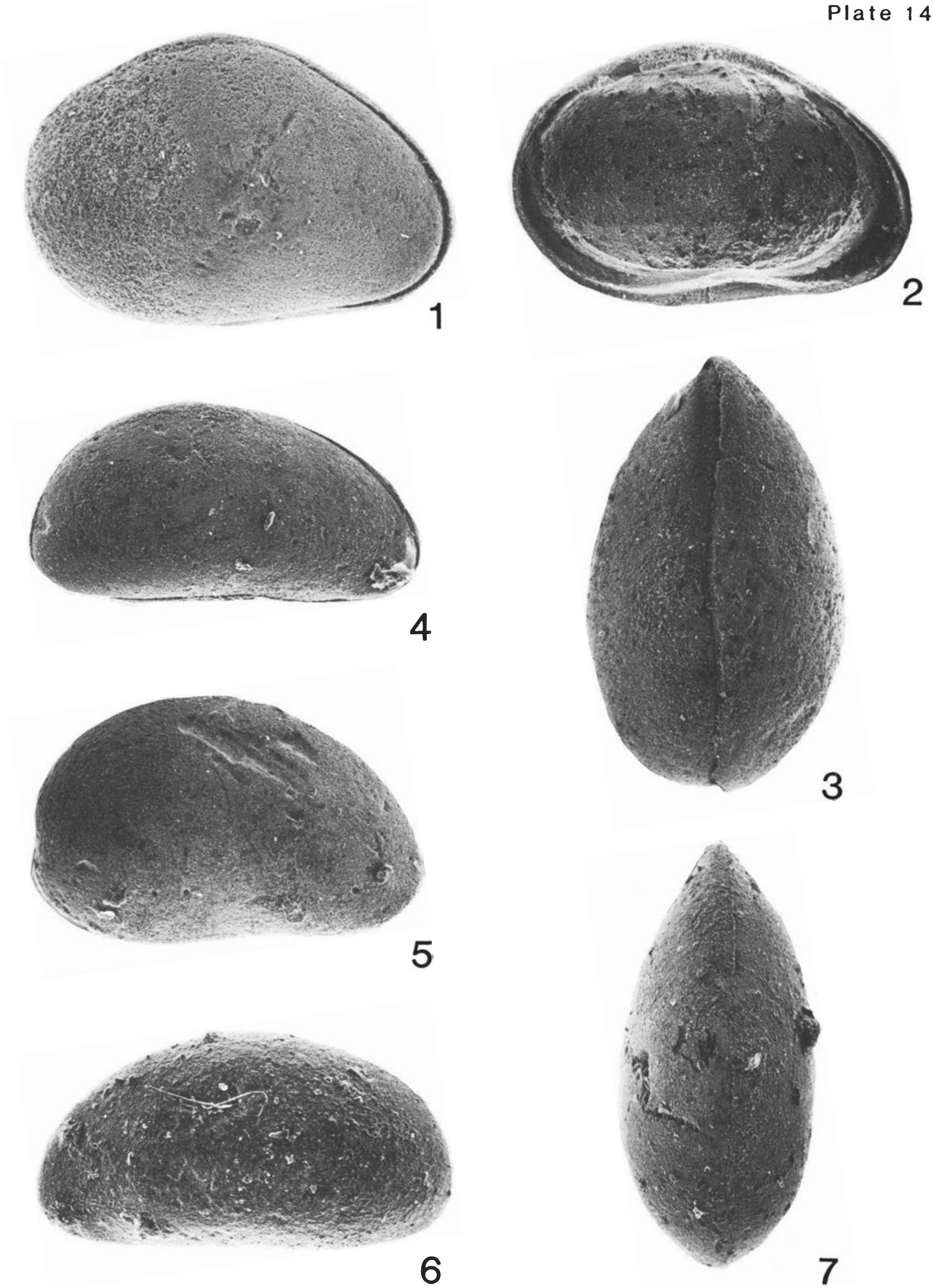


Plate 15

1. *Xestoleberis ventricosa* Müller, 1894. Exterior view of a left valve. Early Pliocene. Almayate. PMSp554. × 200.

2. *Xestoleberis margaritea* (Brady, 1866). Exterior view of a left valve. Early Pliocene. Almayate. PMSp555. × 200.

3. *Pseudocythere caudata* Sars, 1866. Exterior view of a left valve. Early Pliocene. Almayate. PMSp556. × 200.

4. *Monoceratina mediterranea* Sissingh, 1972. Exterior view of a left valve. Early Pliocene. Almayate. PMSp557. × 100.

5. *Bythocythere turgida* Sars, 1866. Exterior view of a right valve. Early Pliocene. Almayate. PMSp558. × 100.

6. *Macrocypris succinea* Müller, 1894. Interior view of a right valve. Early Pliocene. Almayate. PMSp559. × 100.

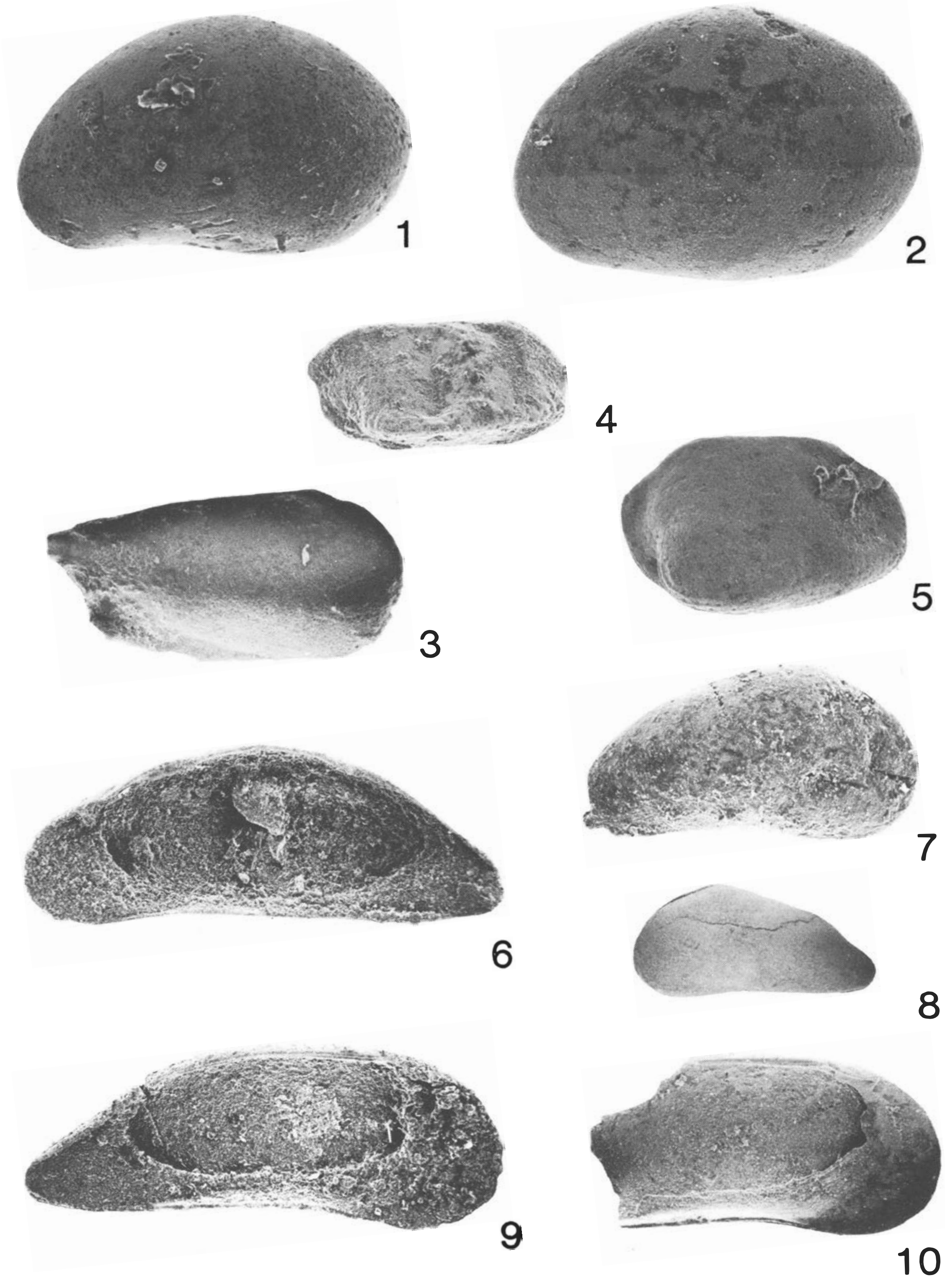
7. *Pontocypris acuminata* (Müller, 1894). Right side of carapace. Early Pliocene. Almayate. PMSp560. × 200.

8. Same species. Left side of carapace. Early Pliocene. Cerro de San Antón. PMSp561. × 100.

9. *Paracypris* aff. *polita* Sars, 1866. Interior view of a left valve. Early Pliocene. Almayate. PMSp562. × 100.

10. Same species. Internal view. PMSp563. × 100.

Plate 15



PLATES

Recent near-shore ostracods

Plate 16

1. *Asterope* cf. *marie* (Baird, 1850). Right side of (damaged) carapace. Recent. Torre del Mar at a depth of 8 m. PMSp564.

2. Same individual, details of the anterodorsal corner, showing parts of the antennae.

3. *Cytherella abyssorum* Sars, 1865. Lateral view of a left valve. Recent. Torre del Mar at a depth of 12 m. PMSp565. × 200.

4. Same species. Details of antero-ventral marginal spines. PMSp566. × 400.

5. *Cytherella vulgata* Ruggieri, 1962. Right side of carapace. Recent. Torre del Mar at a depth of 12 m. PMSp567. × 100.

6. *Neonesidea mediterranea* (Müller, 1894). Stereophotographs of a left valve. Recent. Tarifa at a depth of 1 m. PMSp568. × 100.

7. *Microcythere obliqua* Müller, 1894. Left side of carapace. Recent. Torre del Mar at depths of 4 to 12 m. PMSp569. × 400.

8. *Microcythere levis* Müller, 1894. Left side of carapace showing some of the posterior extremities. Recent. Torre del Mar at depths of 4 to 12 m. PMSp570. × 400.

9. *Microcythere inflexa* Müller, 1894. Right side of carapace. Recent. Torre del Mar at depths of 4 to 12 m. PMSp571. × 400.

10. Same species. Left side of carapace. Recent. Torre del Mar at a depth of 5 m. PMSp572. × 400.

Plate 16

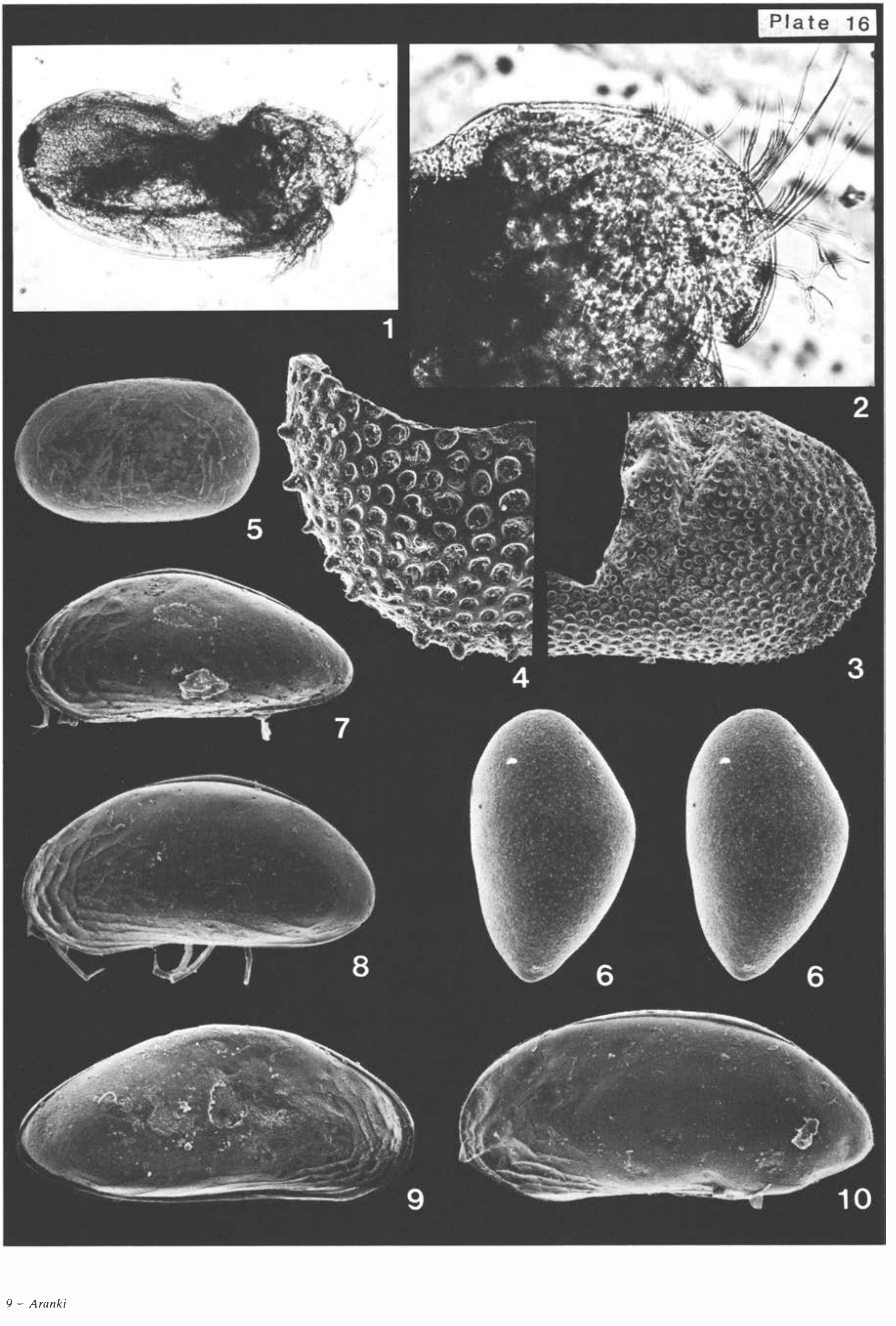


Plate 17

1. *Hemicytherideis elongata* (Brady, 1868). Exterior view of a left valve. Recent. Torrenueva. PMSp573. × 100.

2. Same species. Interior view of carapace showing soft parts (mandible). Recent. Torre del Mar at depths of 5 to 12 m. PMSp574. × 200.

3. Same species. Interior view of a right valve, showing soft parts, including an antenna, posterior leg and mandible. PMSp575. × 200.

4. Same species. Exterior view of a left valve. PMSp576. × 200.

5. *Hemicytherideis turbida.* Left side of carapace. Recent. Torrenueva. PMSp577. × 100.

6. Same species. Interior view of a left valve. Recent. Torre del Mar at depths of 10 to 12 m. PMSp578. × 200.

7. Same species. Anatomy and part of compressed left valve of a juvenile individual. PMSp579. × 400.

8. *Aurila convexa* (Baird, 1850). Left side of carapace. Recent. Tarifa at a depth of 1 m. PMSp580. × 100.

9. *Pseudosammocythere similis* (Müller, 1894). Exterior view of a right valve. Recent. Torre del Mar at a depth of 12 m. PMSp581. × 100.

10. *Paradoxostoma simile* Müller, 1894. Left side of carapace. Recent. Torre del Mar at a depth of 12 m. PMSp582. × 100.

11. *Neocytherideis fasciata* (Brady & Robertson, 1874). Exterior view of a left valve. Recent. Torre del Mar at a depth of 12 m. PMSp583. × 200.

12. *Propontocypris pirifera* (Müller, 1894). Right valve of a juvenile individual. Recent. Torre del Mar at a depth of 12 m. PMSp584. × 200.

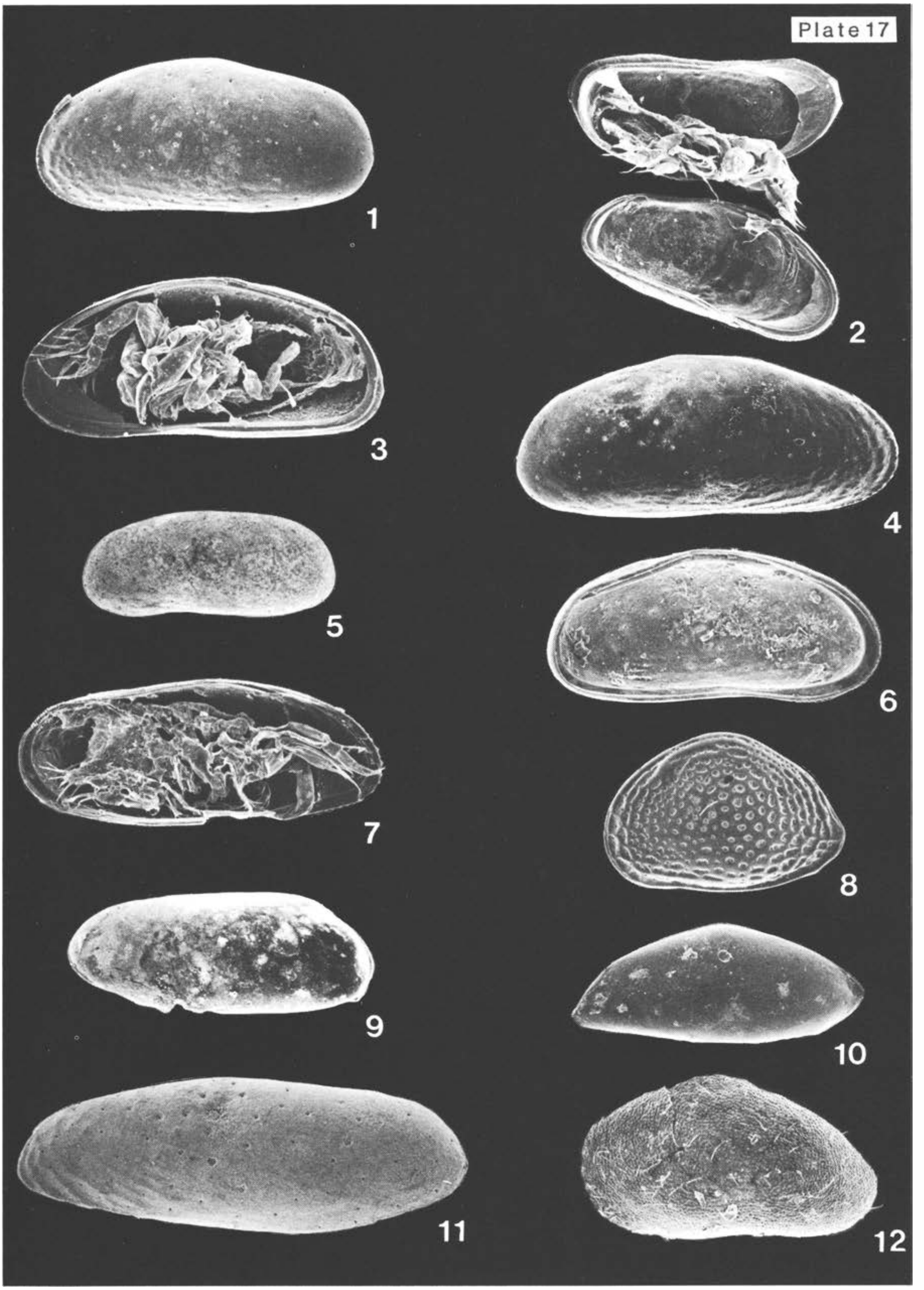


Plate 17
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Plate 18

1. *Sahnicythere retroflexa* (Klie, 1936). Exterior view of a right valve. Recent. Torre del Mar at depths of 10 to 20 m. PMSp585. × 200.

2. Same species. Exterior view of a left valve. Recent. Torre del Mar at a depth of 10 m. PMSp586. × 200.

3. Same species. Detail of the postero-ventral area, showing normal pores and setae. PMSp587. × 1000.

4. Same species. Stereophotographs of interior view of a right valve. PMSp588. × 200.

5. *Leptocythere fabaeformis* (Müller, 1894). Left side of carapace. Recent. Torre del Mar at a depth of 12 m. PMSp589. × 200.

6. *Leptocythere rara* (Müller, 1894). Left side of carapace. Recent. Torre del Mar at a depth of 12 m. PMSp590. × 200.

7. *Leptocythere levis* (Müller, 1894). Left side of carapace. Recent. Torre del Mar at a depth of 12 m. PMSp591. × 200.

8. *Leptocythere* aff. *lagunae* Hartmann, 1958. Left side of carapace. Recent. Torre del Mar at a depth of 10 m. PMSp592. × 200.

9. *Eucypris virens* (Jurine, 1820)? Interior view of a right valve. Recent. Torre del Mar at a depth of 12 m. PMSp593. × 200.

10. Same species. Exterior view of a right valve. PMSp594. × 200.

Plate 18

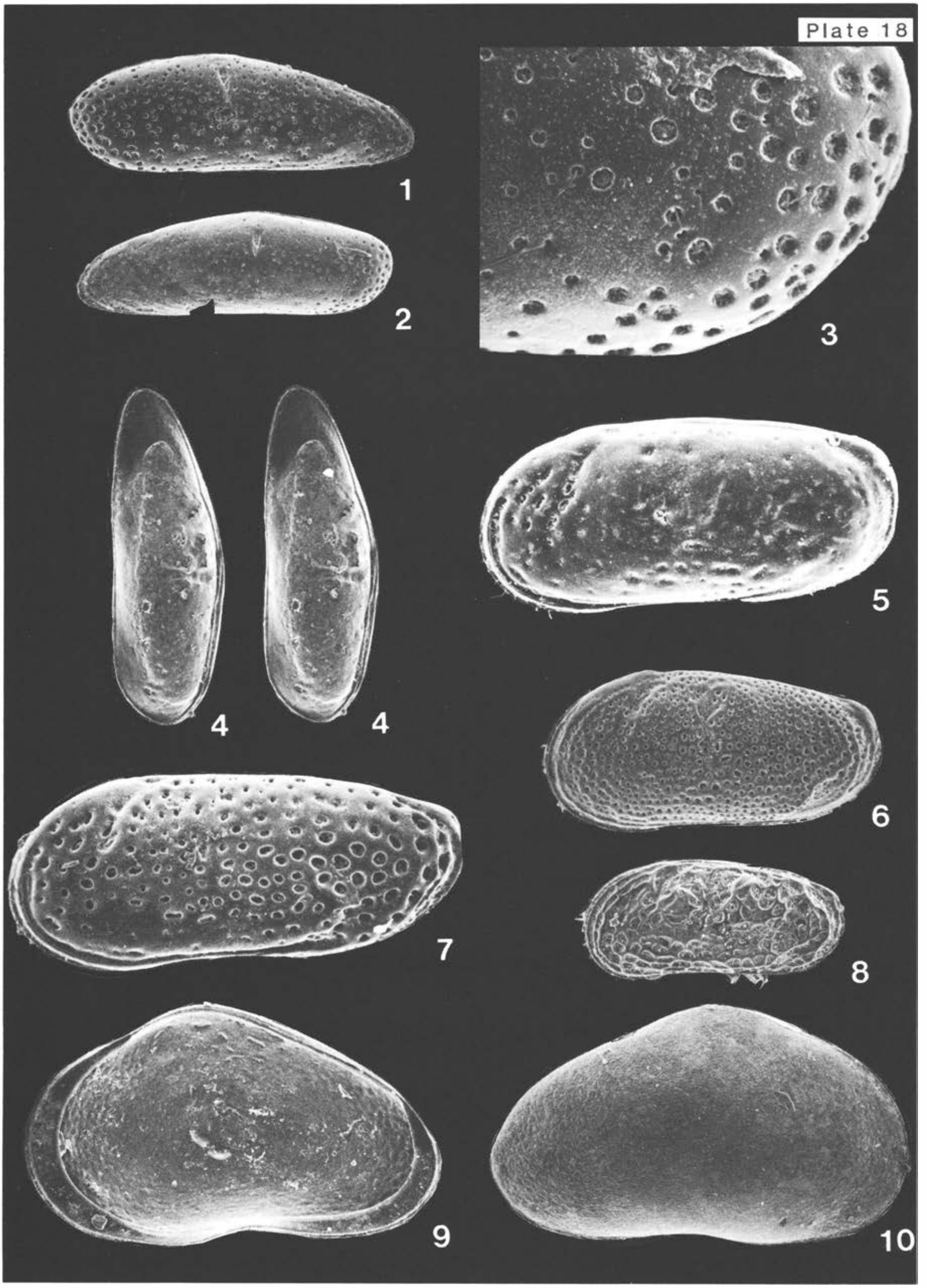

Plate 19

1. *Callistocythere diffusa* (Müller, 1894). Stereophotographs of a right valve. Recent. Estepona. PMSp595. × 200.

2. Same specimen. Oblique view of right side. × 200.

3. Same specimen. Angled view of left side. × 200.

4. *Heterocythereis albomaculata* (Baird, 1838). Stereophotographs of a left valve. Recent. Tarifa. PMSp596. × 100.

5. *Urocythereis margaritifera* (Müller, 1894). Exterior view of a right valve. Recent. Torre del Mar at a depth of 12 m. PMSp597. × 100.

6. Same specimen. Normal pores and setae. × 1000.

7. Same specimen. Marginal pores. × 700.

8. *Urocythereis favosa* (Roemer, 1838). Exterior view of a left valve. Recent. Torre del Mar at depths of 10 to 12 m. PMSp598. × 200.

9. Same species? Right valve of a juvenile individual. PMSp599. × 400.

Plate 19

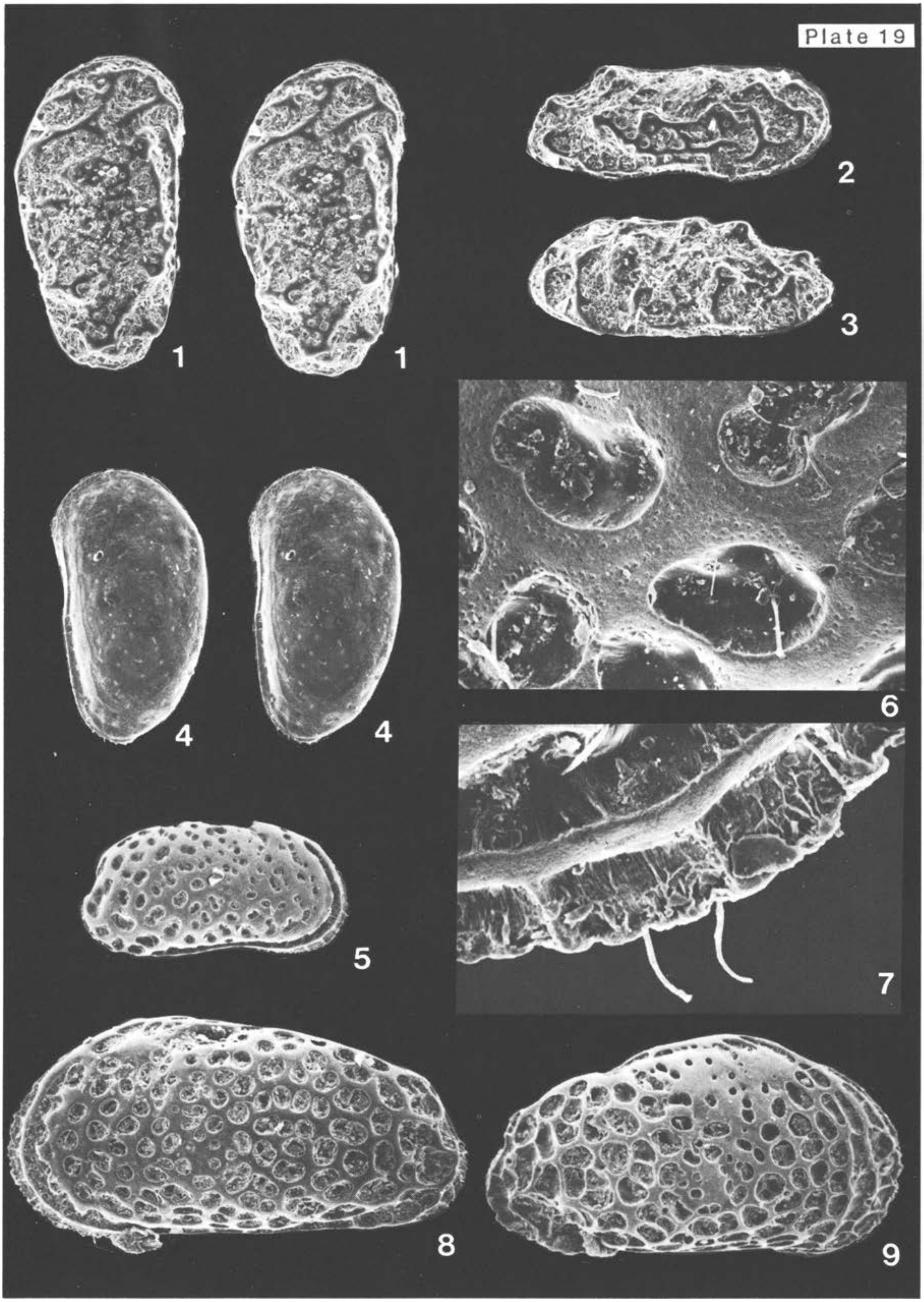

Plate 20

1. *Loxoconcha turbida* Müller, 1894. Right side of carapace. Recent. Torre del Mar at a depth of 12 m. PMSp600. × 200.

2. *Loxoconcha rhomboidea* (Fischer, 1855). Right side of carapace. Recent. Torre del Mar at depths of 5 and 12 m. PMSp601. × 200.

3. Same specimen. Ext. lat., detail of dorsal margin area, showing sieve pores. × 1000.

4. Same species. Stereophotographs. Interior of a left valve. PMSp602. × 200.

5. Same species. Oblique dorsal view of carapace. PMSp603. × 200.

6. *Loxoconcha elliptica* Brady, 1868. Right side of carapace, showing posterior legs and furca. Recent. Torre del Mar at depths of 5 and 12 m. PMSp604. × 100.

7. Same species. Left side of carapace. Recent. Los Barrios. PMSp605. × 200.

8. Same species. Interior view of a right valve. Recent Torre del Mar. PMSp606. × 200.

Plate 20

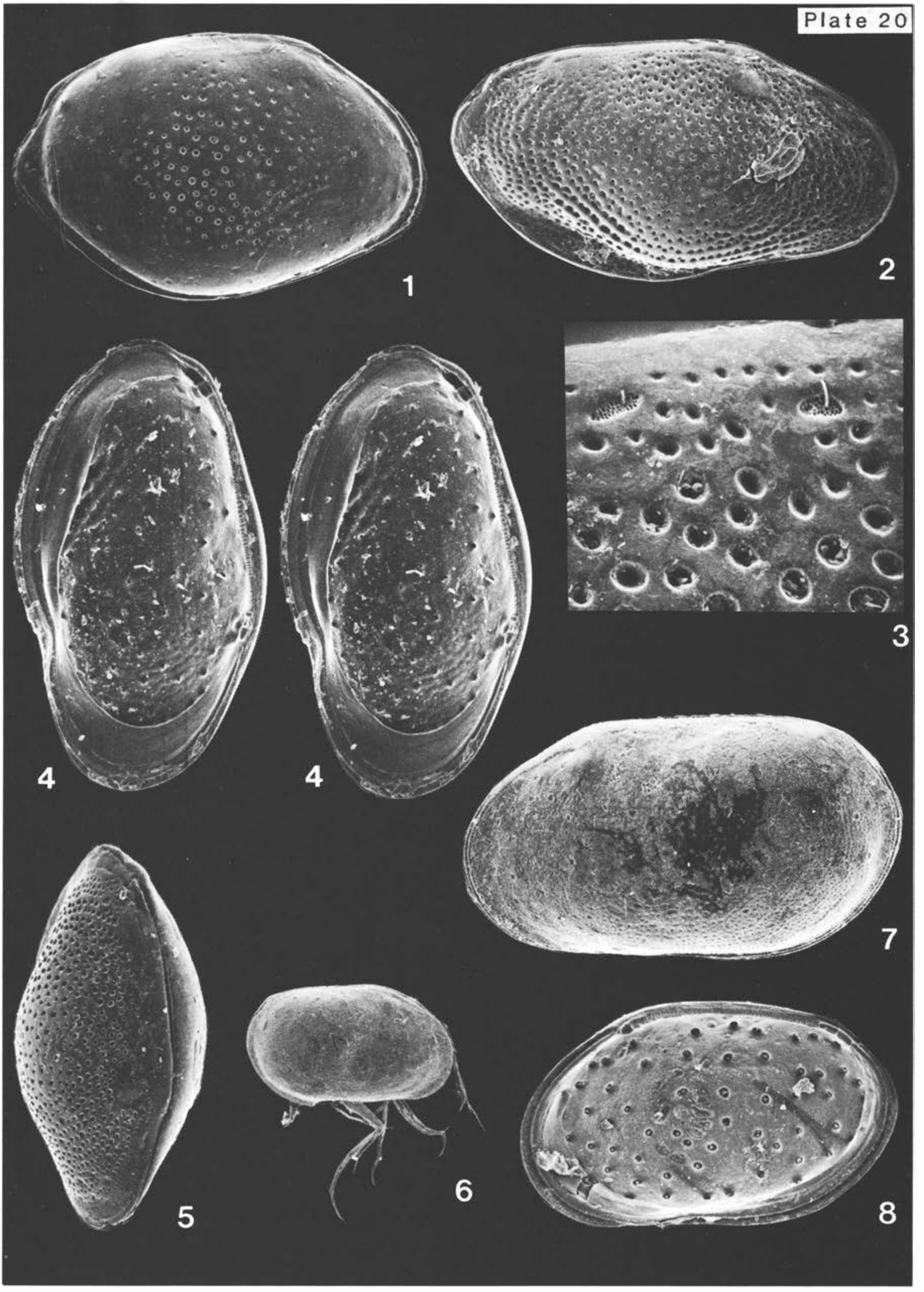

Plate 21

1. *Loxoconcha elliptica* Brady, 1868. Oblique view of left side of carapace, showing appendages (antennae and limbs). The species is encrusted, probably by algae. Recent. Los Barrios. PMSp607. × 400.

2. Same individual. Oblique postero-ventral view, showing antennae. × 1000.

3. Same species. Interior view of a right valve. PMSp608. × 200.

4. Same species. Muscle scars of a left valve. PMSp609. × 1000.

5. Same species. Interior view of a left valve. PMSp610. × 200.

6. Same species. Muscle scars of a right valve. PMSp611. × 1000.

7. *Semicytherura costata* (Sars, 1865). Exterior view of a right valve. Recent. Torre del Mar at a depth of 12 m. PMSp612. × 200.

8. Same individual. Anatomy and part of right valve. Penis visible (cf. Müller, 1894, pl. 32, fig. 33.). × 200.

9. *Semicytherura cribriformis* (Müller, 1894). Stereophotographs of a right valve. Recent. Torre del Mar at a depth of 12 m. PMSp613. × 200.

Plate 21

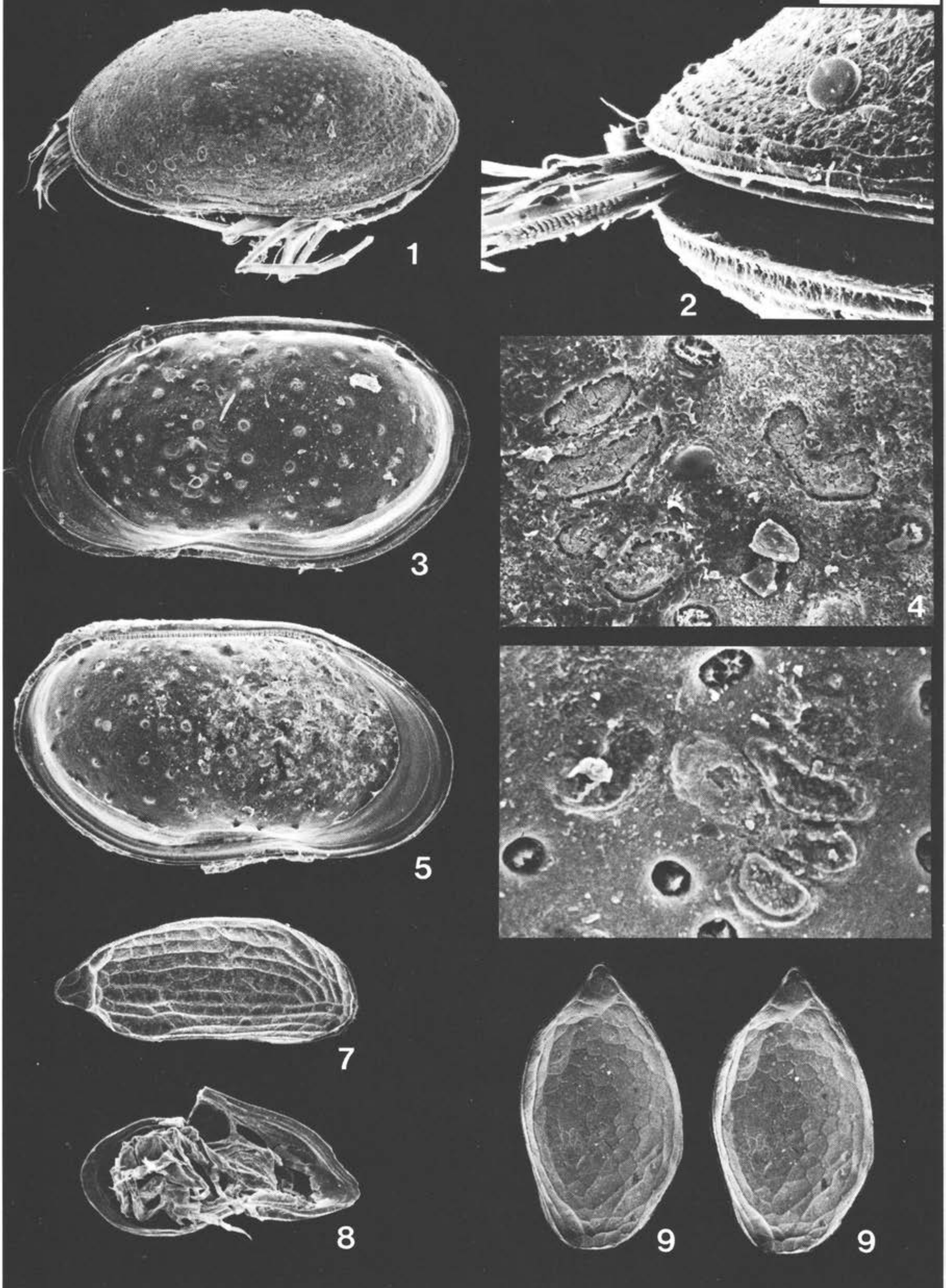

Plate 22

1. *Semicytherura* sp. 3. Left side of carapace. Recent. Torre del Mar at depths of 10 and 12 m. PMSp614. × 200.

2. Same species. Stereophotographs of a left valve. The valve is probably encrusted by algae. PMSp615. × 200.

3. *Semicytherura incongruens* (Müller, 1894). The same individual as below. Anatomy and part of the left valve. Thoracic limbs and antennae visible. Recent. Torre del Mar at depths of 8 and 12 m. PMSp616. × 200.

4. Same individual. Anatomy and part of the right valve. × 200.

5. Same individual. Maxilla. × 1000.

6. *Semicytherura sulcata* (Müller, 1894). Left side of male carapace. Recent. Torre del Mar at depths of 8, 10 and 12 m. PMSp617. × 200.

7. Same species. Left side of female carapace. PMSp618. × 200.

8. Same species. Left side of female carapace, showing thoracic limbs and setae. PMSp619. × 200.

9. Same species. Detail of exterior sulcation, showing normal pores and setae. PMSp620. × 2000.

Plate 22

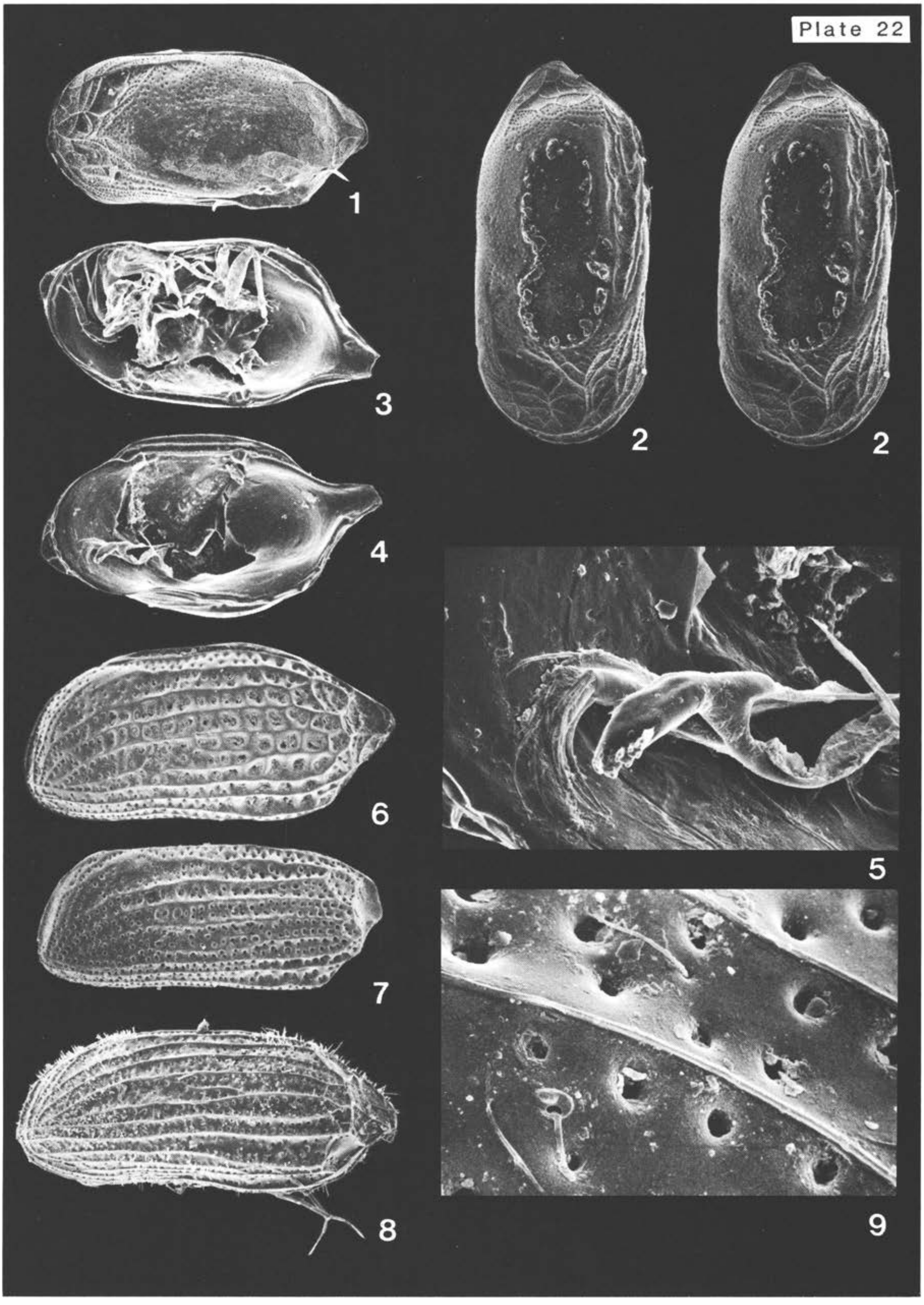

Plate 23

1. *Semicytherura sulcata* (Müller, 1894). Interior view of carapace, showing anatomy. Recent. Torre del Mar at a depth of 10 m. PMSp621. × 200.

2. Same individual. × 400.

3. Same species. Stereophotographs. Anatomy after both valves removed, showing the ejaculatory and copulatory apparatus. PMSp622. × 400.

4. Same species. Ventral view of male carapace. PMSp623. × 200.

5. *Loculicytheretta pavonia* (Brady, 1866). Stereophotographs of a right male valve. Recent. Torre del Mar at depths of 5 and 12 m. PMSp624. × 200.

6. *Hiltermannicythere sphaerulolineata* (Jones, 1856). Left side of carapace. Recent. Torre del Mar at a depth of 12 m. PMSp625. × 200.

7. Same species. Right side of a juvenile individual, showing limbs and antenna. PMSp626. × 200.

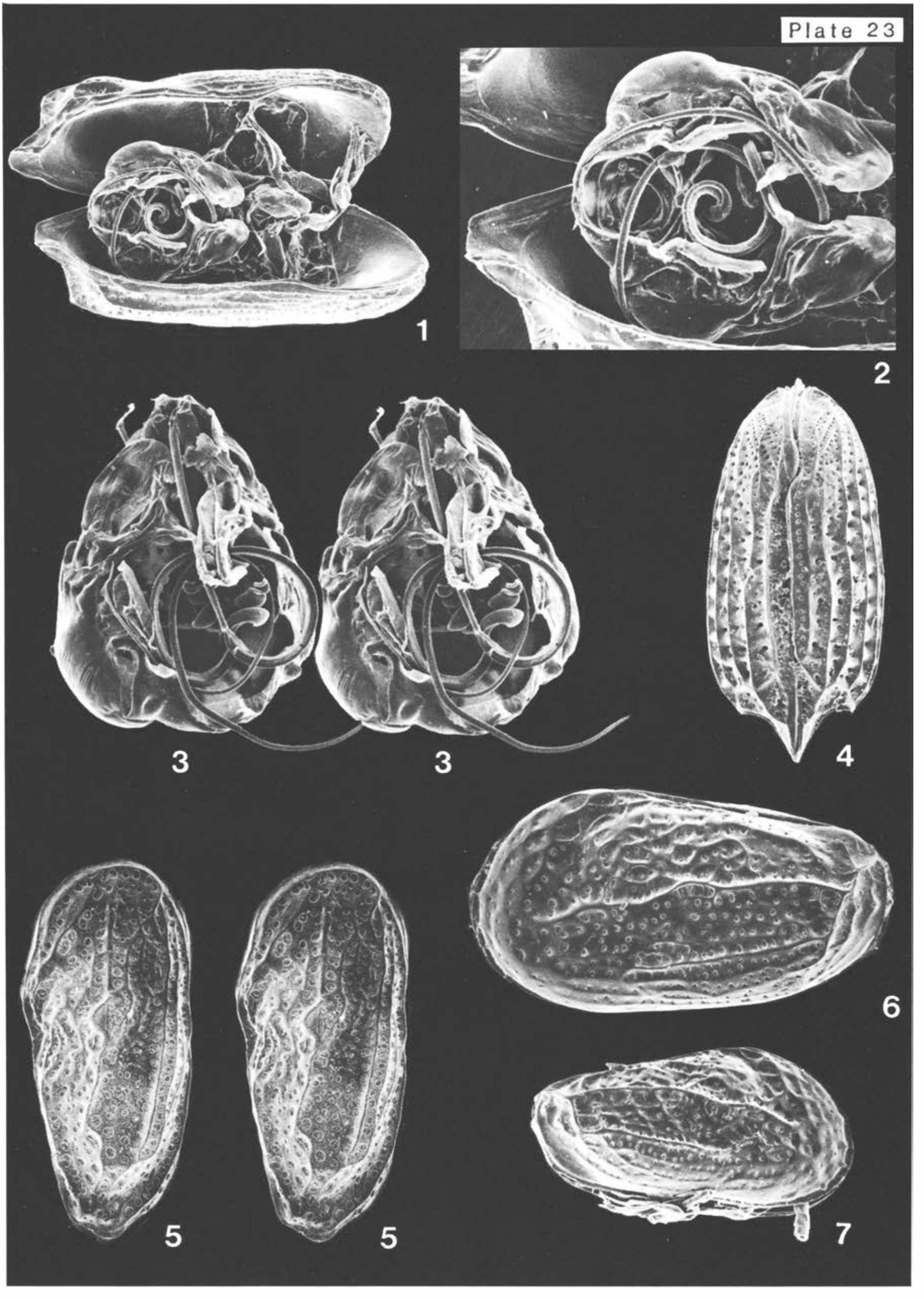
Plate 23
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