Classification and Distribution of the Recent Hemicytheridae and Trachyleberididae (Ostracoda) Off Northeastern North America

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March 3, 1849

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By JOSEPH E. HAZEL

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Descriptions of two families of Recent marine ostracodes from off northeastern North America

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CLASSIFICATION AND DISTRIBUTION OF THE RECENT HEMICYTHERIDAE AND TRACHYLEBERIDIDAE (OSTRACODA) OFF NORTHEASTERN NORTH AMERICA

By Joseph E. Hazel

ABSTRACT

Eighteen species of hemicytherids representing 10 genera and 3 subfamilies and 13 species of trachyleberidids representing 9 genera and 5 subfamilies have been described or are herein described as occurring off northeastern North America or the west coast of Greenland from about lat. 40° N. to nearly 80° N. Two subfamilies are described as new; these are the Thaerocytherinae of the Hemicytheridae and the Echinocythereidinae of the Trachyleberididae. The Campylocytherinae are shown to have hemicytherid anatomy, and are lowered from family rank and considered a subfamily of the Hemicytheridae.

The family Hemicytheridae is considered to be composed of three subfamilies—the Hemicytherinae, Campylocytherinae, and Thaerocytherinae n. subfamily. The latter taxon comprises the genera *Thaerocythere* n. genus, *Jugosocythereis*, *Hermanites*, *Quadracythere*, *Bradleya*, *Aquitaniella*, *Verrucocythereis*, and *Puriana*. The previously described genera of this group have most often been classed in the Trachyleberidinae; however, *Thaerocythere*, *Jugosocythereis*, and *Puriana* have hemicytherid anatomies and this is suspected for the other genera. The genera of the Thaerocytherinae usually have four adductor muscle scars and two frontal scars. The family Trachyleberididae is considered to be composed of seven subfamilies: the Trachyleberidiinae, Echinocythereidinae, Brachycytherinae, Pterygocythereidinae, Cytherettinae, Buntoniinae, and Mauritsininae. The new subfamily Echinocythereidinae is proposed for the genera *Echinocythereis*, *Rabilimis* n. gen., and questionably *Bosquetina*.

The complex muscle-scar pattern found in most Neogene and Quaternary genera of the Hemicytherinae is shown to have developed from the Trachyleberidinae in a series of steps that pass through the Thaerocytherinae and the Hemicytherinae.

Four genera are new: *Baffinicythere* (type species Cythere *costata* Brady, 1866) of the Hemicytherinae, *Bensonocythere* (type species *Leguminocythereis whitei* Swain, 1951) of the Campylocytherinae, *Thaerocythere* (type species *Cythereis crenulata* Sars, 1865) of the Thaerocytherinae, and *Rabilimis* (type species *Cythere mirabilis* Brady, 1868) of the Echinocythereidinae. One species, *Bensonocythere americana*, is new.

INTRODUCTION

The U.S. Geological Survey and the Woods Hole Oceanographic Institution are engaged in a joint geological investigation of the Continental Shelf and slope of the Atlantic coast of the United States (Emery and Schlee, 1963). As a part of this program, I have under study the ostracodes from several hundred bottom-surface samples taken on the Atlantic Continental Shelf and slope from Florida to Nova Scotia. To facilitate the physical and biological studies, at least for the purposes of publication of results, the shelf-slope area was divided into three parts. Initial effort in most of the disciplines was placed on the northern area from about the latitude of Asbury Park, N.J., to Nova Scotia About 400 samples have been processed from this area. Ostracodes were found in approximately 200 of these, and about 70 species have been identified.

Many of the more commonly occurring species in this northern area are in need of taxonomic revision. Therefore, it was decided to study the Hemicytheridae and Trachyleberididae because, in terms of numbers of individuals they, particularly the hemicytherids, dominate the fauna. This will make the lists to be published in later biogeographic studies more meaningful and useful.

The fauna of the area contains many arctic elements, a fact already noted by Cushman (1906) and Blake (1929, 1933). Therefore, for comparative purposes, several samples from the Davis Strait, Ungava Bay, Foxe Basin, Baffin Bay, and Kane Basin were studied and are included in this taxonomic study.

Considered here are 13 species of trachyleberidids arranged in 9 genera and 5 subfamilies, and 18 species of hemicytherids arranged in 10 genera and 3 subfamilies. One trachyleberidid subfamily and one hemicytherid subfamily are new. Three hemicytherid genera and one trachyleberidid genus are new. One hemicytherid species is new. The new taxa are Echinocythereidinae (Trachyleberididae), Thaerocytherinae (Hemicytheridae), *Thaerocythere* (Thaerocytherinae), *Baffinicythere* (Hemicytherinae), *Bensonocythere* (Campylocytherinae), *Rabilimis* (Echinocythereidinae), and *Bensonocythere americana* n. sp.

New and previously described species which have not been recently revised are described. Genera for which there is additional information are diagnosed and discussed. Carapaces or valves are illustrated for nearly all species found. Dissections of living specimens were made where possible and the soft parts are illustrated for those species not covered by Cushman (1906), Sars (1925), or Elofson (1938, 1941).

All the samples used and the exact number of specimens of each species found in each sample are listed in table 1. Also included in table 1 are all the localities off northeastern North America at which trachyleberidids or hemicytherids were found by previous workers, and the species identified at each locality.

The samples (locations on fig. 1) are arranged in order of decreasing latitude. Because latitude and longitude data were not given for most of the samples other than those being used in the joint project of the U.S. Geological Survey and Woods Hole Oceanographic Institution, approximate coordinates were based on geographic data provided by the authors with the help of information obtained from the Board on Geographic Names and from gazetteers.

The samples shown on table 1 were selected for this study from a much larger number of samples which are being used in a regional biogeographic analysis. These particular samples were selected because they (1) contain a large and (or) diversified faunule, (2) give latitudinal coverage of the study area, or (3) contain rare elements of the total hemicytherid-trachyleberidid fauna.

The illustrated specimens have been deposited in the collections of the U.S. National Museum.

The type materials of Cushman (1906) and Blake (1929, 1933) are lost (Puri, 1958a; Neale, 1959). Cushman's and Blake's papers were neontologic treatments, and illustrations of the valves and carapaces are minimal. However, collections from the vicinity of these authors' localities have allowed confident identifications of most of their species. The types or specimens of Brady (1868 a, b, 1870a), Brady and Crosskey (1871), Brady and Norman (1889), and Norman (1877) have not been examined. However, the illustrations in those papers which contained illustrations are, in general, fair to good, and identifications were not difficult. Swain's (1963) types and the types of most of the species described from the Atlantic coast Miocene are in the U.S. National Museum and have been examined.

ACKNOWLEDGMENTS

I am indebted to R. H. Benson and L. S. Kornicker of the U.S. National Museum who have provided comparative materials and publications for my use. Dr. Benson also constructively criticized parts of this manuscript. Work on some of the genera of this paper and preliminary studies of some samples were begun in 1963–64 while I was a National Science Foundation postdoctoral fellow (NSF Fellowship 43092) at the Museum of Comparative Zoology of Harvard University. I am grateful to Ernst Mayr, Director of the Museum, and to his staff, in particular H. B. Whittington, for the courtesies extended me during my stay at that institution.

Geological Survey colleagues who deserve special thanks for their advice during preparation of this manuscript are J. T. Dutro and I. G. Sohn; thanks are also due A. R. Palmer for critically reading the manuscript.

The photographs of the ostracodes were taken by R. H. McKinney and retouched by Elinor Stromberg.

PREVIOUS STUDIES

The first hemicytherids or trachyleberidids listed or described from the Atlantic off northeastern North America appear to be *Cythere septentrionalis* Brady, *Cythere costata* Brady, and *Cythere clathrata* (Reuss) of Brady (1866). The species *C. clathrata* of Brady includes both *Cythereis tuberculata* Sars, 1865, and *Cythereis angulata* Sars, 1865. These taxa were described by G. S. Brady in 1866 from a sample near the Hunde Islands off the southwestern coast of Greenland at approximately 68°52′ N., 53°07′ W.

Brady (1868b) published another list for the Hunde Islands locality, adding more species, and described or listed species from Cumberland Inlet (66°10′ N., 67°15′ W.) and the Davis Strait (67°17′ N., 62°21′ W.). One trachyleberidid was found at the Cumberland Inlet locality and eight trachyleberidids and hemicytherids at the Davis Strait locality.

Brady (1870a) followed with a report on the Recent ostracodes from the Gulf of St. Lawrence in which he identified 29 species. Eleven of these would now be considered hemicytherids or trachyleberidids. Brady and Crosskey (1871) studied the marine Pleistocene ostracodes from the samples taken at Portland, Saco, and Lewiston, Maine, and Montreal, Canada. Thirty-three species were identified; seven of these are either trachyleberidids or hemicytherids, and six of these have been identified from Recent localities.

Norman (1877), reporting on dredgings taken by H.M.S. *Valorous* expedition to the Davis Strait in 1875, listed hemicytherid or trachyleberidid species from Holsteinsborg Harbor, Greenland, approximately 66°55′ N., 53°35′ W.; Godhavn Harbor, Greenland, approximately 69°15′ N., 53°33′ W.; and in Davis Strait at 66°59′ N., 55°21′ W., 64°05′ N., 56°47′ W., and 67°50′ N., 55°27′ W.

Brady (1878a) published lists which contained hemicytherids and trachyleberidids from localities in the Kane Basin area off Ellesmere Island. These localities were: Franklin Pierce Bay, approximately 79°25′ N., 75°00′ W.; off Victoria Head, Bache Island, approx-

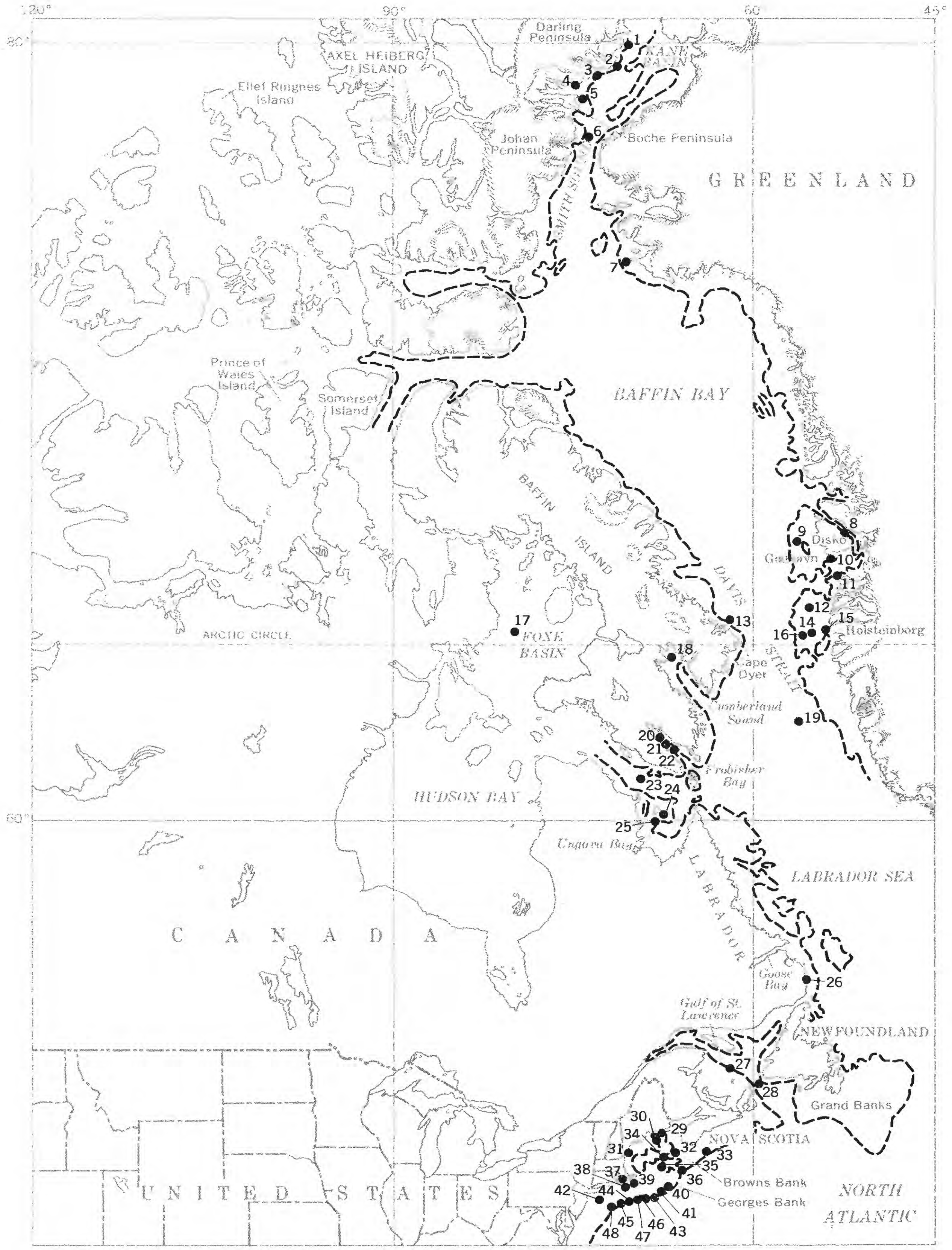

FIGURE 1.—Map showing location of samples used by previous authors and in the present study. The sample numbers are those used in table 1. Dashed line is 200-meter depth contour.

TABLE 1.—*Distribution of species of the Hemicytheridae and Trachyleberididae off northeastern North America*

[Sample sources are as follows: Gos, BCF, and P, current studies by the U.S. Geol. Survey and the Woods Hole Oceanographic Institution; A–1, W. H. Adey, U.S. Natl. Mus.; codes for published localities (followed by year of publication) are B, Brady; B–N, Brady and Norman; Bl, Blake; C, Cushman; N, Norman; Ne, Neale; L–T, Loeblich and Tappan (number is their sample number). × indicates species reported in literature; numbers indicate number of specimens found per sample in this study (carapaces were counted as one specimen)]

Sample		Location				Hemicytheridae																		Trachyleberididae												
No. (locality on fig. 1)	Source	Geographic	Latitude north	Longitude west	Depth (meters)	*Hemicythere* cf. *H. villosa*	*Hemicythere borealis*	*Hemicythere? pulchella*	*Elofsonella concinna*	*Baffinicythere costata*	*Baffinicythere emarginata*	*Nereina finmarchica*	*Nereina angulata*	*Patagonacythere dubia*	*Muellerina lienenklausi*	*Muellerina canadensis*	*Muellerina abyssicola*	*Aurila* sp.	*Normanicythere leioderma*	*Thaerocythere crenulata*	*Bensonocythere whitei*	*Bensonocythere americana*	*Bensonocythere arenicola*	*Actinocythereis dawsoni*	*Actinocythereis vineyardensis*	*Acanthocythereis? dunelmensis*	*Robertsonites tuberculata*	*Carinocythereis whitei*	*Echinocythereis margaritifera*	*Echinocythereis planibalis*	*Echinocythereis echinata*	*Rabilimis septentrionalis*	*Pterygocythereis americana*	*Cytheretta edwardsi*	*Cytheretta tracyi*	*"Cythereis" phalaropi*
1	B 1878	Cape Frazer	79°44′	71°15′	[1] 99–130				X										X																	
2	B 1878	Hayes Point	79°42′	71°36′	70																						X									
3	B–N 1889	Dobbs (?Dobbin) Bay.	79°35′	73°00′	91		X												X																	
4	B 1878	Franklin Pierce Bay	79°25′	75°00′	26–30					X																										
5	B 1878	Bache Peninsula	79°15′	74°30′	69														X								X									
6	B 1878	Smith Sound	78°37′	74°00′	69					X																										
7	L–T 23	North Wolstenholme Island.	76°27′	70°00′	[1] 24–46				3	2	6		12														11									
8	L–T 27	Vaigat Strait	70°00′	52°30′	?		1			1	3		10														5									
9	B–N 1889	Davis Strait	69°31′	56°01′	198		X				X	X	X																							
10	N 1877, B–N 1889.	Godhavn Harbor	69°15′	53°33′	[1] 10–40		X				X					X	X			X							X									
11	B 1866, 1868	Hunde Islands	68°52′	53°07′	[1] 120–140					X	X		X														X					X				
12	N 1877	Davis Strait	67°50′	55°27′	40							X	X																							
13	B 1868	do	67°17′	62°21′	1	X	X	X	X		X	X	X														X									
14	N 1877	do	66°59′	55°21′	110									X																						
15	N 1877, B–N 1889.	Holsteinsborg Harbor	66°55′	53°35′	[1] 14–70		X			X	X	X	X			X											X									
16	B–N 1889	Davis Strait	66°55′	55°30′	113											X																				
17	L–T 34	Foxe Basin	66°43′	80°07′	?				1	5				18																						
18	B 1868	Cumberland Inlet	66°10′	67°15′	31																					X										
19	N 1877	Davis Strait	64°05′	56°47′	810												X			X																
20	L–T 42	Frobisher Bay	63°11′	67°50′	146					10			4	1					7																	
21	L–T 21	do	63°10′	67°45′	55				2				3														10									
22	L–T 22	Kneeland Bay	62°59′	67°28′	31		1		7		10		4						1								13									
23	Ne 1961	Hudson Strait	61°30′	69°00′	[1] 100–290														X?																	
24	L–T 30	Ungava Bay	60°08′	67°47′	73				28	29	13	2	16	11					25																	
25	L–T 29	do	60°00′	68°00′	66				4	2	3		1	3					7								3									
26	A–1	White Bear Arm	52°47′	56°07′	3–9		98			2	30		2						4																	
27	B 1870	Gulf of St. Lawrence	48°00′	62°00′	[1] 20–500	X			X	X	X					X	X		X					X		X	X	X								
28	Ne 1961	Cabot Strait	47°30′	60°00′	?														X																	
29	Bl 1929, 1933	Mount Desert Island	44°20′	68°15′	[1] 3–24				X										X				X	X		X	X			X					X	
30	Gos 1043	Gulf of Maine	44°08′	68°13′	57				25	36	9	3	6		89	300						8		9	3					7			8			
31	Gos 1021	do	43°19′	70°27′	37	1			12	30	118	1			18	95								4									5			
32	BCF S96	Browns Bank	42°53′	66°25′	147											15								1												
33	Gos 1147	do	42°50′	64°00′	116						1		1		3	230				7																
34	BCF S108	Georges Basin	42°41′	67°22′	203											101	115			129																
35	Gos 1046	Stout Swell	42°20′	68°15′	208											3															2					
36	BCF S83	Northeast Channel	42°11′	65°30′	122										34	7	1																			
37	C 1906	Buzzards Bay	41°30′	70°45′	14						X																							X		X
38	C 1906	Vineyard Sound	41°21′	70°45′	26	X			X		X					X		X					X	X	X	X	X							X		
39	Gos 1054	Martha's Vineyard	41°19′	70°43′	23	1					8							2			?1	10														
40	Gos 1121	Georges Bank	41°17′	67°16′	57											2							3													
41	BCF W81	do	40°48′	67°23′	82										2	1													1							
42	Gos 1287	Atlantic Shelf	40°20′	73°15′	36							20			65	1					136	7	5											12		
43	BCF W34	Georges Bank	40°15′	68°50′	111										3	30									2				2				12			
44	BCF N52A	Atlantic Shelf	40°07′	71°01′	165										4	1																				
45	BCF N56A	do	40°07′	71°16′	133											2													1							
46	P 5	do	40°06′	69°05′	138											3													1							
47	P 8	do	40°02′	69°24′	92										2	25								2	3											
48	Gos 1072	do	39°54′	71°44′	139										125	80						1		2					7							

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[1] Composites of two or more samples.

imately 79°15′ N., 75°27′ W.; off Hayes Point, approximately 79°42′ N., 71°36′ W.; Smith Sound, approximately 78°37′ N., 74°00′ W.; and off Cape Frazer, approximately 79°44′ N., 71°15′ W.

In 1889, Brady and Norman published the podocopid part of their monograph of the ostracodes of the North Atlantic. This important paper relisted most of the localities given above; and the following localities, at which hemicytherids or trachyleberidids are known to occur, were added by Brady and Norman: Dobbs Bay (?=Dobbin Bay), approximately 79°35′ N., 73°00′ W.; in the Davis Strait at 69°31′ N., 56°01′ W., and 66°55′ N., 55°30′ W.; and "off Bache Island, about lat. 78° N."

Cushman (1906) described the marine ostracodes of Vineyard Sound. Localities in Vineyard Sound (approx. 41°21′ N., 70°45′ W.) and adjacent Buzzards Bay (41°30′ N., 70°45′ W.) yielded five species of trachyleberidids and six hemicytherids. Blake (1929, 1933) listed or described three hemicytherids and four trachyleberidids from the Mount Desert Island area, Maine, approximately 44°20′ N., 68°15′ W.

Neale (1959) studied *Normanicythere leioderma* (Norman, 1869) and showed its known distribution. No new locality information was given for northeastern North America. Neale (1961) added localities for *N. leioderma* in the Cabot Strait (47°30′ N., 60°00′ W.) and possibly in Hudson Strait (61°30′ N., 69°00′ W.). A locality on the raised beaches of Lake Champlain, N.Y., was also given.

Interest in the marine ostracode fauna of the eastern coasts of Canada and the United States has not been great. Indeed, if it were not for G. S. Brady and his coauthors, the only comprehensive works we would have to refer to would be those of Cushman (1906) and Blake (1929, 1933). The Atlantic coast south of Cape Cod likewise has received scant attention with only papers by Sharpe (1908), Tressler (1940), and Tressler and Smith (1948) having been published.

Other works which did not deal directly or in part with the eastern North American fauna but were used extensively in this work include Sars (1925, pt. 11, 12, p. 177–208), Brady (1868a), and Elofson (1938, 1941, 1943). In his study of the Pleistocene Gubik Formation ostracodes from the Alaskan Coastal Plain, Swain (1963) dealt with several of the species that I or my predecessors have identified from the eastern coast of North America.

CLASSIFICATION

The family Trachyleberididae and subfamily Trachyleberidinae were described by Sylvester-Bradley (1948) for *Cythereis* and related genera which had been placed in the Cytheridae Baird, 1850. In the family, Sylvester-Bradley includes genera which we now consider hemicytherids and trachyleberidids. He does not give a list of genera for the subfamily but includes *Cythereis*, *Oligocythereis*, and *Trachyleberis* in the systematics section of the paper.

Puri (1953c) describes the Hemicytherinae as a subfamily of Cytheridae, stating that *Hemicythere* and *Trachyleberis* are not closely related and both cannot be included in the Trachyleberididae.

Treatises by the following authors deal, at least in part, with post-Paleozoic ostracodes: Pokorný (1958), Chernysheva (1960), Moore (1961), and van Morkhoven (1962, 1963).

Pokorný (1958) does not recognize either Sylvester-Bradley's Trachyleberididae or Puri's Hemicytherinae and places the genera that have been referred to these taxa in the subfamily Cytherinae Baird. He states (1958, p. 256) that "a paleontologically differentiated diagnosis [of the Cytherinae] is, at this time, hardly possible." He considers the Hemicytherinae and Trachyleberididae as unnatural (nonphylogenetic) units.

In the treatise edited by Chernysheva (1960), the subfamily Trachyleberidinae is placed in the Cytheridae and divided into the tribes Hemicytherides, Trachyleberidides, Pterygocythereidides, and Schizocytherides.

In the treatise edited by Moore (1961), the families Hemicytheridae and Trachyleberididae are placed in the superfamily Cytheracea.

Van Morkhoven (1962, 1963) considers the Hemicytheridae and Trachyleberididae as subfamilies of the Cytheridae.

The diagnoses of the family group taxa considered in both the Russian (Chernysheva, 1960) and the American treatise (Moore, 1961) are based on the carapace morphology. The classification of the family group taxa presented by van Morkhoven (1962, 1963) is based primarily on soft parts. Van Morkhoven (1962, p. 98) summarizes his position on the classification: "The framework of this classification is formed by the well-defined taxonomic units of the biologist based of soft parts. As nearly as possible, the fossil groups have been fitted into this framework, according to those characters of the valves which at the present moment are considered the most reliable for this purpose."

Van Morkhoven (1962, p. 96–98) discusses the state of the art and goals of ostracode taxonomy, and laments the fact that the paleontologists have split the family Cytheridae (Cytheracea of Moore, 1961) into many families and subfamilies solely on the basis of carapace morphology. This, he believes, may lead to the establishment of polyphyletic taxa and to increasing discordancy between the classifications of the zoologist and the paleontologist. Van Morkhoven recommends cooperation between the two disciplines in order to construct a classification that will be useful to both.

As van Morkhoven points out, the paleontologists have split the Cytheridae into many families, subfamilies, and genera. However, the Cytheridae (=Cytheracea of Moore, 1961) are the most abundant and diverse group of marine ostracodes found as fossils from the Upper Cretaceous to the Recent, and paleontologists have worked extensively with this taxon in recent years, whereas zoologists, in general, have not. Paleontologists have been less active with, for example, the Cyprididae (=Cypridacea of Moore, 1961), which are not particularly abundant or diverse as fossils, whereas the zoologists have been very active with this group and have split it into many subfamilies, tribes, and genera. The zoologists have split those groups upon which they have concentrated much in the same manner and to the same degree that paleontologists have divided the Cytheridae. The zoologists have, of course, emphasized the soft parts, often ignoring the carapace.

I agree with van Morkhoven that the classification of Recent and extinct related forms should be set up in conjunction with the zoologist. However, the zoologists who have concentrated, at least in part, on marine podocopid ostracodes since the death of G. O. Sars in 1927 can almost be counted on one hand, and the resulting literature is sparse. In contrast, the number of paleontologists who have worked on Cenozoic (including Recent) podocopids is very large, and the literature is voluminous. It is true that, in the description of families, subfamilies, and genera and in the contribution of classification schemes, paleontologists generally have not paid proper attention to the anatomy of living forms. However, I believe paleontologists have recognized the importance of soft-part morphology more than the zoologists have recognized the importance of carapace morphology. Because of the limited number of zoologists working with marine podocopids, it may be some time before a satisfactory classification can be set up in conjunction with the zoologists.

A recent publication by one of the foremost zoologists working with cytheracean ostracodes illustrates the differences in philosophy and rate of introduction of new taxa by the two disciplines. Hartmann (1964) presents a classification of the late Tertiary and Quaternary genera of Trachyleberidinae and Hemicytherinae (considered subfamilies of the Cytheridae) and gives, for the extant genera, lists of living species. Hartmann recognizes 21 genera in the Trachyleberidinae; only 3 of these were described by zoologists. Of the 21, I would consider 1 genus invalid (*Archicythereis*) and 17 actually assignable to the Trachyleberididae; the other 3 I would place in the Hemicytheridae.

Hartmann places 16 genera in the Hemicytherinae; 12 of these were described by paleontologists. I would consider three of these to be trachyleberidids. Hartmann places 18 species in the genus *Hemicythere* Sars. Two of these are questionably placed there, and one is footnoted and explained to belong to the newly described genus *Palaciosa*. This leaves 15 Recent species in *Hemicythere*. Of Hartmann's 15 species, I recognize only 3 as belonging to *Hemicythere* and distribute the rest among at least 6 genera. This illustrates the more conservative classification constructed by the zoologist using, primarily, the appendages alone.

The classification of the Trachyleberididae and Hemicytheridae presented here is based on a combination of what I consider the more important hard- and soft-part features. I contend that the structure of the appendages, particularly the antennules (five or six joints) and mandibles (simple or complex branchial plate), is the most important criterion for delineation of the Hemicytheridae-Trachyleberididae group at the family level. Muscle scars and shape are most important at the subfamily level. Hingement, type of duplicature, details of shape and muscle scars, and primary ornamentation are most important at the generic level. Secondary ornamentation and details of all the above are species criteria.

MORPHOLOGIC FEATURES USED IN DELIMITATION

On the problem of distinguishing Hemicytheridae from Trachyleberididae, Pokorný (1964a, p. 282) concludes that the subfamily Hemicytherinae (Hemicytheridae of Moore, 1961) is a group of horizontal classification—that is, not natural or phylogenetic. This is not precisely true. There is general agreement among paleontologists that the Hemicytheridae arose from the Trachyleberididae. This is the derivation of one taxon from another of equivalent or lower categorical rank and is, by almost anyone's definition, a case of monophyly or natural derivation. In fact, it is the family Trachyleberididae that is more unnatural but not necessarily nonphylogenetic. Some genera are included (Moore, 1961) which are now known to be anatomically hemicytherids; I feel that others will prove to be hemicytherids when dissections are made.

Pokorný (1964a) reviews the different diagnostic features used for the delimitation of the Hemicytheridae and Trachyleberididae (frontal muscle scars, adductor muscle scars, hinge, normal pore canals, sculpture, and soft parts) and concludes that these characters have developed along parallel lines and "that none of them is reliable when taken isolated [and] at the present state of knowledge even their combination cannot lead to a satisfactory result because of a considerable lack of information about their phylogeny." Pokorný is correct in that some of the individual characters are not reliable for separating the Hemicytheridae from the Trachyleberididae, although there are just as many levels of reliability as there are characters.

Pokorný's (1964a) comments on the unreliability of the hinge and gross (primary) sculpture for use at the family level are valid. However, in my opinion, he unjustly minimizes the value of frontal and adductor muscle scars and soft-part anatomy. The examples cited by Pokorný do not warrant his conclusions. Because these are the very criteria I have leaned heavily upon for construction of a classification, Pokorný's paper deserves further detailed comment.

FRONTAL MUSCLE SCARS

Van Morkhoven (1962, p. 48) points out that it is not known if the so-called antennal muscle scars are really attachment areas for muscles running to the antennae or to some other part of the body. Dissections have not been made which show such a connection. He recommends use of "frontal scars" for the muscle scars in front of the adductor row and above the mandibular scars. This terminology is followed herein. Frontal scar is synonymous with antennal scar as used by most authors.

Pokorný (1964a) uses the Jurassic genus *Pneumatocythere* Bate as an argument against the use of frontal scars for delineation of the Hemicytheridae-Trachyleberididae group. Bate (1963) described either a single scar or multiple frontal scars in the same species of *Pneumatocythere.* However, the Jurassic genus is a member of the distantly related Progonocytheridae. Frontal muscle scars may be a poor taxonomic criterion in the Progonocytheridae, or at least in *Pneumatocythere,* but this seems to have little bearing on the Hemicytheridae-Trachyleberididae problem. As Simpson (1961, p. 145) has summarized this problem, "Identical characters may in one group characterize a species or even be a mere variation in a species * * *, in another a genus, and in another a family."

Clearly, if Pokorný had known of an example in the Trachyleberididae or Hemicytheridae, he would have chosen it. Such an example does exist. Some Cretaceous species of the campylocytherine genus *Anticythereis* are known to have a single J-shaped frontal scar. Most related Cenozoic genera are known to have two or three frontal scars, and Paleocene and Eocene species of *Anticythereis* have two frontal scars. The new genus *Bensonocythere,* described herein, is obviously a campylocytherine by its morphological characteristics regardless of the type of frontal scars (it has two). This genus has living representatives, and dissections show that it is a hemicytherid.

Thus, at least in the Campylocytherinae, there is a phylomorphogenic trend toward division of the frontal scars; this parallels the overall development of the divided frontal scars of the Hemicytheridae from the single scar typical of the Trachyleberididae. This is an exception to the general observation that the Trachyleberididae have single frontal scars and the Hemicytheridae possess divided frontal scars. This does not seriously handicap an otherwise usable classification; there are exceptions to any rules we might construct. The great majority of hemicytherid genera have two or more frontal scars, whereas most of the Trachyleberididae have a single frontal scar.

Mauritsina Deroo and *Kikliocythere* Howe and Laurencich, two genera described as having multiple frontal scars, were used by Pokorný to show that families unrelated to the Hemicytheridae may possess multiple frontal scars. The muscle scars, adductor as well as frontal, for these genera are very peculiar; indeed, Deroo (1962) felt it necessary to erect a subfamily for them. The muscle scars of *Mauritsina* and *Kikliocythere* are probably in need of further study; however, the two genera also have other distinctive characteristics which easily separate them from the Hemicytheridae. The pecularities of these two Cretaceous genera do not bear directly on the Trachyleberididae-Hemicytheridae problem.

Pokorný (1964a, p. 277) points out that, although the type species of *Bradleya* Hornibrook and some other species also placed in that genus by Hornibrook (1952) possess frontal scars much like *Hemicythere*, *Bradleya lactea pakaurangia* Hornibrook, 1952, has a V-shaped frontal scar with a second oval scar above it; and *Bradleya semivera* Hornibrook, 1952, has only a V-shaped scar. *Bradleya lactea pakaurangia* has a rather different shape from most of the other *Bradleya* described by Hornibrook, and I do not consider it congeneric with the type species. It would seem more closely related to *Jugosocythereis. Bradleya semivera* also differs from other *Bradleya* species described by Hornibrook (1952) and probably is a trachyleberidid. Hornibrook (1952, p. 43) had his doubts about the *Bradleya* placement of *B. semivera,* for he writes: "this species is classed tentatively as *Bradleya.*"

Pokorný (1964a, p. 277) states that "*Patagonacythere* Hartmann, 1962, a hemicytherine genus according to the soft parts and the three antennal muscle scars, has a carapace like *Costa* Neviani, 1928, a trachyleberine genus." *Patagonacythere* in fact does not closely resemble *Costa*, but bears a strong resemblance to *Ambostracon* Hazel, 1962, a hemicytherine genus with three frontal scars; this is discussed by Benson (1964, p. 27).

Pokorný (1964a, p. 277) is disturbed by the fact that *Echinocythereis* has a double frontal scar but is obviously a trachyleberidid by the morphology of the antennules and mandibles. The six-jointed antennules and complex exopodites (branchial plates) of the mandibles do make *Echinocythereis* a trachyleberidid. Therefore, the development of the double frontal scar must parallel the development of this feature in the hemicytherids. Indeed, and this seems to be Pokorný's principal objection to the use of frontal scars, multiple frontal scars have developed from the trachyleberidines at least in the Thaerocytherinae, Campylocytherinae and Echinocythereidinae, and possibly in the Mauritsininae. The Hemicytherinae very probably developed from the Thaerocytherinae and not directly from the trachyleberidids. To try to classify these four subfamilies into families on the basis of only the presence or absence of multiple frontal scars would certainly produce a horizontal classification.

I agree with Pokorný that subdivision of the Trachyleberididae-Hemicytheridae group into phyletically significant groups on the basis of gross frontal scar pattern alone would be difficult. However, it is very doubtful if the Mauritsininae type of multiple frontal scars could be confused with those of the Hemicytheridae. In addition, the genera of the Mauritsininae are otherwise morphologically distinct.

The double frontal scar of the Echinocythereidinae parallels the development of this feature in the Hemicytheridae. However, there should be little difficulty in separating this subfamily from the hemicytherid subfamilies on other characters such as shape. In addition, we know that living Echinocytherinae possess the appendages of the Trachyleberididae.

Rather than "the taxonomic importance of the divided frontal muscle scar [being] generally small * * *" (Pokorný, 1964a, p. 278), I interpret it as of great importance. The Mauritsininae are made up of only two genera and the Echinocythereidinae contain only three. Therefore, more than 35 of the Trachyleberididae genera have only the single U-shaped frontal scar; and all the genera of the three subfamilies of the Hemicytheridae, except *Anticythereis* which apparently has one or two frontal scars, possess double or triple frontal scars. Certainly this makes the divided frontal muscle scar of generally great taxonomic importance.

ADDUCTOR MUSCLE SCARS

Pokorný (1964a, p. 278) states that "as an iteratively realized character the subdivision of the adductor muscle scars cannot be taken as a reliable criterion for the natural delimitation of the Trachyleberidinae and the Hemicytherinae."

The only subfamily of the Hemicytheridae having consistently split adductor scars is the Hemicytherinae. The Thaerocytherinae and Campylocytherinae, which appear to have arisen from the Trachyleberidinae in the Paleocene and Senonian, respectively, generally possess a trachyleberidid type of adductor scar pattern. The Hemicytherinae were, in my opinion, derived from the Thaerocytherinae in the Paleocene and, therefore, are not directly derived from the Trachyleberididae.

The subfamily Brachycytherinae, which is here tentatively included in the Trachyleberididae, has split adductor scars and a J-shaped frontal scar. The taxon may or may not have evolved from the Trachyleberidinae. Even if it is included in the Trachyleberididae its genera are morphologically far removed from the Hemicytheridae and no confusion should exist in distinguishing brachycytherines from hemicytherines. Therefore, the divided adductor scars of the hemicytherinae are a useful criterion for distinguishing the Hemicytherinae from the other subfamilies of the Hemicytheridae and from the Trachyleberididae.

SOFT PARTS

Pokorný's statement (1964a, p. 281) that five-jointed antennules are more phylogenetically advanced than the six-jointed type is correct. He also indicates that five-jointed antennules developed polyphyletically. Apparently this would minimize the use of antennules in separating the Trachyleberididae from the Hemicytheridae. This is an unnecessarily strict view of polyphyly. In the first place, the term polyphyletic means very little unless one qualifies it with the level or levels in the hierarchic system to which he is applying the term. Second, we are concerned with the question of development of one taxon from another and are interested in a particular character's development, polyphyletic or otherwise, only because of this question. Several families of ostracodes, for example the Cytherideidae and Limnocytheridae, possess five-jointed antennules. Obviously, neither of these taxa has developed from the Trachyleberididae; there are too many other differences regardless of the type of antennules. But most everyone agrees that the Hemicytheridae did develop from the Trachyleberididae. In this context, the derivation of the five-jointed antennules of one taxon from the six-jointed antennules of another taxon of the same rank is certainly a monophyletic one. Within the Trachyleberididae-Hemicytheridae group the type of antennules can be used with complete reliability to separate the two families.

Pokorný (1964a, p. 281) quotes the statement by Reyment (1960, p. 121) that *Trachyleberis* has antennae with six joints as well as six-jointed antennules and that this is very different from the four-jointed (protopod plus endopod) antennae of *Buntonia*, which also is a trachyleberidid. This erroneous statement cannot possibly cast doubt on the validity of the use of the antennules or antennae. In fact, *Trachyleberis* has four-jointed antennae (Harding and Sylvester-Bradley, 1953); no podocopid has six-jointed antennae.

MUSCLE SCARS IN RELATION TO PHYLOGENY

Within the Trachyleberididae-Hemicytheridae group the antennules, whether five or six jointed, and the mandibular exopodites (branchial plates), whether complex with five setae or simple with one or two, are the most valuable criteria for placing a genus in one family or the other. If the genus is extinct, or information on the soft parts is not available, the carapace shape and muscle scars particularly are most useful.

The oldest of the nine trachyleberidid or hemicytherid subfamilies is the Trachyleberidinae which has a stratigraphic range of Jurassic to Recent. The genera of this subfamily possess four adductor muscle scars which are arranged in a near-vertical row. There is one J-, U-, or heart-shaped frontal scar. Because this type of muscle-scar pattern was in existence long before any other type in the Hemicytheridae-Trachyleberididae group appeared, we can refer to both the J-shaped frontal and four discrete adductor scars as primitive; most genera of the Trachyleberididae possess this pattern.

Workers have known for some time that the muscle-scar pattern is a useful criterion for distinguishing Hemicytheridae from Trachyleberididae in the absence of information on the structure of the appendages. As defined by Howe (in Moore, 1961 p. Q300), the Hemicytheridae have one or two of the four adductor scars divided and also have two or three frontal scars. All genera which have this muscle-scar pattern are hemicytherids, but not all hemicytherids have this pattern.

Several genera have a carapace morphology somewhat intermediate between morphologies normally considered typical hemicytherid and typical trachyleberidid. Such genera as *Hermanites*, *Jugosocythereis*, *Bradleya*, *Aquitaniella*, *Quadracythere*, *Verrucocythereis*, and *Puriana* fall in this class. Depending on the author, some of these have been placed first in one and then in the other family. To further complicate matters, whereas these genera have a vertical row of four almost always undivided adductor scars, they have two frontal scars. Most authors have considered all these genera as trachyleberidids. A notable exception is van Morkhoven (1963) who considers the two frontal scars a hemicytherid characteristic and places *Quadracythere* and *Bradleya* in the Hemicytheridae. The Cretaceous species assigned to *Bradleya*, at least the ones described or discussed by Hazel and Paulson (1964), have trachyleberidid frontal scars and are probably true trachyleberidids referable or, at least closely related, to the recently described genus *Oertliella*.

I have recently had the opportunity to study the soft parts of *Jugosocythereis* aff. *J. deltoides* (Brady, 1890) and *Puriana fissispinata* Benson and Coleman, 1963. These two species have the five-jointed antennules and simple mandibular branchial plates typical of the Hemicytheridae. These genera, plus *Quadracythere*, *Bradleya*, *Hermanites*, *Verrococythereis*, *Aquitaniella*, and the new genus *Thaerocythere*, which are intermediate in their carapace morphology, including the muscle scars, are placed in the Thaerocytherinae new subfamily. The range of the subfamily is Paleocene to Recent.

A second group of genera which nearly always have divided frontal scars but undivided adductor scars have been placed in the subfamily Campylocytherinae Puri, 1960. Living genera of the Campylocytherinae also possess a hemicytherid anatomy.

Both these hemicytherid subfamilies seem to be a cladogenic development from the Trachyleberidinae, the Campylocytherinae appearing first in the Santonian and the Thaerocytherinae in the Paleocene. Thus, the most primitive muscle-scar pattern in the Hemicytheridae has adductor scars like the Trachyleberidinae, but the primitive frontal scar of this subfamily has given way to two discrete scars in most species; however, some Cretaceous and Paleogene species of Campylocytherinae maintain the single J-shaped frontal scar. The campylocytherines continue on to the Recent but have never been abundant and apparently were not progenitors of another major group. The Thaerocytherinae, though not comprised of many genera, are an important phylogenetic link between one of the more diverse and abundant ostracode families of Cretaceous and Paleogene seas and one of the more diverse and abundant groups of Neogene and Quaternary seas, the Hemicytherinae.

Within the Hemicytheridae, muscle scars and shape delineate the subfamilies. The muscle scars for most genera of the Campylocytherinae are like those for the genera of the Thaerocytherinae. The distinctive ovate shape (widest posterior to middle) in dorsal view of the campylocytherine genera, however, makes separation easy.

The Hemicytherinae can be divided into two groups on the basis of the frontal muscle scars. Four hemicytherine genera are known to have only two frontal scars—*Pokornyella*, *Nephokirkos*, *Absonocytheropteron*, and *Hemicythere*. The muscle scars of *Urocythere* have not been described, but as van Morkhoven (1963) avers, the genus is very closely related to *Pokornyella*. It seems likely that *Urocythere* possesses only two frontal scars. The rest of the hemicytherine genera seem to possess three frontal muscle scars. *Muellerina* and *Pokornyella* are the oldest known genera of the Hemicytherinae, occurring in rocks as old as Paleocene.

Keij's (1957) illustration of the type species of *Pokornyella*, *P. limbata* (Bosquet, 1852), seems to show three frontal scars, but in the text he states that the genus has only two frontal scars. Oertli (1956) describes two frontal scars for *P. limbata*. Van Morkhoven (1963, p. 152) states that one or more adductor scars on *Pokornyella* may be divided. Keij's (1957) illustration of the type species shows four undivided adductor scars. Howe and Reyment (in Moore 1961, p. Q306) give four adductor scars for the genus. Oertli (1956, p. 98) states that the adductor scars agree with those of *Heterocythereis*, *Aurila*, and *Hemicytheria*—that is, with a split dorsomedian scar. Sönmez-Gökçen (1964) states that *Pokornyella limbata* has four adductor scars and two frontal scars.

Van Morkhoven (1963, p. 153) places the early and middle Eocene *Cythere ventricosa* Bosquet, 1852, in *Pokornyella*. Keij (1957) describes and illustrates this species as having four undivided adductor scars and three frontal scars. I am inclined to think that the lower scar, which is set further away from the second scar than the second is from the first, is a mandibular scar and not a true frontal scar.

I would place in *Pokornyella* five of the six late middle Eocene species described as *Hemicythere* by Howe (1951); these are *Hemicythere phrygionia*, *H. lienosa*, *H. cribraria*, *H. bellula*, and *H. mota*. I have observed the adductor muscle scars of *H. lienosa*, and there seem to be four undivided scars. The frontal and adductor scars were observed on specimens of *H. mota*, and there are two frontal scars and four adductor scars. *Brachycythere ogboni* Reyment, 1963, described from the Paleocene of Nigeria, appears to be a *Pokornyella*. Reyment (1963, p. 116) states that the species has two frontal scars and a vertical row of four adductor scars.

My interpretation of the muscle scars for *Pokornyella* is that there are only two frontal scars and four or sometimes five (dorsomedian scar split according to Oertli, 1956, and van Morkhoven, 1963) adductor scars.

It is significant that *Pokornyella* usually has four undivided adductor scars and two frontal scars, for this is the muscle-scar pattern usually found in the Thaerocytherinae. However, the carapace shape both in lateral and dorsal view clearly ally *Pokornyella* to the Hemicytherinae. *Pokornyella* is considered to be the most primitive known member of the Hemicytherinae.

Except for *Hemicythere*, all the genera of the Hemicytherinae which have only two frontal scars first appear in the Paleogene. *Pokornyella* has a known range from Paleocene to Oligocene. *Urocythere*, *Nephokirkos*, and *Absonocytheropteron* have been found only in the Eocene. Of the hemicytherine genera with three frontal scars, only *Muellerina* is known from the lower Paleogene. Of the remaining 17 hemicytherine genera with three frontal scars, 1 appears in the Oligocene, 5 appear first in the Miocene, 3 appear in the Pliocene, 5 in the Pleistocene, and 3 genera are known as yet only from the Recent.

The subfamily Thaerocytherinae is composed almost entirely of individuals and species which usually have four discrete adductor muscle scars in an oblique or vertical row. The dorsomedian scar is usually elongated but rarely divided. *Pokornyella* is known to possess either a discrete or divided dorsomedian adductor scar. *Nephokirkos* has two frontal scars and a divided dorsomedian adductor scar (Howe, in Moore, 1961, p. Q305). *Absonocytheropteron* also possesses two adductor scars (Krutak, 1961), however, on the two known species the dorsomedian scar is undivided. *Nephokirkos* and *Absonocytheropteron* are here considered to be more closely related to *Pokornyella* and *Urocythere* than to other hemicytherines.

In general, the species of other genera in the Hemicytherinae have the dorsomedian adductor scar divided. The genera in which this scar is variously divided or undivided are all Paleogene. Except for *Muellerina* and *Aurila*, all the genera which have the dorsomedian scar rather consistently divided are Neogene or Quaternary. These genera can be divided into two groups; those genera which contain species which also have ventromedian adductor scar divided but which also have species with this scar discrete, and those genera in which the ventromedian scar is generally consistently divided. Those genera which apparently have the ventromedian scar consistently divided do not appear until the Miocene. Two first appear at this level (*Orionina*, *Caudites*), one in the Pliocene (*Ambostracon*), three in the Pleistocene (*Normanicythere*, *Nereina*, and *Elofsonella*), and three in the Recent (*Patagonacythere*, *Palaciosa*, and *Australicythere*.) Genera which have either the ventromedian scar discrete or divided first appear in the Paleocene (*Muellerina*), one genus appears in the Oligocene (*Aurila*), two genera appear in the Miocene (*Mutilus* and *Hemicytheria*), three in the Pliocene (*Urocythereis*, *Hemicythere*, and *Heterocythereis*), one in the Pleistocene (*Baffinicythere*), and one in the Recent (*Tyrrhenocythere*).

In the hemicytherines related to *Pokornyella* (the *Aurila* and *Pokornyella* groups in text fig. 2), there is, therefore, a trend toward division of one of the two frontal scars possessed by the Paleogene representatives to form the three scars found in most Neogene and Quaternary members of the lineage.

The oldest hemicytherine with three frontal muscle scars seems to be *Muellerina parallelokladia* (Munsey, 1953) from the middle Paleocene of Alabama. This species extends the range of the genus back from the Oligocene. No Eocene species have yet been found. The *Muellerina* lineage (text fig. 2) probably evolved from the Thaerocytherinae independently, and the splitting of the frontal scars went on at a more rapid rate than in the *Pokornyella* lineage.

What anatomical change is concomitant with this scar division is as yet problematical; however, Neale (1959) suggests that development of the multiple frontal scars is connected "with the great development of the exopodite of the second antenna and its associated antennal gland * * *." Whatever its causation, the development of two scars from one of the Trachyleberidinae and the time successive development of three scars from two in the Hemicytherinae must be considered a phylomorphogenic trend.

There is, therefore, a trend through time in the Hemicytherinae toward division of the median adductor muscle scars. The oldest members of the subfamily have either the dorsomedian scar divided or discrete and the ventromedian scar discrete (Paleocene to Oligocene). Species which the the ventromedian scar sometimes divided do not appear until the Oligocene, and genera in which the ventromedian is consistently divided do not appear until the Miocene. The splitting of the median adductor scars, first the dorsomedian and the ventromedian, is considered a phylomorphogenic trend.

Because in the Hemicytheridae—the oldest subfamily which could have given rise to the Hemicytherinae, the Thaerocytherinae—possesses, with rare exceptions, four undivided adductor scars and two frontal scars, these two characters can be considered primitive for the Hemicytheridae; and the divided adductor scars found in the Hemicytherinae, as well as the three frontal scars of most of the genera, can be considered advanced. In the *Pokornyella* lineage the genera with only two frontal scars and discrete ventromedian and variously discrete or divided dorsomedian adductor scars appear before those genera with three frontal scars, divided dorsomedian adductor scars, and variously divided ventromedian adductor scars. In the *Muellerina* lineage all the genera have three frontal scars and divided dorsomedian adductor scars, but forms with discrete ventromedian adductor scars appear in time before those with divided ventromedian scars. The more advanced scar patterns are derivable through stages from the pattern first displayed by the Thaerocytherinae and ultimately by the Trachyleberidinae. This muscle-scar sequence is considered a phylomorphogenic trend that reflects the phylogenetic development of the Hemicytherinae from the Trachyleberidinae through the Thaerocytherinae.

Text figure 2 gives a tentative phylogenetic scheme for the Trachyleberididae and Hemicytheridae. The muscle-scar types known in each taxon are also shown in the figure. The number of described genera is also given.

The fact that some muscle-scar types are found only in particular taxa is evidence of the taxonomic importance of muscle scars. Only one type of scar is found in some subfamilies—for example, Cytherettinae, Trachyleberidinae, and Echinocythereidinae. This is also generally true for the Pterygocythereidinae and Buntoniinae; however, the dorsal adductor scar seems to divide on some Pterygocythereidinae (Hazel and Paulson, 1964), and some Buntoniinae have been described with divided frontal scars (Reyment, 1960; Apostolescu, 1961). These are rare, however, and for this reason are not shown on the diagram.

Two very similar patterns are known in the Mauritsininae; those found in *Mauritsina* and its possible descendent *Kikliocythere*. Two patterns are also known in the Brachycytherinae; those found in *Brachycythere* and its descendent *Digmocythere*. In each of the above, the range of a particular scar pattern is the same as that of a particular taxon.

In the Campylocytherinae, three basic scar patterns are found. In this subfamily the ranges of scar patterns are not entirely coincident with ranges of taxa. Single and double frontal scars have been described for *Anticythereis*, and double and triple antennal scars have been described for *Leguminocythereis*. A phylomorphogenic trend is present, however. because the single frontal scar gives rise to the double frontal scar which gives rise to three scars.

In the Hemicytherinae, heterogenous groups are represented by some scar types. For example, the muscle-scar types found in the *Muellerina*, *Orionina*, and *Aurila* informal taxonomic groups are very similar; however, these groups of genera represent two principal lineages within the subfamily. Here again there can be seen phylomorprogenic trends towards division of the frontal scar and, first, the dorsomedian adductor and, then, the ventromedian adductor scars. The more primitive muscle-scar type is found in the *Pokornyella* group. This includes *Pokornyella* and *Urocythere*,

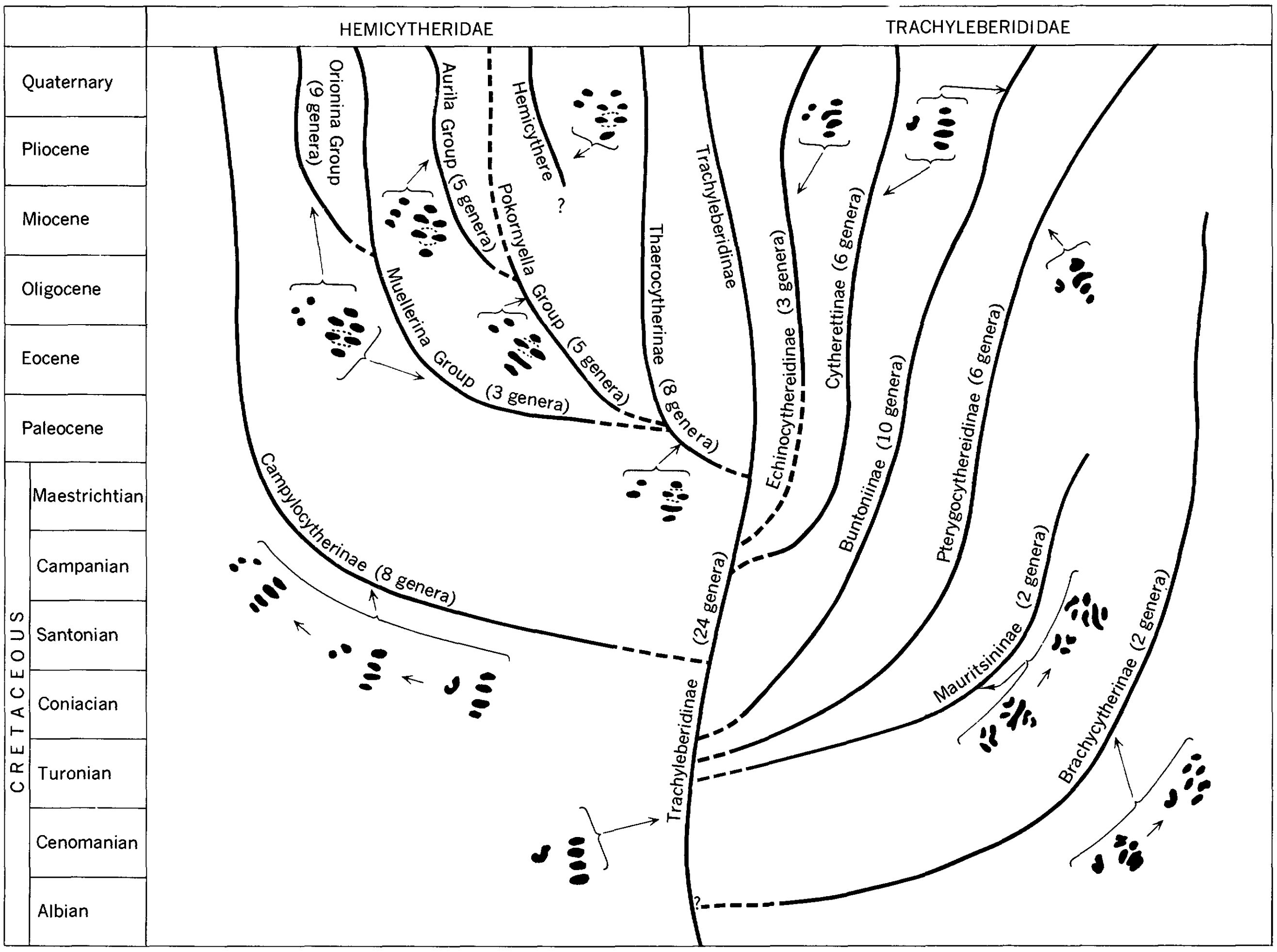

FIGURE 2.—Tentative phylogenetic scheme for the major formal and informal taxonomic groups of the Trachyleberididae and Hemicytheridae, also showing the general type of muscle-scar pattern found in each major grouping.

which surely are closely related, and *Nephokirkos*, and *Absonocytheropteron*, whose relationship to each other and the other two genera is not at all clear. In this group there are only two frontal scars, and the dorsomedian adductor scar is sometimes not divided.

Such genera as *Aurila*, *Mutilus*, *Heterocythereis*, *Hemicytheria*, and *Tyrrhenocythere* are very probably descended ultimately from *Pokornyella* and (or) *Urocythere*. They possess a muscle-scar pattern with three frontal scars and have the ventromedian adductor sometimes divided.

Hemicythere may be the only Neogene and Quaternary hemicytherine genus retaining only two frontal scars, a possible exception being Neogene and Quaternary species that have been referred to *Procythereis*. The ancestry of *Hemicythere* is not clear. Even though it is the nominal genus of the family, it appears to be unique.

The Neogene and Quaternary genera here placed in the *Orionina* group apparently have the ventromedian adductor scar consistently divided; included are *Orionina*, *Ambostracon*, *Nereina*, *Patagonacythere*, *Australicythere*, *Elofsonella*, and *Palaciosa*. *Baffinicythere*, in which the ventromedian scar is not divided, is also included. These genera are probably descended from ostracodes of the *Muellerina* group, which includes *Muellerina*, *Urocythereis*, and *Normanicythere*. *Ambostracon* is similar to *Caudites* and *Orionina*, which are no doubt closely related ostracodes (van den Bold, 1963a). Benson (1964) considers *Australicythere*, *Patagonacythere*, and *Ambostracon* to be related. *Nereina* and *Elofsonella* are also probably related to these genera. In addition to other similar features, *Orionina* and *Caudites* possess the peculiar pillar structure proximal to the fused zone of the calcified inner lamella. This is also present (van den Bold, 1963a) in the genus *Palaciosa*. *Baffinicythere* is included in this group, though in some ways it is not a typical representative. It has an undivided ventromedian scar, and the females are rather auriform in lateral outline; this outline is reminiscent of genera of the *Aurila* group. However, the males are totally unlike anything in the *Aurila* group, being very elongated. The primary ornamentation of the genus is more similar to that found in genera included in the *Orionina* group. Even though the genus is known only from Quaternary deposits, it has several primitive characters.

The muscle scars are as yet not known for the genus *Procythereis* Skogsberg. Puri (1953c) places *Hemicythere calhounensis* Smith in *Procythereis*. I have not been able to determine what the muscle scars of this species are. *Hemicythere calhounensis*, although probably not a *Pokornyella*, bears a close resemblance to species of that genus and could be one of the "transitional" Miocene forms referred to by van Morkhoven (1963, p. 152). If this is true, then the muscle scars may prove to be like those of *Pokornyella* and extend the range of the *Pokornyella* type of muscle scar into the Miocene. It remains to be proven that *Hemicythere calhounensis*, a tropical Miocene species, is congeneric with the Recent Antarctic species Skogsberg (1928) placed in his genus *Procythereis*.

When the data on muscle-scar patterns are combined with data on other morphologic features, it appears that the Hemicytherinae are divisible into several tribes. At present there is not, to my satisfaction, enough morphologic and distributional information available on some genera to formally propose such a division. Tentatively, however, this important subfamily seems to be composed of five major groupings which are here treated as informal taxonomic groups. The *Orionina* and *Aurila* groups, mentioned above, probably represent two valid taxa. *Pokornyella*, *Urocythere*, and probably *Nephokirkos* and *Absonocytheropteron* may represent a third taxon. The genus *Hemicythere*, even though it is the nominal genus of the family, appears to be unique and may represent a monotypic tribe. Another taxon may be represented by *Muellerina*, *Urocythereis*, and *Normanicythere*.

Muscle scars are, of course, subject to variation just as other features of the carapace, and their study must be attacked from within the framework of population systematics. Whereas the pattern within a species is very consistent, variants are not uncommon; and it is risky to judge the pattern for a species from that seen on an individual. The pattern of a genus cannot generally be considered known if only the scars of a single species have been delineated, unless, of course, the genus is monotypic.

Muscle scars are generally not easily seen, and it is discouraging to examine numerous specimens without being able to resolve the pattern of a single one. Excellent preservation does not always help, and often slightly abraded specimens show patterns the best. Muscle scars aid but are not a panacea for delineating genera or species. Many of the genera in the Hemicytheridae were described without the knowledge of the muscle-scar patterns of the type or other species. However, muscle scars are extremely useful criteria for placing genera within subfamilies and relating subfamilies within families; for this reason the type of muscle-scar pattern displayed by the species of proposed genera should be searched for assiduously.

SYSTEMATIC PALEONTOLOGY

All types and illustrated specimens are deposited in collections of the U.S. National Museum.

Measurements of specimens are indicated by the notations *L* and *H* for length and height. The number of specimens measured is noted by *N* and is followed by the mean (*M*), standard deviation (*Sd*), observed range (*OR*), and coefficient of variation (*V*).

The descriptive terminology used is principally that of Moore (1961) and van Morkhoven (1962, 1963). One new term is proposed. The so-called antislip tooth that is prominent in some genera of the Campylocytherinae and other subfamilies actually has nothing to do with the hingement. Most recent authors have recognized this and indicated such by carrying antislip tooth in quotes. Dissections of two species of *Bensonocythere* show that the "antislip tooth" is a site for the attachment of dorsal body muscles. It is therefore homologus with the large dorsal muscle scar or scars found in many genera. The term "dorsal muscle platform" is proposed for this feature.

Subclass OSTRACODA Latreille, 1802
Order PODOCOPIDA Sars, 1865
Suborder PODOCOPINA Sars, 1865
Superfamily CYTHERACEA Baird, 1850

Family HEMICYTHERIDAE Puri, 1953

Diagnosis.—Carapace auriform, subquadrate, subrectangular, oblong, or subtrapezoidal in lateral view, often produced posteroventrally; elliptic or ovate in dorsal view; surface ornamentation variable; few marginal denticles; hinge amphidont or modified amphidont; marginal areas wide; anterior and posterior vestibules usually present; radial canals generally many; eye tubercle absent or moderately developed; adductor muscle scars a near-vertical row of four scars, one or both of the middle scars, and sometimes the dorsal scar, may be divided; two or three frontal scars; antennules with five podomeres; endopodite of antennae with three podomeres, exopodite well developed; exopodite of mandible (branchial plate) reduced to one or two setae; chitinous supports in knees of thoracic legs.

Discussion.—As considered here, this family comprises the following three subfamilies:

Campylocytherinae Puri, 1960, Santonian to Recent
Hemicytherinae Puri, 1953, Paleocene to Recent
Thaerocytherinae Hazel, new subfamily, Paleocene to Recent

Subfamily **HEMICYTHERINAE** Puri, 1953

Diagnosis.—Auriform to subquadrate or subrectangular in lateral view; generally elliptic in dorsal view, widest at or in front of middle; adductor muscle scars usually with single upper and lower scars and two pairs of divided scars or one pair and one single scar between; two or three frontal scars.

Discussion.—This subfamily can be distinguished from the Campylocytherinae by its more elliptic shape in dorsal view and the presence of divided adductor muscle scars. The divided adductor muscle scars also separate the Hemicytherinae from the Thaerocytherinae. The following genera are considered as members of the Hemicytherinae:

Pokornyella group
Pokornyella Oertli, 1956, Paleocene to Oligocene
Urocythere Howe, 1951, Eocene
Nephokirkos Howe, 1951, Eocene
Absonocytheropteron Puri, 1957, Eocene
?*Procythereis* Skogsberg, 1928, Miocene(?), Recent
Orionina group
Australicythere Benson, 1964, Recent
Palaciosa Hartmann, 1959, Miocene to Recent
Patagonacythere Hartmann, 1962, Recent
Caudites Coryell and Fields, 1937, Miocene to Recent
Elofsonella Pokorný, 1955, Pleistocene to Recent
Ambostracon Hazel, 1962, Pliocene to Recent
Nereina Mandelstam, 1957, Pleistocene to Recent
Orionina Puri, 1954, Miocene to Recent
Aurila group
Mutilus Neviani, 1928, Miocene to Recent
Aurila Pokorný, 1955, Oligocene to Recent
Heterocythereis Elofson, 1941, Pliocene to Recent
Hemicytheria Pokorný, 1955, Miocene to Pliocene
Tyrrhenocythere Ruggieri, 1955, Recent
Baffinicythere Hazel, n. gen., Pleistocene to Recent
Hemicythere group
Hemicythere Sars, 1925, Pliocene to Recent
Muellerina group
Urocythereis Ruggieri, 1950, Pliocene to Recent
Muellerina Bassiouni, 1965, Paleocene to Recent
Normanicythere Neale, 1959, Pleistocene to Recent

Genus **HEMICYTHERE** Sars, 1865

Type species, *Cythereis villosa* Sars, 1865.

Diagnosis.—Subreniform; surface variously pitted; duplicature moderately broad; radial canals many; narrow vestibules present; hinge amphidont with smooth anterior tooth in right valve, postjacent socket, crenulate bar, multilobate elongated posterior tooth; two frontal muscle scars and five or six adductor scars.

Discussion.—Van Morkhoven (1963, p. 136) states that the generic diagnosis of *Hemicythere* "would seem to fit no other published species than the type." An opposite view is taken by Hartmann (1964, p. 107) who places at least 17 species in the genus.

The subreniform shape, distinctive hingement, and muscle scars are important features that characterize the type species. *Cythere borealis* Brady, 1868, has the same shape as the type species, and Brady (1868b, p. 31) describes the hinge as "a crenulated median bar, with a moderately strong anterior tooth-like process [in the left valve]; in the right valve * * * a small anterior tooth and a slightly crenulated posterior projection." This is close to the described hinge of the type species. *Cythere pulchella* Brady, 1868, has the subreniform shape, but the hingement is incompletely known. Brady (1868b) states that *Cythere rubida* Brady, 1866, is closely related to *C. pulchella* and also compares it to *Cythereis villosa.* Therefore, it may also be a *Hemicythere.* There appear to be at least two, and possibly three, other arctic or boreal species in addition to the type species of *Hemicythere.* Van Morkhoven (1963, p. 136) also mentions an undescribed species from New Zealand.

Stratigraphic range.—Pliocene to Recent.

Hemicythere cf. **H. villosa** (Sars, 1865)

Plate 2, figure 4

1865. *Cythereis villosa* Sars, Vidensk, Selsk. Christiania, Förh., p. 42.
1941. *Cythereis* (*Eucythereis*) villosa Sars. Elofson, Zool. Bidrag från Uppsala, v. 19, p. 287 (gives full synonymy from 1865–1941).
1943. *Cythereis* (*Eucythereis*) *villosa* Sars. Elofson, Archiv Zoologi., v. 35A, no. 2, p. 9.
1952. *Hemicythere villosa* (Sars). Pokorný, Ústředniho Ústavu Geol. Sborník [Czechoslovakia], v. 19, p. 156.
1953. *Hemicythere villosa* (Sars). Puri, Washington Acad. Sci. Jour., v. 43, no. 6, p. 174, pl. 1, figs. 11, 12.
1957. *Hemicythere villosa* (Sars). Wagner, * * * ostracodes du Quaternaire Recent des Pays-Bas * * *, p. 56, pl. 23.
1963. Not *Hemicythere villosa* (Sars). Swain, Jour. Paleontology, v. 37, no. 4, p. 828, pl. 99, figs. 4, 6; text fig. 10c (=*Hemicythere borealis* and *Elofsonella concinna*).

Measurements.—One adult female measures 0.64 mm long and 0.37 mm high.

Discussion.—Brady (1868b) reported this species from the Davis Strait and later (1870a) listed it as occurring in the Gulf of St. Lawrence. Cushman (1906) reported it from Vineyard Sound. Only one adult specimen, a left valve which may be conspecific with *Hemicythere villosa*, was found in the present study (sample 31). The specimen compares favorably with specimens of *H. villosa* from the North Sea area in shape and internal features, but the ornamentation is reduced to shallow pits, contrasting with the more coarsely pitted or reticulated North Sea specimens. More material will need to be examined to evaluate the taxonomic importance, if any, of this difference.

Specimens found.—Two, one adult female and one juvenile.

Occurrence.—Various localities near the British Isles, North Sea, Norwegian Sea, English Channel, Bay of Biscay, Greenland Sea, Baltic Sea, Davis Strait, Gulf of St. Lawrence, and Vineyard Sound. Pleistocene of England, Scotland, Ireland, Norway, and Canada. In the present study, two specimens which may represent this species were found; one from the Gulf of Maine (sample 31) and the other near Martha's Vineyard (sample 39).

Repository.—USNM 112728.

Hemicythere borealis (Brady, 1868)

Plate 2, figures 3, 5, 6, 10, 11

1868. *Cythere borealis* Brady, Annals and Mag. Nat. History 4th ser., v. 2, p. 31, pl. 4, figs. 1–4, 6, 7.
1889. *Cythere borealis Brady.* Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d ser., v. 4, no. 2, p. 147, figs. 18, 19.
1963. *Hemicythere villosa* (Sars). Swain (partim), Jour. Paleontology v. 37, no. 4, p. 828, pl. 99, fig. 4; not pl. 99, fig. 6 or text fig. 10c (=*Elofsonella concinna*).

Diagnosis.—Large; irregularly and coarsely pitted; characteristic depression in posteroventral area of valves; males relatively more elongate, but actually smaller than females.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	10	0.861	0.018	0.838–0.900	2.1
H	10	.501	.011	.488– .525	2.2
Male:					
L	7	.809	.021	.775– .833	2.6
H	7	.452	.015	.425– .462	3.3

Discussion.—The carapace and soft parts of this species are well described by Brady (1868b) and Brady and Norman (1889). The latter authors point out the close relationship with the type species of *Hemicythere*. It is much larger than *H. villosa* and is also distinguished by a depression in the posteroventral area of the valves. The species is undoubtedly a true *Hemicythere*.

Specimens found.—100.

Occurrence.—Dobbin Bay, Davis Strait, Godhavn Harbor, and Holsteinsborg Harbor. Pleistocene of Alaska. In the present study the species was found to be abundant in White Bear Arm, Labrador, and rare in Kneeland Bay and Vaigat Strait.

Repository.—USNM 112723–112727.

Hemicythere? pulchella (Brady, 1868)

1868. *Cythere pulchella* Brady, Linnean Soc. London Trans., v. 26, p. 404.
1868. *Cythere pulchella* Brady. Brady, Annals and Mag. Nat. History, 4th ser., v. 2, p. 32, pl. 5, figs. 18–20.
1869. *Cythere pulchella* Brady. Brady and Robertson, idem., v. 3, p. 369, pl. 20, figs. 1–3.
1874. *Cythere pulchella* Brady. Brady, Crosskey, and Robertson, A monograph of the Post-Tertiary Entomostraca * * *, p. 157, pl. 3, figs. 29–37.
1889. *Cythere pulchella* Brady. Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d, ser., v. 4, no. 2, p. 34, pl. 15, figs. 7, 8.

Discussion.—This species was reported from the Davis Strait by Brady (1868b). I have not identified it in my material.

Occurrence.—Various localities in the British Isles, Scheldt River in the Netherlands, and Davis Strait. Pleistocene of Scotland and Ireland.

Genus ELOFSONELLA Pokorný, 1955

(=Paracythereis Elofson, 1941)

Type species, *Cythere concinna* Jones, 1857.

Diagnosis.—Subtrapezoidal in lateral view; strong anteroventral rim, low but distinct muscle swelling; surface pitted or reticulate; hinge strong holamphidont; three frontal muscle scars; median two adductor muscle scars divided.

Stratigraphic range.—Pleistocene to Recent.

Elofsonella concinna (Jones, 1857)

Plate 4, figures 10, 11, 13

1857. *Cythere concinna* Jones, A monograph of the Tertiary Entomostraca * * *, p. 29, pl. 4, figs. 7a–f.
1941. *Cythereis* (*Paracythereis*) *concinna* (Jones). Elofson, Zool. Bidrag från Uppsala, v. 19, p. 289 (gives full synonymy from 1857–1941).
1943. *Cythereis* (*Paracythereis*) *concinna* (Jones). Elofson, Archiv Zoologi, v. 35A, no. 2, p. 9.
1955. *Elofsonella concinna* (Jones). Pokorný, Carolinae Univ. Acta Geologica, v. 3, p. 10, figs. 3–7.
1963. *Elofsonella concinna* (Jones). Swain, Jour. Paleontology. v. 37, no. 4, p. 829, pl. 98, figs. 1a, b; pl. 99, figs. 11a–c, text fig. 12c.
1963. *Hemicythere villosa* (Sars). Swain (partim), Jour. Paleontology, v. 37, no. 4, p. 828, pl. 99, fig. 6; text fig. 10c; not pl. 99, fig. 4 (=*Hemicythere borealis*).
1965. *Elofsonella concinna concinna* (Jones). Bassiouni, Dansk Geol. Fören., Medd., v. 15, no. 4, p. 511, pl. 2, figs. 1, 2.

1965. *Elofsonella concinna neoconcinna* Bassiouni, idem., pl. 2, fig. 3a–c.

Diagnosis.—Subtrapezoidal in lateral view: strong anterior rim; surface with ridges and pits which may be strongly or weakly developed.

Measurement in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	12	0.998	0.091	0.900–1.215	9.1
H	12	.576	.053	.488–.650	9.2
Male:					
L	6	1.029	.062	.975–1.125	6.0
H	6	.552	.035	.500–.588	6.3

Discussion.—Jones (1857) described *Cythere concinna* from Pleistocene deposits of Yorkshire, England. The species has been subsequently reported many times from the Pleistocene and Recent. Bassiouni (1965) gives an incomplete synonymy for the species, but apparently restricts *Elofsonella concinna* sensu stricto to the Pleistocene and names *E. concinna neoconcinna* for the Recent forms, at least those of Elofson (1941) and Pokorný (1955). The two subspecies are distinguished by differences in surface ornamentation. *Elofsonella concinna neoconcinna* is said to possess a reticular ornamentation with the reticules divided by fine branches, whereas *E. concinna concinna* is ornamented with fine pits and has an indication of a reticular sculpture developing on the lower half of the valves.

Both the pitted and reticulate forms are living off northeastern North America and, further, can be found in the same samples. Therefore, *Elofsonella concinna concinna* and *E. concinna neoconcinna* are not chronologic subspecies as implied by Bassiouni. Both types were found in samples from Ungava and Frobisher Bay (60° to 63° N.). Only the reticulate form was found farther north; however, only three specimens in all were found north of 63° N. Only the pitted form was found in two samples from the Gulf of Maine. This would seem to indicate a variation with latitude; however, all the specimens illustrated from the Pleistocene of Alaska (70° N.) by Swain (1963) seem to be the pitted form. In a sample in which both forms occur in some abundance (sample 24), a gradational series from one form to the other occurs. Therefore, it is not likely that the two forms represent closely related morphologically similar species. I am inclined to consider this pitted-to-reticulate variation infrasubspecific in nature, and at least until more knowledge on the geographic distributions of the morphotypes is known, synonymize Bassiouni's two subspecies.

The specimens found in the Gulf of Maine are nearly 15 percent smaller than those found in the colder waters to the north. Thus, the species shows considerable variation in size as well as ornamentation.

Specimens found.—82.

Occurrence.—Baltic Sea, North Sea, Norwegian Sea, Barents Sea, near Iceland, near Spitzbergen, various localities in the British Isles, Kane Basin, Gulf of Maine, Gulf of St. Lawrence, and Vineyard Sound. Pleistocene of Alaska, Maine, England, Scotland, Ireland, Denmark, and Norway. In the present study the species was found in samples from near North Wolstenholme Island, the Foxe Basin, Frobisher Bay, Kneeland Bay, Ungava Bay, and the Gulf of Maine.

Repository.—USNM 112764–112766.

Genus **BAFFINICYTHERE** n. gen.

Type species, *Cythere costata* Brady, 1866.

Etymology.—Baffin, from Baffin Bay, plus the genus *Cythere.*

Diagnosis.—Elongate subrectangular (males) to subtrapezoidal or auriform (females); ridges form a triangle in posteroventral area of the lateral surface; small vestibules at anterior and posterior; radial canals many, swollen at midlength; hinge holamphidont, posterior tooth of right valve reniform; ocular sinus conspicuous; normal pore canals scattered, sieve type; muscle scars consist of three unsplit adductor scars, one (dorsomedian) split adductor, and three rounded frontal scars with the median scar forward; nodes between central muscle field and mandibular scars and between central muscle field and dorsal scars.

Discussion.—I interpret this genus as being related to such genera as *Ambostracon*, *Orionina*, *Elofsonella*, *Caudites*, *Nereina*, and *Patagonacythere*, though perhaps less closely related to any of these than they are to each other. The two species here placed in *Baffinicythere* have muscle-scar patterns similar to the above genera but differ in having the ventromedian scar undivided. The females of *Baffinicythere* are somewhat auriform in lateral view, a characteristic of the *Aurila* group, but *Baffinicythere* differs from this group by being strongly sexually dimorphous, the males being in no way auriform but subrectangular. In this respect, and in some primary ornamental features present in both sexes, such as major ribs, the genus resembles genera of the *Orionina group.* Particularly diagnostic for *Baffinicythere* is the triangle formed by the intersection of ribs in the posteroventral area of the lateral surface.

The genus is proposed for the species *Cythere costata* Brady, 1866, and *Cythereis emarginata* Sars, 1865. Brady (1868a) first pointed out the close relationship between these two species. I have not seen the types of

Cythere costata. However, the type species has been well illustrated by Brady (1866), Brady, Crosskey, and Robertson (1874), and Brady and Norman (1889). It is a distinct and easily recognized species.

Baffinicythere is known from about 80° N. to about 59° N. in the eastern North Atlantic and from about 80° N. to about 41° N. in the western North Atlantic.

Stratigraphic range.—Pleistocene to Recent.

Baffinicythere costata (Brady, 1866)

Plate 2, figures 7, 12–15; plate 8, figures 1–8

1866. *Cythere costata* Brady, Zool, Soc. London Trans., v. 5, p. 375, pl. 60, figs. 5a–f.
1869. *Cythere costata Brady.* Norman, Shetland final dredging report, pt. 2, British Assoc. Adv. Sci., rept. 38th Mtg., p. 290.
1874. *Cythere costata.* Brady, Crosskey, and Robertson, A monograph of the Post-Tertiary Entomostraca * * *, p. 166, pl. 5, figs. 21–24.
1878. *Cythere costata.* Brady, *in* Nares, Narrative of a trip to the Polar Sea during 1875–6 * * *, v. 2, no. 7, p. 254.
1889. *Cythere costata.* Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d ser., v. 4, p. 164, pl. 16, figs. 7, 8.

Diagnosis.—Large; very strong sexual dimorphism, males much longer than females; posterior leg of bifurcated posteromedian ridge angles towards posteroventral area, anterior leg better developed than posterior leg; posteroventral area with several moderately strong denticles; eye tubercle present.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	14	1.120	0.063	1.038–1.250	5.6
H	14	.646	.033	.575–.688	5.1
Male:					
L	13	1.166	.043	1.088–1.200	3.7
H	13	.592	.029	.550–.638	4.9

Description.—In lateral view, subrectangular (males) to subtrapezoidal or auriform (females); surface coarsely reticulate; prominent rib runs from eye tubercle around anterior rim, along anterior half of ventrolateral area then curves upward and bifurcates, one leg continuing parallel to ventral outline, the other curving upward towards posterodorsal area where it is joined by a less prominent ridge leading from posterior end of first leg; these ridges form a triangle in the posteroventral area; main ridge curves anteriorly to form short dorsolateral ridge in posterior half of valves; muscle swelling broad, indistinct, at conjunction of several reticulation riblets. Lanceolate in dorsal view, valves subequal, left valve slightly larger. Hinge holamphidont; posterior tooth large, reniform, smooth, connected to anterior deep socket behind a strong, stepped, smooth tooth by a smooth bar; left valve complimentary, posterior socket open to interior; marginal areas broad with anterior and posterior vestibules; radial canals many, swollen in middle; ocular sinus conspicuous; normal pore canals scattered, sieve type. Muscle scars a vertical row of scars, the dorsomedian scar distinctly divided; and three frontal scars, two large round scars in oblique row, with small third scar set below and behind second scar.

Antennules have five podomeres; tufts of very fine setae on anterior edge of second podomere; one seta at distal end of posterior edge of second podomere; one seta at distal end of anterior edge of third podomere; fourth podomere has three setae—one thin, one medium, and one large at anterior midlength, one of which comes from side of podomere—and three like sized setae at anterodistal end and one long thin seta at posterodistal end; fifth podomere has one large and at least two other smaller setae. Endopodite of antennae has three podomeres, exopodite poorly developed on males and not seen on females, three terminal claws; cutting edge of mandible has many well developed teeth; thoracic legs have chitinous supports in knees and strong terminal claws.

Discussion.—*Baffinicythere costata* has the same basic pattern of ornamentation as does *B. emarginata*, but differs in detail (see diagnosis). *Baffinicythere costata* is larger and the males of this species are actually longer than the females; the opposite is true in *B. emarginata.* The lower frontal muscle scar of *B. costata* is small and easily overlooked.

Specimens found.—117.

Occurrence.—Near the Hunde Islands, Holsteinsborg Harbor, near Franz Josef Land, Franklin Pierce Bay, and Smith Sound. Pleistocene of England and Scotland. In the present study the species was found in samples from near North Wolstenholme Island, the Vaigat Strait, the Foxe Basin, Frobisher Bay, Ungava Bay, White Bear Arm, and the Gulf of Maine.

Repository.—USNM 112686–112688, 112729–112733.

Baffinicythere emarginata (Sars, 1865)

Plate 2, figures 1, 2, 8, 9; plate 9, fig. 2

1865 *Cythereis emarginata* Sars, Vidensk. Selsk. Christiania, Förh., p. 38.
1941 *Cythereis* (*Eucythereis*) *emarginata* Sars. Elofson, Zool. Bidrag från Uppsala, v. 19, p. 283 (gives full synonymy from 1865–1941).
1943 *Cythereis* (*Eucythereis*) *emarginata* Sars. Elofson, Archiv Zoologi, v. 35A, no. 2, p. 8.

Diagnosis.—Relatively small; males shorter than females; posterior leg of bifurcated posteromedian ridge vertical and more strongly developed than anterior leg; eye tubercle not well developed.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	20	0.816	0.043	0.775–0.900	5.3
H	20	.492	.030	.450– .562	6.1
Male:					
L	16	.766	.038	.725– .850	4.8
H	16	.426	.020	.400– .450	4.7

Discussion.—The soft parts of this species were illustrated by Sars (1925) and Cushman (1906). Cushman shows the antennules to have six podomeres; however, this is undoubtedly a drawing or observational error.

Baffinicythere emarginata is smaller than *B. costata* and differs in details of ornamentation. The males of *B. emarginata* are smaller than the females; the opposite is true in *B. costata.*

Specimens found.—201.

Occurrence.—North Sea, Norwegian Sea, near Spitsbergen, near Iceland, near Franz Josef Land, Greenland Sea, Barents Sea, Franklin Pierce Bay, Davis Strait, Godhavn Harbor, Holsteinsborg Harbor, near the Hunde Islands, Gulf of St. Lawrence, Vineyard Sound, and Buzzards Bay. Pleistocene of England, Scotland, Ireland, Norway, and Maine. In the present study the species was found in samples from near North Wolstenholme Island, the Vaigat Strait, Kneeland Bay, Ungava Bay, White Bear Arm, the Gulf of Maine, Browns Bank, and near Martha's Vineyard.

Repository.—USNM 112691, 112719–112722.

Genus NEREINA Mandelstam, 1957

(=Finmarchinella Swain, 1963)

Type species, *Nereina barenzovoensis* Mandelstam, 1957 (? = *Cythereis angulata* Sars, 1865).

Diagnosis.—Subtrapezoidal to subrectangular in lateral view; venter flattened: elliptic in dorsal view; surface pitted, may be rugose; sexual dimorphism strong, males more elongate and much lower at posterior than females; hinge of right valve consists of very elongate multilobate anterior tooth connected to elongate multilobate posterior tooth by crenulate groove; left valve complementary; vestibules at anterior and posterior; many radial canals, swollen medially; selvage well developed; three frontal muscle scars; median two adductor muscle scars divided at sharp angle to valve length.

Discussion.—The most distinctive character in *Nereina* is the unusual hingement. This type of hingement is not primitive, for its three-fold elements are not homologous with the three-fold merodont hinge. Pokorný (1964a, p. 280) states that "* * * *Nereina* would represent not the most primitive state of Hemicytherinae-hinge, but the final stage of a regressive evolution, comparable morphologically to some phenomena of foetalisation, where larval morphology persists in adult forms."

Swain (1963, p. 813) proposed the genus *Finmarchinella* for the species *Cythereis angulata* Sars, 1865, and *Cythereis finmarchica* Sars, 1865. The latter species was selected as the type. He describes the muscle scars for *Finmarchinella*—presumably the scar pattern described is that of *Cythereis angulata* and not of *C. finmarchica* because *C. finmarchica* was not found by Swain, even though he selected it as the type species—as consisting of "a row of three or four elongate spots on the posterior portion of median tubercle (a pit on internal surface) together with one or two spots on anterior slope of median node and an additional one or more spots anterior to median node." However, the muscle-scar patterns shown here on plate 11, figures 7 and 8, for both species agree with the pattern described for the type species of *Nereina* by Howe (in Moore, 1961, p. Q305). Mandelstam (1957, p. 179) had already placed *C. angulata* in his *Nereina.* I consider *C. angulata* and *C. finmarchica* to be congeneric; thus *Finmarchinella* is a subjective synonym of *Nereina.*

Stratigraphic range.—Pleistocene to Recent.

Nereina finmarchica (Sars, 1865)

Plate 1, figures 1–4, 6; plate 11, figure 7

1865. *Cythereis finmarchica* Sars, Vidensk. Selsk. Christiania, Förh., p. 41.
1868. *Cythere finmarchica* (Sars). Brady, Linnean Soc. London Trans., v. 26, p. 410, pl. 31, figs. 9–13.
1874. *Cythere finmarchica* (Sars). Brady, Crosskey, and Robertson, A monograph of the Post-Tertiary Entomostraca * * *, p. 153, pl. 10, figs. 18–21.
1889. *Cythere finmarchica* (Sars). Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d ser., v. 4, no. 2, p. 163.
1925. *Hemicythere finmarchica* (Sars). Sars * * *, Crustacea of Norway, v. 9, Ostracoda, p. 185, pl. 85, fig. 3.

Diagnosis.—Small; coarsely, evenly reticulate; small dorsal muscle platform present.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	11	0.712	0.019	0.688–0.750	2.7
H	11	.391	.010	.375– .415	2.6
Male:					
L	3	----------	----------	.675– .700	----------
H	3	----------	----------	.325– .350	----------

Discussion.—*Nereina finmarchica* is easily distinguished from *N. angulata* by its smaller size, more evenly ornamented surface, and by the presence of a dorsal muscle platform (the so-called antislip tooth of many authors).

Specimens found.—26.

Occurrence.—Several localities off England, Scotland, and Ireland; Norwegian Sea, Barents Sea, Bay of Biscay, Davis Strait, Holsteinsborg Harbor, and near Cape Verde Islands. The species appears to be an arctic to cool-temperature form. The locality in the Cape Verde Islands (Brady and Norman, 1889) is inconsistent with its other occurrences and, tentatively, is considered to be based on a misidentification. Known also from the Pleistocene of Scotland and Norway. In the present study the species was found in Ungava Bay, the Gulf of Maine, and off Lower New York Bay.

Repository.—USNM 112701, 112703–112707.

Nereina angulata (Sars, 1865)

Plate 1, figures 7–11; plate 11, figs. 5, 8

1865. *Cythereis angulata* Sars, Vidensk. Selsk. Christiania, Förh., p. 40.

1941. *Cythereis* (*Eucythereis*) *angulata* Sars. Elofson, Zool. Bidrag från Uppsala, v. 19, p. 285 (gives full synonymy from 1865–1941).

1946. *Hemicythere angulata* (Sars). Akatova, Dreifuyushchei ekspeditsii glavsemorputi na ledokol'nom parokode "G. Sedov", 1937–1940 g.g., Trudy: v. 3, p. 227, text figs. 5a, b.

1951. Not *Trachyleberis*? cf. *T.*? *angulata* of Swain, U.S. Geol. Survey Prof. Paper 234–A, p. 29, pl. 3, figs. 9–12.

1957. "*Hemicytherinae*" (Genre?) *angulata* (Sars). Wagner, * * * Ostracodes du Quaternaire Recent des Pays-Bas * * *, p. 61, pl. 38, figs. 1, 2.

1957. [?] *Nereina barenzovoensis* Mandelstam, Vsesoyuznogo Paleont. Obshchestva, Ezhegodnik, v. 16, p. 180, pl. 3, figs. 7, 8.

1963. *Finmarchinella angulata* (Sars). Swain, Jour. Paleontology, v. 37, no. 4, p. 813, pl. 97, fig. 22; pl. 99, fig. 9; text fig. 11c.

Diagnosis.—Surface irregularly ornamented with reticulations and ribs; loop formed by one rib in area posterodorsal to muscle swelling.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	5	0.860	0.010	0.850–0.875	1.2
H	5	.480	.007	.475– .488	1.5
Male:					
L	5	.808	.046	.750– .875	5.7
H	5	.423	.032	.375– .462	7.5

Discussion.—The poor illustrations of the type species of the genus, *Nereina barenzovoensis*, preclude a close comparison of *N. angulata* with it. The photograph of a male of the type species by Howe (in Moore, 1961, p. Q305, fig. 231, 3d) aids very little. The size, outline, and few morphologic features that can be distinguished from the available illustrations, as well as the rather inadequate description by Mandelstam (1957, p. 180), are reminiscent of *N. angulata.* I suggest that future workers compare the two forms closely in order to contrast and define the differences between them.

Specimens found.—59.

Occurrence.—Several localities off Ireland, Scotland, Northern England; North Sea, Laptev Sea, Norwegian Sea, Barents Sea, off Spitsbergen, off Iceland, Davis Strait, Hunde Islands, and Holsteinsborg Harbor. Pleistocene of England, Scotland, Ireland, Norway, and Alaska. In the present study the species was found in the Davis Strait, near North Wolstenholme Island, in Frobisher Bay, Kneeland Bay, Ungava Bay, White Bear Arm, the Gulf of Maine, and on Browns Bank.

Repository.—USNM 112699, 112709–112713.

Genus PATAGONACYTHERE Hartmann, 1962

Type species, *Patagonacythere tricostata* Hartmann, 1962.

Discussion.—Additional information about other species of *Patagonacythere* and a diagnosis of the genus in English can be found in Benson (1964). The diagnoses given by Hartmann (1962) and Benson (1964) are compatible except for the type of hingement.

Hartmann (1962, p. 251) describes the posterior tooth of the right valve in the type species as being crenate (gekerbt). Benson (1964) describes the hinge of *Patagonacythere devexa* (Mueller, 1908) and *P. longiducta antarctica* Benson, 1964, as holamphidont. Specimens of both *P. devexa* and *P. longiducta antarctica*, kindly provided by Dr. Benson, showed multilobate posterior teeth when stained with food dye. *Patagonacythere dubia* also has a multilobate posterior tooth in the right valve; thus it appears that the lobation of the posterior tooth is a taxonomic character of generic importance in *Patagonacythere.*

In addition to the species mentioned above, Benson (1964) also placed *Cythere wyvillethompsoni* Brady, 1880, in the genus. *Patagonacythere dubia* is the first species recorded from the northern hemisphere.

Stratigraphic range.—Recent.

Patagonacythere dubia (Brady, 1868)

Plate 4, figures 1, 6, 7, 9, 12; plate 9, figures 1, 3, 5, 6

1868. *Cythere dubia* Brady, Linnean Soc., London Trans., v. 26, p. 409, pl. 32, figs. 75, 76.

1877. *Cythere dubia* Brady. Norman, Royal Soc. London Proc., v. 25, p. 209.

1889. *Cythere dubia* Brady. Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d ser., v. 4, no. 2, p. 162.

Diagnosis.—Narrow but prominent ridge runs from muscle swelling to anterior rim; posterodorsal loop poorly defined.

Description.—Carapace subquadrate to subrectangular; anterior broadly, slightly obliquely rounded; posterior produced below middle; anterior not denticulate; posterior has four or five prominent denticles; surface finely reticulate; sieve-type normal pore canals at end of short curved riblets which branch from main reticulation riblets; reticulate pattern radiates from moderate muscle swelling; anterior rim runs from eye tubercle around anterior and continues length of ventral surface; well-defined ventrolateral ridge; posterodorsal loop poorly defined; low, narrow but conspicuous ridge runs from muscle swelling to center of anterior rim. Carapace subelliptic in dorsal view, posterior compressed; left valve larger and overlaps right at cardinal angles. Hinge amphidont with large rounded, smooth anterior tooth having very prominent anterior step, moderately deep postjacent socket, sinuous and crenulate median groove, and multilobate elongate-reniform posterior tooth having about eight lobes; marginal areas wide having narrow anterior and wider posterior vestibule; about 40 radial canals around anterior and 15 at posterior; canals tend to be swollen medially. Ocular sinus prominent. Two dorsomedian and two ventromedian adductor scars with single scars above and below these; upper adductor scar somewhat U-shaped, open towards anteroventer; three frontal scars, lower scar forward, middle scar most posterior; three raised (muscle attachment?) areas arranged in a triangle above muscle scars and still another above these.

Antennules have five podomeres; second podomere has one large seta at posterodistal end and very fine setae along anterior edge; third podomere has one large seta at anterodistal end; fourth podomere has three setae at nearly midlength, one large and one small on anterior edge and one coming from middle of podomere; third podomere has one large and one small seta in anterodistal half and one long but narrow seta in posterodistal half; fifth podomere has one large seta and two thinner but equally long setae at terminus. Endopodite of antennae has three podomeres; three strong terminal claws; exopodite well developed.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	10	0.995	0.039	0.938–1.050	3.9
H	10	.549	.025	.512–.600	4.6
Male:					
L	1	---	---	.925	---
H	1	---	---	.475	---

Discussion.—*Patagonacythere dubia* is morphologically very close to *P. longiducta* (Skogsberg, 1928) but can be distinguished by the ridge in the anterocentral area and by its larger size. The posterior tooth of the right valve of *P. dubia* also has more lobations. I have observed an undescribed species of *Patagonacythere* in one sample from the Beaufort Sea off Point Barrow, Alaska, which is very closely related to *P. dubia.* This species, which could be only a subspecies of *P. dubia*, differs principally by having two large nodes in the anterocentral area and no anterior rim.

Brady (1868a) described *Cythere dubia* from samples submitted to him by A. M. Norman. Brady's description fits my specimens, and the dorsal and lateral outlines are also a good fit for my specimens; however, the surface ornamentation is not shown by Brady's illustrations. The specimens I have referred to Brady's species were found in four samples; one from the Foxe Basin (67° N.), two from Ungava Bay (60° N.), and one from off southern Nova Scotia (43° N.). The fact that Norman (1877) reported *Cythere dubia* from a Davis Strait locality (67° N.) lends some confidence to the present identification. However, Brady and Norman (1889) do not mention the Davis Strait occurrence, but Mueller (1931) gives a Greenland occurrence of the species, presumably based on Norman's 1877 paper. I am fairly confident, but less than positive, of my identification.

Specimens found.— 36.

Occurrence.—Shetland Islands and Davis Strait. In the present study the species was found in the Foxe Basin, Ungava Bay, Frobisher Bay, and on Browns Bank.

Repository.—USNM 112689, 112690, 112754–112758.

Genus **MUELLERINA** Bassiouni, 1965

Type species, *Cythere latimarginata* Speyer, 1863.

Diagnosis.—Subrectangular in lateral view; posterior slightly produced below; surface coarsely pitted; pits may be arranged in longitudinal rows between low ridges; hinge modified amphidont, anterior and posterior multilobate teeth in right valve connected by narrow groove which opens anteriorly to receive small elongate tooth at end of median bar of left valve; two median adductor scars usually divided; three frontal scars; the lower two are very close together or fused; second podomere of endopodite of antennae very elongate.

Discussion.—Species of *Muellerina* are generally smaller than those of *Urocythereis* Ruggieri, and *Muellerina* is less produced posteroventrally. The surface pitting of *Muellerina* is generally not as coarse; and the pits tend to line up in rows, particularly in the area just above and behind the muscle swelling. The second podomere of the endopodite of the antennae is more elongate than in *Urocythereis.* Whereas, the frontal muscle scars of *Urocythereis* consist of an oblique row of three scars, in *Muellerina* the lower scar is off line and very close or fused to the median scar. Bassiouni (1965) considers *Muellerina* to possess only two frontal scars. However, specimens of *M. abyssicola*, *M. canadensis*, *M. paralleloklladia*, and *M. lienenklausi* that I have examined show either two discrete lower frontal scars or, commonly, a single dumbell-shaped scar. The two rounded ends of this scar are raised above the middle part, a fact indicating that the scar was formed mainly by two bundles of muscles rather than one. The lower frontal scar is often divided into two discrete scars in *M. canadensis* and *M. lienenklausi*. In *M. abyssicola* it is sometimes divided but most often is a dumbbell-shaped scar. According to Bassiouni (1965), the lower scar is not divided in the Oligocene *M. latimarginata*.

Muellerina has a carapace shape similar to that of *Urocythereis*, and the marginal areas and hingement are alike. The two genera seem very closely related, and *Muellerina* may be ancestral to *Urocythereis*.

Van Morkhoven (1963, p. 153) mentions the occurrence of *Urocythereis* on the east coast of North America, and Hazel (1965f) states that *Urocythereis* occurs off New England. The species that Hazel and, probably, van Morkhoven considered to be *Urocythereis* actually represent *Muellerina*.

Four species of *Muellerina* are known to occur in North America; these are *M. lienenklausi* (Ulrich and Bassler, 1904), *M. canadensis* (Brady, 1870), *M. abyssicola* (Sars, 1865), and *M. paralleloklladia* (Munsey, 1953). The last taxon is the oldest known species of the genus. It has been found in the Paleocene Porters Creek Formation of Alabama. *Muellerina canadensis* and *M. abyssicola* are known only from the Recent, but *M. lienenklausi* is also known from the Miocene of the Atlantic Coastal Plain and Florida.

Stratigraphic range.—Paleocene to Recent.

Muellerina lienenklausi (Ulrich and Bassler, 1904)

Plate 3, figures 3–6, 11; plate 7, figures 1, 4, 5, 7

1904. *Cythere lienenklausi* Ulrich and Bassler, Maryland Geol. Survey, Miocene [volume], p. 114, pl. 38, fig. 31.
1904. *Cythere micula* Ulrich and Bassler, idem, p. 116, pl. 36, figs. 18–20.
1951. *Trachyleberis? martini* (Ulrich and Bassler). Swain, U.S. Geol. Survey Prof. Paper 234–A, p. 29, pl. 3, figs. 8, 15.
1951. *Trachyleberis?* cf. *T. micula* (Ulrich and Bassler). Swain, idem, p. 29, text fig. 31.
1953. *Trachyleberis martini* (Ulrich and Bassler). Malkin, Jour. Paleontology, v. 27, no. 6, 793, pl. 82, figs. 6–13.
1954. *Murrayina martini* (Ulrich and Bassler). Puri, Florida Geol. Survey Bull. 36 (1953d), p. 256, pl. 12, figs. 11–13, text figs. 8e, f.
1954. Not *Orionina lienenklausi* (Ulrich and Bassler). Puri, idem, p. 254, pl. 12, fig. 14; text fig. 8d.
1957. *Murrayina martini* (Ulrich and Bassler). McLean, Bull. Am. Paleontology, v. 38, no. 167, p. 86, pl. 11, figs. 1a–c, 2a,b, 3a–d.
1965. *Murrayina martini* (Ulrich and Bassler). Pooser, Kansas Univ. Paleont. Contr., Arthropoda, Art. 8, p. 60, pl. 21, figs. 3, 5, 8.

Diagnosis.—Small; quadrate; anterior broadly rounded; two ridges, formed as raised reticulation riblets, prominent, running slightly upwards and back from muscle swelling.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	22	0.682	0.028	0.600–0.725	4.1
H	22	.377	.013	.350– .400	3.4
Male:					
L	16	.648	.018	.625– .675	2.8
H	16	.330	.012	.312– .362	3.6

Discussion.—This species has lately been carried in the genus *Murrayina*. When Puri (1953d) erected the genus *Murrayina* he included in it *M. howei* Puri, 1954, a new name for *Cythere producta* Ulrich and Bassler, 1904, not Brady (1866), *Cythereis gunteri* Howe and Chambers, 1935, and *Cythere martini* Ulrich and Bassler, 1904, which Puri considered a senior synonym of *Cythere micula* Ulrich and Bassler, 1904. *Murrayina howei* was selected as the type species. Puri (1953d, p. 255) calls attention to a resemblance to *Urocythereis* and gives the muscle scar pattern as "consisting of posteriorly located two vertical rows of three scars, with two additional oblique rows of scars located anteriorly." It is very probable that the description of the muscle scars is based on what Puri called *Murrayina martini*, a hemicytherine with divided adductor and frontal muscle scars, because the type and other species placed in the genus by Puri possess the single U-shaped frontal scars and undivided adductor row of four scars of the Trachyleberidinae.

Ulrich and Bassler (1904) described *Cythere martini*, *Cythere producta*, *Cythere micula*, and *Cythere lienenklausi*. On the cotype slide of *C. martini* in the U.S. National Museum collections are six specimens, five females and one male. Three of the females (pl. 36, figs. 11, 12, 15) and the male (fig. 13) were illustrated by Ulrich and Bassler. The carapace illustrated by their figure 14 is not present.

Cythere producta Ulrich and Bassler is represented by two right vales on one slide and a broken left valve (pl. 36, fig. 17) on a second slide. Sexual dimorphism is not mentioned by the authors but Maryland Miocene material has yielded many specimens of both males and females. The female of this species, in my opinion, was described by Howe and Chambers (in Howe and others, 1935, p. 21) as *Cythereis gunteri.* Therefore, *Murrayina howei* Puri and *Cythere producta* Ulrich and Bassler, not Brady (1866) should be synonymized under *Murrayina gunteri*, and this then becomes the valid binomen for the type species of *Murrayina.*

Ulrich and Bassler (1904) did not recognize the molting of ostracodes, and several of their species are based on juveniles. *Cythere micula* is represented by two left valves; both are molts (Ulrich and Bassler, 1904, pl. 36, figs. 18, 20). The right valve (fig. 19) is not present in the type material; and Puri (1953b, p. 750), in a critique of Swain's 1951 paper, incorrectly states that the original description of *C. micula* was based on molts of *C. martini.* It is true that these molts are conspecific with what Puri (1953d), Swain (1951), Malkin (1953), McLean (1957), and Pooser (1965) have called *Cythere martini;* but *Cythere martini* is quite a different thing, belonging in a different family. I have compared the molts of *Cythere micula* Ulrich and Bassler, which are penultimate or next to that, with molt sequences for *Cythere martini*, with molt sequences of what the above authors have called *Cythere martini*, and with molt sequences of specimens that I have identified as *Cythere lienenklausi* Ulrich and Bassler. I conclude that *Cythere micula*, *Cythere martini* of most authors (but not Ulrich and Bassler, 1904, or Swain, 1948), and *Cythere lienenklausi* are synonymous; the latter name has page priority over *Cythere micula.* The holotype of *Cythere lienenklausi* is represented by an adult male left valve (Ulrich and Bassler, 1904, pl. 38, fig. 31) which is now unfortunately broken; however, the Recent specimens are very similar to the Miocene holotype and they are included in *Muellerina lienenklausi*, at least until more fossil material can be examined.

The appendages of *Muellerina lienenklausi* are typically hemicytherid. The muscle scars consist of single upper and lower adductor scars with two divided adductor scars between. The frontal scars are three; the two lower scars very close together, sometimes fused.

Muellerina lienenklausi is closely related to *M. canadensis* (Brady 1870), but can be distinguished from that species by its more quadrate shape, coarser ornamentation, smaller size, and more broadly rounded anterior.

Specimens found.—345.

Occurrence.—Miocene of New Jersey, Maryland, North Carolina, and Florida. In the present study *Muellerina lienenklausi* was found in samples from the Gulf of Maine, Browns Bank, Northeast Channel, Georges Bank, off Lower New York Bay, and several other localities on the Atlantic Shelf at about 40° N., 70° W.

Repository.—USNM 112740–112744, 112681, 112682.

Muellerina canadensis (Brady, 1870)

Plate 3, figures 9, 12–15, 17–20; plate 7, figures 2, 3, 6, 8

1870. *Cythere canadensis* Brady, Annals and Mag. Nat. History, 4th ser., v. 6, p. 452, pl. 19, figs. 4–6.

1889. *Cythere canadensis* Brady. Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d ser., v. 4, no. 2, p. 166, pl. 15, figs. 14–15.

1906. *Cythereis canadensis* (Brady). Cushman, Boston Soc. Nat. History Proc., v. 32, no. 10, p. 377.

Diagnosis.—Anterior obliquely rounded; posterior bluntly rounded, slightly produced below; surface ornamentation generally weakly developed.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	22	0.764	0.038	0.712–0.825	4.9
H	22	.394	.021	.362–.425	5.3
Male:					
L	18	.730	.035	.675–.788	4.7
H	18	.349	.019	.325–.375	5.4

Discussion.—The surface ornamentation of this species is varied. On some specimens the pitting is greatly reduced and the surface appears almost smooth. Other specimens have rather coarse pits in the posterior half, but the pitting is reduced in the anterior half. Still other specimens are rather coarsely pitted over the entire surface. However, the pitting is generally not as coarse as that found on *Muellerina lienenklausi.*

Muellerina canadensis resembles *M. abyssicola* (Sars, 1865), but is easily distinguished from the latter by its less angular outline in dorsal view and more subdued marginal rim. Also see discussion under *M lienenklausi.*

Specimens found.—896.

Occurrence.—Gulf of St. Lawrence, Davis Strait, Godhavn Harbor, Holsteinsborg Harbor, and Vineyard Sound. In the present study the species was found in samples from the Gulf of Maine, Browns Bank, Northeast Channel, Georges Bank, Georges Basin, Stout Swell, off Lower New York Bay, and several localities on the Atlantic Shelf at about 40° N., 70° W.

Repository.—USNM 112683–112685, 112745–112753.

Muellerina abyssicola (Sars, 1865)

Plate 3, figures 1, 2, 7, 8, 10, 16

1865. *Cythereis abyssicola* Sars, Vidensk. Selsk. Christiania, Förh., p. 40.

1869. *Cythere abyssicola* (Sars). Norman, Shetland final dredging report, Pt. 2, British Assoc. Adv. Sci., rept. 38th Mtg., p. 290.

1874. *Cythere latimarginata* (Speyer). Brady, Crosskey and Robertson, Amonograph of post-Tertiary Entomostraca * * *, p. 163, pl. 16, fig. 6.

1878. *Cythere latimarginata* (Speyer). Brady, Zool. Soc. London Trans., v. 10, pt. 8, p. 389, pl. 64, figs. 8a–d.

1889. *Cythere latimarginata* (Speyer). Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d ser., v. 4, no. 2, p. 156, pl. 15, figs. 16, 17.

1925. *Hemicythere latimarginata* (Speyer). Sars, * * * Crustacea of Norway, v. 9, p. 188, pl. 86, fig. 3.

1941. *Cythereis* (*Paracythereis*) *latimarginata* (Speyer). Elofson, Zool. Bidrag från Uppsala, v. 19, p. 291.

1965. *Muellerina abyssicola* (Sars). Bassiouni, Dansk Geol. Foren. Medd., v. 15, pt. 4, p. 510, pl. 1, figs. 3–6.

Diagnosis.—Strong anterior and posterior rims; valves inflated in area below and behind muscle swelling.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	10	0.762	0.008	0.738–0.800	2.4
H	10	.428	.008	.415– .438	1.9
Male:					
L	10	.739	.017	.712– .762	2.3
H	10	.381	.012	.362– .400	3.1

Discussion.—This species is easily distinguished from both *Muellerina canadensis* and *M. lienenklausi* by its stronger marginal rims. *Muellerina abyssicola* was described in 1865 by Sars from the Recent; 2 years previous to this, Speyer (1863) had described *Cythere latimarginata* from the Oligocene of Germany. Except for Norman (1869) and Bassiouni (1965), all subsequent workers have placed Sars' species in synonymy with Speyer's. However, Bassiouni (1965) has shown that there are two species represented, and he reinstates Sars' name for the Quaternary forms referred to *Cythere latimarginata.*

Specimens found.—116.

Occurrence.—North Sea, Norwegian Sea, near Spitzbergen, near Iceland, Davis Strait, Gulf of St. Lawrence, Godhavn Harbor. Pliocene of Belgium, Pleistocene of Scotland and Denmark. In the present study the species was found in samples from the Georges Basin and Northeast Channel.

Repository—USNM 112734–112739.

Genus **AURILA** Pokorný, 1955

(=**Auris** Neviani, 1928)

Type species, *Cythere convexa* Baird, 1850, (?= *Cythere punctata* Muenster, 1830).

Diagnosis.—Auriform in lateral view; dorsal margin strongly convex; surface finely to coarsely pitted; posterior hinge tooth of right valve incised; three frontal scars; dorsomedian adductor muscle scar divided, ventromedian scar may be divided.

Stratigraphic range.—Oligocene to Recent.

Aurila sp.

Plate 1, figure 5

1906. *Cythereis albomaculata* (Baird). Cushman, Boston Soc. Nat. History Proc., v. 32, no. 10, p. 378, pl. 35, fig. 83.

Measurements.—One juvenile right valve is 0.550 mm long and 0.312 mm high.

Discussion.—In sample 39 two juvenile valves of a species of *Aurila* have been found. This sample is from the same general area where Cushman (1906) found the specimens he, not without question, referred to *Cythere albomaculata* Baird, 1850, now the type species of *Heterocythereis.* No other species of *Aurila* have been found in this study, and it seems likely that my specimens and Cushman's are conspecific. The outline of the adult illustrated by Cushman is similar to that of females of *A. laevicula* (Edwards, 1944), but more specimens must be found before a comparison can be made.

Specimens found.—Two juveniles.

Occurrence.—In the present study the species was found in one sample off Martha's Vineyard. Specimens of a species which is probably conspecific were found by Cushman (1906) in Buzzards Bay.

Genus **NORMANICYTHERE** Neale, 1959

Type species, *Cythere leioderma* Norman, 1869.

Diagnosis.—Elongate oblong in lateral view; carapace oblong in dorsal view; valves very inflated; surface generally smooth, but with pits sometimes forming at normal pore canal exists; strong holamphidont hingement; three frontal muscle scars; dorsal and two median adductor scars divided.

Stratigraphic range.—Pleistocene to Recent.

Normanicythere leioderma (**Norman, 1869**)

Plate 1, figures 12–16

1869. *Cythere leioderma* Norman, Shetland final dredging report. Pt. 2, British Assoc. Adv. Sci., rept. 38th Mtg., p. 225, 291.

1959. *Normanicythere leioderma* (Norman). Neale, Palaeontology, v. 2, pt. 1, p. 78, pl. 13, figs. 1, 2; pl. 14, figs. 1–8; text fig. 2, figs. 1–8; text fig. 3, figs. 1–6 (gives full synonymy 1869–1959).

1961. *Normanicythere leioderma* (Norman). Neale, Palaeontology, v. 4, pt. 3, p. 424.

1963. *Normanicythere leioderma* (Norman). Swain, Jour. Paleontology, v. 37, no. 4, p. 826, pl. 95, figs. 10, 17; text fig. 11a.

1963. *Normanicythere concinella* Swain, idem, p. 827, pl. 95, figs. 18a–d; text fig. 11b.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	7	0.993	0.023	0.962–1.025	2.3
H	7	.550	.010	.538–.562	1.8
Male:					
L	6	1.017	.026	1.000–1.050	2.6
H	6	.514	.021	.488–.550	4.1

Discussion.—This species has been the subject of an excellent study by Neale (1959). The reader is referred to that paper for illustrations of both hard and soft parts.

The external exits of the normal pore canals do not form pits on most specimens of this species. However, on some, particularly males, pits are present, almost always in the posteroventral area of the lateral surface. Swain (1963) considers specimens of this type to represent a different species, *Normanicythere concinella* Swain; but the pitting may be in the nature of intraspecific variation.

Specimens found.—44.

Occurrence.—Skagerrak, off southern Norway, off northwestern Scotland, near Iceland, near King Charles Land (=Wiches Land), Kane Basin, Cabot Strait, the Gulf of Maine, and possibly in Hudson Strait. Pleistocene of Yorkshire, England, New York, and Alaska. In the present study *Normanicythere leioderma* was found in samples from Frobisher Bay, Kneeland Bay, Ungava Bay, and White Bear Arm.

Repository.—USNM 112714–112718.

Subfamily **THAEROCYTHERINAE** Hazel, n. subfam.

Diagnosis.—Subquadrate to subrectangular or subtriangular in lateral view; surface ornate; hinge strong amphidont; near-vertical row of four adductor muscle scars, dorsomedian and (or) ventromedian scars more elongate, dorsomedian scar sometimes divided; two frontal scars, the lower one sometimes U-shaped. Antennules have five podomeres; exopodites of antennae well developed.

Discussion.—The genera of this subfamily can be distinguished from those of the Hemicytherinae by their generally more quadrate shape and by the four discrete adductor muscle scars possessed by most thaerocytherine genera. In most of the genera here placed in this subfamily, the dorsomedian adductor scar is not divided. Rarely, an individual will have this scar divided, but a greater number of specimens of a species and species of a genus will not. There is at least one important exception to this general rule.

In the Paleocene and Eocene, particularly in the Atlantic and Gulf Coastal Plains of the United States, are a number of related species which have been generally, in recent years, carried in the genus *Hermanites*. *Cythereis midwayenisis* Alexander, 1934, is a typical example. These forms are probably referable to the genus *Aquitaniella* Deltel. One of the features which characterizes this group of species is a very well developed muscle node. In most *Aquitaniella* the dorsomedian scar is divided; thus, a divided dorsomedian adductor scar seems to be concomitant with a well-developed muscle node, at least in *Aquitaniella*.

The genera of the Thaerocytherinae tend to be more quadrate than those of the Trachyleberidinae and have two discrete frontal scars rather than one J- or U-shaped scar. The member genera of the Thaerocytherinae whose soft parts are known have the antennules with five joints and simple brachial plates on the mandibles as in the Hemicytheridae. The Echinocythereidinae have a muscle field like many of the Thaerocytherinae but are anatomically trachyleberidids and have a distinctive ovate shape.

Several Upper Cretaceous species bear a superficial resemblance to the Cenozoic genera *Hermanites* and *Bradleya*, such species, for example, as *Cythereis verricula* Butler and Jones, 1957, and the Cretaceous species assigned to *Bradleya* by Hazel and Paulson (1964). On close examination, however, it can be shown that these species are probably referable to the recently described trachyleberidine genus *Oertiella* Pokorný, 1964. *Oertliella* may be an important link between the Thaerocytherinae and Trachyleberidinae.

Jugosocythereis has been little used since it was described. However, species of the genus are common in Eocene to Recent gulf coast and Caribbean faunas. The genus also occurs in the Pacific and Mediterranean.

The following genera are placed in the Thaerocytherinae:

Thaerocythere Hazel, n. gen., Miocene to Recent
Jugosocythereis Puri, 1957, Eocene to Recent
Hermanites Puri, 1955, Eocene to Recent
Verrucocythereis Ruggieri, 1962, Miocene
Quadracythere Hornibrook, 1952, Paleocene to Recent
Bradleya Hornibrook, 1952, Eocene to Recent
Puriana Coryell and Fields, 1953, Oligocene to Recent
Aquitaniella Deltel, 1964, Paleocene to Recent

Though all the genera but one are still living, the soft parts are known only for *Thaerocythere* (Sars, 1925, and Elofson, 1938, for the type species), *Jugosocythereis* (original data), and *Puriana* (original data). I am fairly confident that when dissections are made of *Hermanites*, *Quadracythere*, *Aquitaniella*, and *Bradleya* they will show that these genera are anatomically hemicytherids. Van Morkhoven (1962, 1963) places *Bradleya* and *Quadracythere* in the Hemicytherinae. Van den Bold (1963b) places *Quadracythere*, *Bradleya*, and *Jugosocythereis* in the Hemicytherinae. Mandelstam (in Chernysheva, 1960, p. 391) places *Hermanites* in the tribe Hemicytherides, and Hartmann (1964) places *Hermanites* in the subfamily Hemicytherinae. Puri (1953d) correctly placed *Hermanites* in the Hemicytherinae at the time of original description. Most other authors have considered the genera here placed in the Thaerocytherinae as members of the Trachyleberididae.

Genus **THAEROCYTHERE** Hazel, n. gen.

Type species, *Cythereis crenulata* Sars, 1865.

Etymology.—Thairos (Greek) meaning hinge plus the genus *Cythere.*

Diagnosis.—Carapace generally subquadrate; thick shelled; surface has delicate to coarse reticular, sometimes rugose, pattern; anterior and posterior rimmed; very short dorsal rib in posterior half of valve curves downward at posterior ending in knob; ventral rib longer, more prominent; radial canals many, straight, ending in small marginal denticles; hinge very strong amphidont; large slightly reniform posterior tooth of right valve connected by deep slightly crenulate furrow to deep socket behind a large complex anterior element which consists of high rounded tooth with a raised elongate rounded platform anterior to the tooth; muscle scars a near-vertical row of four adductor scars, middle two elongate, and two rounded frontal scars in oblique row.

Discussion.—This genus is placed in the Hemicytheridae on the basis of the five-jointed antennules coupled with the double frontal muscle scars. The row of four undivided adductor scars distinguishes *Thaerocythere* from most genera of the Hemicytherinae. *Thaerocythere* is not as lenticular in dorsal view, has a finer ornamentation, and possesses a different hinge than *Quadracythere. Thaerocythere* does not possess the characteristic two riblets on the muscle swelling of *Jugosocythereis* and has a different hinge; also, the lower frontal scar of *Jugosocythereis* tends to be U-shaped.

Thaerocythere is proposed for the following species: *Cythereis crenulata* Sars, 1865, *Hemicythere schmidtae* Malkin, 1953, *Trachyleberis*? cf. *T.*? *angulata* (Sars) of Swain (1951, p. 29), and *T. reesidei* of Swain (1951). I have examined specimens of these species. A fourth species I have not seen specimens of, but which may belong to the genus, is *Cythere oedichilus* Brady, 1878. *Thaerocythere schmidtae* occurs in the upper Miocene (and perhaps Pliocene) Yorktown Formation of Virginia. *Trachyleberis*? cf. *T.*? *angulata* of Swain was described from subsurface middle Miocene rocks of North Carolina. *Trachyleberis reesidei* of Swain (1951) came from upper Miocene rocks, also from the subsurface of North Carolina. *Thaerocythere*? *oedichilus* was described from the Pliocene Antwerp Crag of Belgium. *Thaerocythere crenulata* is known only from the Recent.

Thaerocythere crenulata (Sars, 1865)

Plate 4, figures 2–5, 8; plate 9, figure 4

1865. *Cythereis crenulata* Sars, Vidensk. Selsk. Christiania, Förh., p. 39.

1941. *Cythereis* (*Eucythereis*) *crenulata* Sars. Elofson, Zool. Bidrag från Uppsala, v. 19, p. 284 (gives full synonymy 1865–1941).

1943. *Cythereis* (*Eucythereis*) *crenulata* Sars. Elofson, Arkiv. Zoologi, v. 35A, no. 2, p. 9.

Diagnosis.—Faintly, evenly, reticulate; anterior rim does not connect directly to eye tubercle in left valve.

Description.—Thick shelled; subquadrate in lateral view; highest at anterior cardinal angle; anterior broadly, slightly obliquely rounded; posterior blunt, produced below; anterior has several very small denticles; posterior has about 10 larger denticles at the posteroventral extension; surface faintly reticulate; individual reticules have many very small papillae; anterior rim not directly connected to eye tubercle in left valve; in right valve anterior rim bifurcates in anterodorsal area, one branch going to eye tubercle, the other around it; thick ventrolateral rib runs two-thirds length of valve; short dorsolateral rib in posterior half curves downward at posterior and ends in a knob; muscle swelling low and broad. Elliptic in dorsal view having compressed posterior; left valve larger, overlapping right at cardinal angles. Inner marginal areas moderately wide, crossed by simple straight radial canals; selvage moderately developed; hinge strong amphidont; posterior tooth of right valve very large, reinform, smooth, connected to deep anterior socket by a crenulate furrow; anterior tooth of right large, rounded and having very thick, prominent "step" anterior to tooth; left valve complementary; muscle scars a vertical row of four adductor scars, the middle scars elongate; two rounded frontal scars set obliquely in front; normal pore canals few, scattered, difficult to analyze because of thickness of valves, but at least some seem to be of sieve type. Males relatively more elongate than females, but actually shorter. Antennules have five podomeres; second podomere has hairs in proximal and distal areas of anterior edge and at mid-length on posterior edge, long seta at posterodistal end; third podomere has one medium-sized seta at anterodistal end; fourth podomere has two setae at mid-length, one on anterior edge, the other coming from side of podomere, and three distal setae, two at anterodistal and one at posterodistal end;

fifth podomere has three distal setae. Endopodite of antennae has three podomeres, moderately developed exopodite, and three terminal claws. Data on soft parts from Sars (1925) and Elofson (1938).

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	10	0.788	0.016	0.762–0.812	2.0
H	10	.476	.010	.462–.488	2.1
Male:					
L	10	.740	.015	.725–.762	2.0
H	10	.427	.010	.415–.438	2.3

Discussion.—This species was described by Sars (1865) but first illustrated by Brady and Norman (1889). Sars (1925) and Elofson (1938) illustrate and describe the soft parts and carapace. The carapace illustrations of Sars and Elofson are adequate for shape analysis but do not show the ornamentation. The illustrations of Brady and Norman (1889) do show the surface features, and their identification of Sars species was accepted by Sars (1925) and Elofson (1938, 1941) who treated the species taxonomically. The descriptions of the species by Sars (1865) (see Norman, 1869, for an English translation) and by Brady and Norman (1889) fit my specimens perfectly.

Thaerocythere crenulata is larger than *T. schmidtae* (Malkin, 1953). The individual reticules of *T. crenulata* are relatively and actually larger than those of *T. schmidtae*, but are relatively not as deep. The surface ornamentation of *T. crenulata* is uniform compared with the irregular ornamentation of pits, riblets, and nodes on *Trachyleberis? cf. T.? angulata* of Swain (1951). The dorsal and ventral ribs of *T. crenulata* converge towards each other at their posterior ends at an angle smaller than that on *T. schmidtae* or *Trachyleberis?* cf. *T.? angulata* of Swain (1951). *Thaerocythere crenulata* is reticulate, where as *T.? oedichilus* is apparently more pitted. The dorsal rib of *T. crenulata* also does not extend into the anterior part of the carapace as it does in *T.? oedichilus.*

Specimens found.—136.

Occurrence.—Norwegian Sea, North Sea (Skagerrak), Baltic Sea, Shetland Islands, Godhavn Harbor, and Davis Strait. In the present study *Thaerocythere crenulata* was found on Browns Bank and in Georges Basin.

Repository.—USNM 112692, 112759–112763.

Subfamily CAMPYLOCYTHERINAE Puri, 1960

Diagnosis.—Carapace quadrate to oblong in lateral view; ovate in dorsal view, widest behind middle; surface smooth or reticulate; extremities smooth to moderately denticulate; eye tubercles absent to moderately developed; vestibules may be developed at anterior and posterior; hinge amphidont or modified amphidont; adductor muscle scars a near-vertical row of four; one, two, or sometimes three frontal scars; dorsal muscle platform may be present.

I would place the following genera in the Campylocytherinae:

Campylocythere Edwards, 1944, Miocene to Recent
Leguminocythereis Howe and Law, 1936, Paleocene to Miocene
Triginglymus Blake, 1950, Eocene
Bensonocythere n. gen., Oligocene(?), Miocene to Recent
Anticythereis van den Bold, 1946, Santonian to Eocene
Chrysocythere Ruggieri, 1962, Maestrichtian to Miocene, Recent(?)
Basslerites Howe, 1937, Eocene to Recent
Leniocythere Howe, 1951, Eocene

Discussion.—In 1960 Puri erected the subfamily Campylocytherinae and placed in it *Campylocthere*, *Acuticythereis*, *Basslerites*, *Buntonia*, and *Thalmannia.* Howe (*in* Moore, 1961, p. Q306), unaware of Puri's work, proposed the family Leguminocythereididae for *Leguminocythereis*, *Triginglymus*, *Campylocythere*, *Acuticythereis*, and *Basslerites.* Howe (1962) considers his taxon a synonym of Puri's. Benson and Coleman (1963), following Swain (1955) and Malkin (1953), synonymize *Acuticythereis* with *Campylocythere;* they otherwise accept Howe's diagnosis of the family level taxon, point out the priority of Campylocytherinae, and exclude *Buntonia* and *Thalmannia.* Apostolescu (1961) had already made *Buntonia* the nominal genus of a new and useful subfamily.

Van den Bold (1964) has restudied the type species of *Anticythereis*, *Pseudocythereis reticulata* Jennings, 1936, Campanian to Maestrichtian, and states that the genus is allied to *Velarocythere*, a genus which he believes is transitional with *Triginglymus.* He believes that *Anticythereis* is an early form of *Leguminocythereis* and therefore belongs to the family Leguminocythereididae (=Campylocytherinae).

Van den Bold (1964) describes a Santonian species of *Anticythereis* and agrees with the placement by Apostolescu (1961) of several west African Eocene species in *Anticythereis.* Neither van den Bold nor Apostolescu describes the frontal muscle scars for any of these species. However, Reyment (1963) reports one of Apostolescu's species, *A. bopaensis*, from the Paleocene of Nigeria. He describes the frontal muscle scars of this species as "two muscle scars, which are at times coalesced."

Brown (1957) placed five species from the upper Campanian to Maestrichtion of North Carolina in his genus *Velarocythere* at the time of description. Hazel and Paulson (1964) consider one of these, *V. arachoides* (Berry, 1925), a trachyleberidid belonging to *Veenia* (*Nigeria*) Reyment (see also Reyment 1960, 1963). Van den Bold (1964) considers *Velarocythere eikonata* Brown, 1957, to be a junior synonym of the type species of *Anticythereis;* van den Bold also places *Velarocythere cacumenata* Brown, 1957, in *Anticythereis.* This leaves the types species *Velarocythere scuffeltonensis* Brown, 1957, and *V. legrandi* Brown, 1957. In my opinion these two species and *Anticythereis reticulata* (=*Velarocythere eikonata*) are congeneric. Thus *Velarocythere* becomes a subjective synonym of *Anticythereis.*

Brown (1957, p. 21) describes the muscle scars of *Velarocythere scuffeltonensis* as a "subvertical row of three spots and a single anterior spot." Thus *Anticythereis* seems to have two antennal scars on some species (Tertiary) and a single scar on others (Cretaceous).

Howe and Laurencich (1958) place *Cythereis saratogana* Israelsky, 1929 (upper Campanian of Arkansas), in the genus *Triginglymus.* The illustrated specimen has more the shape of a male *Anticythereis*, and this species may be better placed in that genus.

Chrysocythere Ruggieri, 1962, has two frontal muscle scars and an outline in dorsal and lateral view that require its consideration as a member of the Campylocytherinae. Van den Bold (1964) places species in *Chrysocythere* which have a stratigraphic distribution of Maestrichtion to Recent.

The poorly known Eocene genus *Leniocythere* is related to *Leguminocythereis* (Howe, 1951) and is here included in the Campylocytherinae.

Butler (1963) has described a species of *Leguminocythereis*, *L. crassus*, with three frontal muscle scars. Howe (in Moore, 1961, p. Q306) and others have diagnosed the genus as having two frontal scars. Van Morkhoven (1963) diagnoses the genus with two or three frontal scars. Howe and Law (1936) describe three antennal scars for *Leguminocythereis cookei* Howe and Law, but van Morkhoven (1963, p. 176) would prefer to exclude this species from the genus. The muscle scars of the type species have not been described.

The soft parts are known with any completeness for only *Bensonocythere* and *Basslerites.* Swain (1955) describes the antennules and some other features for *Campylocythere concinnoidea* Swain. The antennules of *Basslerites*, *Campylocythere*, and *Bensonocythere* consist of five podomeres. The branchial plates of the mandibles of *Bensonocythere* consist of one plumose seta. It is on the basis of these two anatomical features, coupled with the multiple frontal scars of most genera, that the Campylocytherinae are considered a subfamily of the Hemicytheridae.

Genus BENSONOCYTHERE n. gen.

Type species, *Leguminocythereis whitei* Swain, 1951.

Etymology.—This genus is named in honor of R. H. Benson of the U.S. National Museum.

Diagnosis.—Carapace quadrate to subrectangular or oblong in lateral view; no marginal denticles; posterior and anterior of nearly equal height; surface coarsely pitted; anterior rim has two paralleling ridges posterior to it; no eye tubercle; carapace ovate in dorsal view, widest in posterior half; anterior and posterior hinge teeth of right valve multilobate to nearly smooth; anterior tooth of left valve manifest as a strong swelling at anterior end of slightly crenulate bar; large dorsal muscle platform below hinge one-third from anterior end; vertical row of four adductor scars with dorsomedian scar most elongate; two frontal scars in oblique row, lower scar tending to be elongate.

Discussion.—*Bensonocythere* is placed in the Hemicytheridae on the basis of its five-jointed antennules, vestigial exopodites of the mandibles, and double antennal muscle scars. It is placed in the subfamily Campylocytherinae on the basis of its muscle scars and ovate outline in dorsal view.

Bensonocythere differs from *Leguminocythereis* in shape, being relatively higher at the posterior, and the hinge of *Bensonocythere* is more weakly developed. The shape of *Bensonocythere* is nearly the same as that of *Triginglymus*, and *Triginglymus* also has the well-developed dorsal muscle platform; but *Bensonocythere* has no ocular sinus, as does *Triginglymus*, and the hingement is different, being more weakly developed. *Bensonocythere* can be distinguished from *Campylocythere* by its coarsely pitted surface; *Campylocythere* has a smooth to finely pitted surface.

The following species are referable to *Bensonocythere: Leguminocythereis whitei* Swain, 1951, *Cythereis arenicola* Cushman, 1906, *Cythere calverti* Ulrich and Bassler, 1904, and *Bensonocythere americana* n. sp. *Loxoconcha? postdecliva* Swain, 1948, probably represents still another species of the genus.

Stratigraphic range.—Oligocene(?), Miocene to Recent.

Bensonocythere whitei (Swain, 1951)

Plate 5, figures 2, 3, 8–10; plate 10, figures 1–8; Plate 11, figures 1, 2

1951. *Leguminocythereis whitei* Swain, U.S. Geol. Survey Prof. Paper 234–A, p. 43, pl. 3, figs. 14, 16–18; pl. 4, fig. 1.

1953. *Leguminocythereis whitei* Swain. Malkin, Jour. Paleontology, v. 27, p. 785, pl. 80, figs. 7–12.

1957. *Leguminocythereis*? *whitei* Swain. McLean, Bulls. Am. Paleontology, v. 38, no. 167, p. 80, pl. 9, figs. 4a–6.
1958. *Leguminocythereis whitei* Swain. Brown, North Carolina Div. Mineral Resources Bull. 72, p. 63, pl. 6, fig. 10.
1965. *Triginglymus whitei* (Swain). Pooser, Kansas Univ., Paleont. Contr. Arthropoda, art. 8, p. 36, pl. 15, figs. 2, 5, 6, 8, 9.

Diagnosis.—Coarsely pitted, the pits roughly arranged in vertical rows in dorsal half of valves with reticulation riblets forming sinuous vertical ridges; slight sulcus behind low muscle swelling.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	11	0.793	0.030	0.750–0.838	3.8
H	11	.431	.020	.400– .462	4.6
Male:					
L	12	.743	.019	.700– .775	2.6
H	12	.375	.010	.362– .388	2.7

The carapace morphology of *Bensonocythere whitei* has been described; however, the soft parts have not been. The following is a description of the appendages of the species.

Antennules have five podomeres; second podomere has one seta in anteroproximal area and one longer seta at posterodistal edge; third podomere has one thick seta at anterodistal edge; fourth podomere has one prominent seta and one or more longer but thinner setae at midlength on anterior edge and one prominent and one or more thinner setae at anterodistal edge; fifth podomere has one prominent seta and two lesser setae. Endopodite of antennae has three podomeres; three terminal claws; exopodite pronounced on both males and females. Mandibles have about 12 sharp teeth on cutting edge; branchial plate is one plumose seta. Thoracic legs have chitinous supports in knees.

Bensonocythere whitei is relatively less elongate, more coarsely pitted, and more bluntly rounded at the extremities than *B. arenicola* (Cushman, 1906). The pitting in *B. whitei* is more dense than that in *B. calverti* (Ulrich and Bassler, 1904), and the individual pits are larger; *B. whitei* is also more broadly rounded at the anterior than *B. calverti. Bensonocythere whitei* is very closely related *to B. americana* n. sp. but can be distinguished from that taxon by its larger pits and by being less angular ventrolaterally in the posterior half of the valves; it is also larger than *B. americana.*

Pooser (1965, p. 36) considers McLean's (1957) report of the species from the Yorktown Formation to be based on a misidentification. McLean (1957, p. 80) also had his doubts about placing his single specimen in Swain's (1951) species. However, the illustrations seem to be that of a typical male right valve of *Bensonocythere whitei.*

Specimens found.—137.

Occurrence.—This species has not been previously reported from the Recent. Swain (1951) and Brown (1958) record its occurrence in the subsurface of North Carolina in deposits having a stratigraphic range of Oligocene(?), lower Miocene to Pleistocene. Pooser (1965) reports its occurrence in the upper Miocene of South Carolina, and Malkin (1953) and McLean (1957) report it from the Miocene of the Virginia-Maryland area. In the present study the species was found off Lower New York Bay and questionably near Martha's Vineyard.

Repository.—USNM 112693, 112694, 112696, 112772–112775.

Bensonocythere americana Hazel, n. sp.

Plate 5, figures 1, 4, 5; plate 11, figure 3

Diagnosis.—Small size; coarsely pitted; pits arranged at random.

Description.—Carapace quadrate to subrectangular in lateral view; extremities obliquely rounded; subtriangular in end view; ovate in dorsal view; surface coarsely, randomly pitted; two ridges, interior one less well developed, parallel anterior rim; slight muscle swelling marked by small area with no pits; conspicuous elongate pit inside dorsal margin just anterior to middle; no eye tubercle; left valve larger, overlapping right strongly at cardinal angles; anterior marginal rim and outside ridge continue from anterior along venter. Internally, marginal areas wide; vestibules at posterior and anterior; about 20 straight radial canals around anterior, lesser number around posterior; hinge modified amphidont; terminal teeth of right valve multilobate; anterior tooth of left valve evident only as swollen end of median bar, right valve socket complimentary; posterior socket of left valve open to interior; muscle scars a vertical row of four adductor scars, the middle two more elongate; frontal scars not observed. Sexual dimorphism strong, females relatively more quadrate and wider. Specimens with workable soft parts were not found.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	3	0.679	0.008	0.675–0.688	1.2
H	3	.375	.013	.362– .388	3.5
Male:					
L	2	---------	---------	.712– .762	---------
H	2	---------	---------	.338– .388	---------

Discussion.—*Bensonocythere americana* is more closely related to *B. whitei* than to *B. arenicola;* it can be distinguished from *B. whitei* by its smaller size and different surface ornamentation. *Bensonocythere americana* does not have the pits tending to be arranged in vertical rows in the dorsal half of the valves as does *B. whitei.* The males of *B. whitei* are smaller than the females, but those of *B. americana* are larger than the females. One valve of what may be another species of *Bensonocythere* very closely related to *B. americana* was found in sample 30 with specimens of *B. americana.* This female valve is much larger (0.88 mm) than, but is otherwise very similar to, female valves of *B. americana.* More material will have to be examined to determine if this is in fact another species or only an aberrant representative of *B. americana.*

Specimens found.—25.

Occurrence.—This species has been found in samples from the Gulf of Maine, near Martha's Vineyard (all juveniles), and off lower New York Bay.

Repository.—USNM 112697 (holotype), 112770, 112771.

Bensonocythere arenicola (Cushman, 1906)

Plate 5, figures 6, 7, 11; plate 11, fig. 9

1906. *Cythereis arenicola* Cushman, Boston Soc. Nat. History, Proc., v. 32, no. 10, p. 379, pl. 36, figs. 97–107.

1933. *Cythereis* (*Hemicythere*) *arenicola* (Cushman). Blake, Biol. Survey Mount Desert region, pt. 5, p. 239.

Diagnosis.—Carapace elongate; subovate in end view; coarse pits randomly arranged over surface.

Description.—Carapace elongate in lateral view; anterior and posterior of nearly equal height; extremities evenly rounded in left valves to obliquely rounded in right valves; surface ornamented with large randomly arranged pits, each with a sieve-type pore canal; no eye tubercle; two weakly defined ridges parallel anterior marginal rim; one very large elongate pit just anterior to middle and just inside dorsal margin; left valve larger, overlapping right strongly at cardinal angles; marginal rim and outer ridge continue from anterior along venter. Internally, marginal areas wide; vestibules at anterior and posterior; about 25 straight radial canals around anterior and about 15 around posterior; hinge modified amphidont, anterior tooth of left valve reduced to large swelling at end of smooth bar; terminal teeth of right valve multilobate; large dorsal muscle platform; no ocular sinus. Muscle scars a vertical row of four adductor scars, the dorsomedian one most elongate, and two oblique frontal scars, the lower scar forward and larger. Sexual dimorphism strong, males more elongate, narrower, and lower than females. For anatomy, see Cushman (1906).

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	3	0.888	0		0
H	3	.458	.007	0.450–0.462	1.5
Male:					
L	3	.858	.029	.825–.875	3.4
H	3	.388	.013	.375–.400	3.4

Discussion.—Cushman's (1906) illustration of the carapace is not very informative; however, he describes the carapace morphology, and describes and fully illustrates the anatomy of the species. My dissected specimens agree with Cushman's illustrations and descriptions of the soft parts. In addition, the outline and carapace features described by Cushman fit the specimens I refer to his species.

Bensonocythere arenicola is distinguished from both *B. whitei* and *B. americana* by its more elongate shape in lateral view, more oval shape in end view, and by details of ornamentation.

Specimens found.—Nine.

Occurrence.—Gulf of Maine and Vineyard Sound. In the present study this species was found in samples from the Georges Bank, off Lower New York Bay, and on the Atlantic Shelf at 39°54′ N., 71°44′ W.

Repository.—USNM 112776–112778, 112702.

Family **TRACHYLEBERIDIDAE** Sylvester-Bradley, 1948

Diagnosis.—Carapace subtriangular to oblong in lateral view; may be alate; ornamentation varied; eye tubercles usually well developed; extremities denticulate; marginal areas narrow to wide; vestibules rare; radial canals few to moderately numerous, sometimes branched; hinge amphidont or modified amphidont; sexual dimorphism usually pronounced; valves of males may show asymmetry; adductor muscle scars usually four discrete scars, but may be complexly divided; frontal scar usually single J- or U-shaped, but may be divided; antennules with six podomeres; endopodite of antennae with three podomeres, exopodite usually weakly developed; branchial plates of the mandibles with five setae; thoracic legs of males may differ from females and males may show asymmetry of legs; legs usually without chitinous supports in knees.

Discussion.—The Trachyleberididae as considered herein comprises the following subfamilies:

Trachyleberidinae Sylvester-Bradley, 1948, Jurassic to Recent

Echinocythereidinae new subfamily, Campanian(?), Paleocene to Recent

Brachycytherinae Puri, 1954, Albian to Miocene

Pterygocythereidinae Puri, 1957, Albian to Recent

Mauritsininae Deroo, 1962, Turonian to Maestrichtian
Cytherettinae Triebel, 1952, Campanian to Recent
Buntoniinae Apostolescu, 1961, Coniacian to Recent

Anatomically, all the genera of the living subfamilies possess antennules with six podomeres and mandibular branchial plates with five setae. The Trachyleberidinae, Cytherettinae, and most Buntoniinae, possess almost the same type of central muscle field; that is, with a single J- or U-shaped frontal scar and four discrete adductor scars. The living cytherettines differ anatomically from most genera of the other two subfamilies by having the right first thoracic leg of the males characteristically modified. In addition, most of the species which have been referred to this subfamily have a very wide calcified inner lamella with the inner margin sinuous. The Cytherettinae and the Buntoniinae characteristically have a more subovate shape than the Trachyleberidinae. Some genera of the Buntoniinae may have a subtriangular shape (see Apostolescu, 1961).

Of the seven trachyleberidid subfamilies, the extinct Brachycytherinae is probably the least closely related to the nominal subfamily. Many recent American workers have considered *Brachycythere* as belonging to a taxon equivalent in rank to the Trachyleberididae, raising Puri's (1953d) subfamily to a family (Howe, in Moore, 1961, p. Q260; Hazel and Paulson, 1964; Benson and Tatro, 1964; Pooser, 1965). However, a number of taxa have been included in the Brachycytheridae which are seemingly not related to *Brachycythere*, making the family an unwieldy taxonomic unit. The Jurassic genera *Amphicythere*, *Dictyocythere*, and *Macrodentina* and the Jurassic to Lower Cretaceous *Polydentina* are included in the family by Moore (1961). Van Morkhoven (1963) includes the first three taxa in the Progonocytherinae; he does not treat *Polydentina*. The genera *Alatacythere*, *Pterygocythere*, and *Pterygocythereis* are also included in the Brachycytheridae in Moore (1961). These genera also are not closely related to *Brachycythere*, and should be referred to Puri's (1957a) Pterygocythereidinae. The distinctive adductor muscle scar pattern and very tumid carapace distinguish *Brachycythere* and related genera from those of the Pterygocythereidinae. The Brachycytherinae are here tentatively considered to belong to the Trachyleberididae. However, further studies may prove that, if the subfamily is restricted to those forms with tumid carapaces and muscle scar patterns such as possessed by *Brachycythere* and *Digmocythere*, the taxon serves a useful purpose at the family level.

The Mauritsininae are accorded equal rank with the Trachyleberidinae (as a subfamily of Cytheridae) by Deroo (1962). He compares *Mauritsina* with *Cythereis* and the other genus of the subfamily, *Kikliocythere*, with *Brachycythere*. Howe and Laurencich (1958, p. 368) state that *Kikliocythere* probably should be assigned to the Brachycytherinae. Howe (in Moore, 1961, p. Q260) assigns *Kikliocythere* to the *Brachycythere*. It may be that the subfamily may have arisen from the Brachycytherinae, but an origin directly from the stem group Trachyleberidinae is equally, if not more, possible. The subfamily Mauritsininae is distinguished from other trachyleberidids in that its genera possess very unusual multiple frontal and adductor muscle scars (Deroo, 1962).

The Pterygocythereidinae have muscle scars very similar to the Trachyleberidinae, Buntoniinae, and Cytherettinae, but are easily recognized by their very alate valves. The dorsal scar of the adductor row may be C-shaped or apparently sometimes divided (Hazel and Paulson, 1964).

The extinct Brachycytherinae have a frontal scar like the Trachyleberidinae but possess divided adductor scars (Hazel and Paulson, 1964). Genera of the subfamily also are recognized by their tumid carapaces and characteristic hingement.

The Cytherettinae were raised to family status by Howe (in Moore, 1961, p. Q268); however, the appendage morphology and muscle scars seem to me to call for a separation from the Trachyleberidinae by no more than subfamily rank. For the same reasons the Buntoniinae are included in the Trachyleberididae. The Cytherettinae and Buntoniinae appear to be very closely related.

The Echinocythereidinae possess two frontal muscle scars and four undivided adductor scars. In addition, the subovate shape and concentric surface ornamentation are distinctive.

Mandelstam (in Chernysheva, 1960, p. 398) proposed the subfamily Faluniinae for *Falunia* Grekoff and Moyes, 1955, and three other genera which would seem not closely related to *Falunia*. As Keij (1957) states, *Falunia* is probably a trachyleberidid. The genus is difficult to place in any of the existing subfamilies of the Trachyleberididae, and the Faluniinae may be valid. I have not had an opportunity to study the genus so the Faluniinae are not considered here.

Subfamily **TRACHYLEBERIDINAE** Sylvester-Bradley, 1948

Diagnosis.—Subtriangular, subquadrate, or subrectangular in lateral view; oblong in dorsal view, extremities may be compressed; extremities denticulate; four adductor muscle scars in near-vertical row; single J-, U-, or heart-shaped frontal scar.

Discussion.—The genera of the Trachyleberidinae are more laterally compressed than those of the Echinocythereidinae or Mauritsininae. The latter two subfamilies possess different muscle-scar patterns, the

Echinocythereidinae having two frontal scars and the Mauritsininae possessing complexly divided adductor and frontal scars. The Buntoniinae and Cytherettinae have the same type of muscle-scar pattern but are shaped differently, both subfamilies being more subovate in lateral view and more elliptic in dorsal view. The Brachycytherinae are ventrally tumid and possess divided adductor muscle scars. The Pterygocythereidinae are alate ventrally.

The following is a list of Upper Cretaceous and Cenozoic genera usually considered to be referable to the Trachyleberidinae. The first 13 taxa seem to be typical for the subfamily. The remaining genera are either not known fully at present or do not closely resemble those genera generally considered to be typical of the subfamily. Further study of the taxon is certainly called for.

Trachyleberis Brady, 1898, Campanian(?) Paleocene to Recent
Actinocythereis Puri, 1953, Eocene to Recent
Acanthocythereis Howe, 1963, Campanian(?), Paleocene to Recent
Cythereis Jones, 1849, Cretaceous
Henryhowella Puri, 1957, Oligocene to Recent
Murrayina Puri, 1954, Miocene to Pliocene(?)
Occultocythereis Howe, 1951, Paleocene to Recent
Costa Neviani, 1928, Miocene to Recent
Oertliella Pokorný, 1964, Turonian to Maestrichtian
Platycosta Holden, 1964, Campanian to Paleocene
Idiocythere Triebel, 1958, Campanian to Eocene
Neocaudites Puri, 1960, Miocene to Recent
Trachyleberidea Bowen, 1953, Coniacian to Miocene
Veenia (*Veenia*) Butler and Jones, 1957, Turonian to Maestrichtian
Veenia (*Nigeria*) Reyment, 1963, Campanian to Maestrichtian
Robertsonites Swain, 1963, Pleistocene to Recent
Carinocythereis Ruggieri, 1956, Pliocene to Recent
Cativella Coryell and Fields, 1937, Eocene to Recent
Falunia Grekoff and Moyes, 1955, Miocene
Hirsutocythere Howe, 1951, Eocene
Platycythereis Triebel, 1940, Valanginian to Turonian
Spongicythere Howe, 1951, Eocene
Climacoidea Puri, 1956, Pleistocene
Reticulocythereis Puri, 1960, Recent

Genus ACTINOCYTHEREIS Puri, 1953

Type species, *Cythere exanthemata* Ulrich and Bassler, 1904.

Diagnosis.—Subrectangular to subquadrate in lateral view, anterior broadly, obliquely rounded, posterior bluntly rounded; extremities denticulate; surface spinose with spines usually alined in three rows; surface smooth between the spines, but riblets on some species form a pseudoreticular pattern; anterior rim broken into spines in ventral half; curved riblet runs from prominent eye tubercle to spinose muscle swelling; characteristic three or four spines in front of and below muscle swelling, these sometimes connected by riblets forming a V or U open towards anterior; male carapaces show valve asymmetry with right valve indented in posteroventral area; marginal areas narrow to moderately wide, crossed by straight radial canals; hinge holamphidont; muscle scars a curved row of four adductor scars with a single J- or U-shaped scar in front.

Antennules with six podomeres, particularly strong setae at anterodistal edge of fourth and fifth podomeres; right legs of male differ from left legs, first thoracic right leg has only two podomeres and a claw.

Stratigraphic range.—Eocene to Recent.

Discussion.—Puri (1953a) distinguishes his genus *Actinocythereis* from *Trachyleberis* because *Actinocythereis* has the spines on the valve surface arranged in three distinct longitudinal rows. Van Morkhoven (1963) considers *Actinocythereis* as a subgenus of *Trachyleberis* differing only by having "the tubercles in the posterior half of the valves arranged in three more or less distinct longitudinal rows."

It is true that the type species of *Trachyleberis*, *Cythere scabrocuneata* Brady, 1880, shows very little linear arrangement of spines; but *Trachyleberis lytteltonensis* Harding and Sylvester-Bradley, 1953, *T. thomsoni* Hornibrook, 1952, and *T. tridens* Hornibrook, 1952, are, in my opinion, closely related species and they all show some alinement of spines.

Puri (1953a) placed 8 species in his new genus *Actinocythereis* and 10 species in *Trachyleberis*. All 10 of the species placed in the latter genus show some alinement of the spines, as do, of course, those placed in *Actinocythereis*. There is a gradation in morphotypes in the North American and Caribbean species of the *Trachyleberis-Actinocythereis* group from those with very strong alinement of spines such as *Cythere exanthemata* to those such as *Cythereis montgomeryensis* Howe and Chambers, 1935, where the alinement is weak. The latter species along with similar taxa such as *Trachyleberis citrusensis* Puri, 1957, *Cythereis quadrataspinata* Howe and Law, 1936, *Cythereis bermudezi* van den Bold, 1946, *Trachyleberis bollii* van den Bold, 1960, *Actinocythereis allisoni* Holden, 1964, and possibly *Cythereis davidwhitei* Stadnichenko, 1927, more closely resemble in shape and ornamentation the type species of *Trachyleberis* and possibly should be placed in that genus. Most of the remaining North American or Caribbean species assigned to *Trachyleberis* have a carapace shape and ornamentation like the type species of *Actinocythereis* and are better referred to that genus. Reticulate species often placed in *Actinocythereis* or *Trachyle-*

beris are better classified in the genus *Acanthocythereis* Howe, 1963.

In 1906 Cushman described some of the soft parts of a species he named *Cythereis vineyardensis.* I consider this species to be a typical member of the genus *Actinocythereis.* Cushman (1906) shows three setae on the fifth podomere of the antennules of *A. vineyardensis.* Harding and Sylvester-Bradley (1953) illustrate four setae for the fifth podomere of the antennules of both *Trachyleberis lytteltonensis* and *T. scabrocuneata.* Cushman (1906) describes the sixth podomere of *Actinocythereis vineyardensis* as having three setae. Harding and Sylvester-Bradley (1953) describe the sixth podomere of *Trachyleberis lytteltonensis* as having four setae. The sixth podomere of *T. scabrocuneata* is incompletely known.

Harding and Sylvester-Bradley (1953) point out that the male of *Trachyleberis lytteltonensis* shows asymmetry of the first thoracic legs. This asymmetry is apparently not imparted to the carapace, for none of the specimens of *T. lytteltonensis* I have observed nor specimens of other New Zealand species of the genus show valve asymmetry.

Blake (1933) notes that the fifth through seventh thoracic legs of *Actinocythereis dawsoni* (Brady, 1870) are unlike on the two sides of the body. The second and third pairs of legs on *Trachyleberis lytteltonensis* are symmetrical (Harding and Sylvester-Bradley, 1953). Cushman (1906) describes the first thoracic leg (the illustrated specimen appears to be a right leg) as "* * * 2-jointed, outer joint very long, swollen in the middle, with a short stout strongly curved claw." Harding and Sylvester-Bradley (1953) show the right first thoracic leg of *T. lytteltonensis* to be composed of four segments and a claw. Thus there are several anatomical differences between at least two species of *Trachyleberis* and one of *Actinocythereis.*

Important from a paleontologic standpoint is the fact that the anatomical asymmetry in the males of *Actinocythereis* is manifest in the carapace. All adult males of *Actinocythereis* that I have examined show asymmetry of the valves. The area on the venter behind the middle on right valves is characteristically indented. This can be seen both in lateral and ventral views.

Two species of *Actinocythereis* occur in several samples, of the more than 400 examined, from off northeastern North America. In the literature covering the Recent ostracodes of this area, only two species of *Actinocythereis* seem to have been described. One is *Cythere dawsoni* Brady, 1870, described from the Gulf of St. Lawrence and reported later from marine Pleistocene deposits at Montreal, Canada, and Portland, Maine, (Brady and Crosskey, 1871), from the Gulf of Maine (Blake, 1933), and from Vineyard Sound (Cushman, 1906). The second species is *Cythereis vineyardensis* Cushman, 1906, described from Vineyard Sound.

The two species found in my samples are superficially very similar, but separation is easy when attention is paid to details of ornamentation. Unfortunately, the illustrations of Brady (1870a) and Cushman (1906) do not show such detail. However, one of the species I have found is considerably larger than the other, females of the larger species measuring about 0.90 mm in length and those of the smaller species about 0.76 mm.

Brady (1870a) gives a length of one thirty-fifth of an inch (=0.74 mm) for a female or his *Cythere dawsoni*, and Brady and Crosskey (1871) illustrate a male of the species that is (measured from the plate) 0.64 mm in length. Cushman (1906) gives a length of 0.9 mm for his male specimen of *Cythereis vineyardensis.* These measurements plus the fact that my specimens came from areas where Brady's and Cushman's species were reported give me almost complete confidence in the identification of my smaller species as *Cythere dawsoni* and the larger as *Cythereis vineyardensis.*

Actinocythereis dawsoni (Brady, 1870)

Plate 5, figures 12–15, 17; plate 11, figure 6

1870. *Cythere dawsoni* Brady, Annals and Mag. Nat. History, 4th ser., v. 6, p. 453, pl. 19, figs. 8–10.

1871. *Cythere dawsoni* Brady. Brady and Crosskey, Geol. Mag., v. 8, p. 64, pl. 2, figs. 10, 11.

1878. Not *Cythere dawsoni?.* Brady, Zool. Soc. London Trans., v. 10, pt. 8, p. 393, pl. 66, figs. 3a, b.

1889. *Cythere dawsoni* Brady. Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d, ser., v. 4, no. 2, p. 166, pl. 16, figs. 19, 20.

1906. *Cythere dawsoni* Brady. Cushman, Boston Soc. Nat. History Proc., v. 32, n. 10, p. 372, pl. 35, figs. 84, 85.

1933. *Cythereis dawsoni* (Brady). Blake, Biol. Survey Mount Desert region, pt. 5, p. 238.

Diagnosis.—Small; spines of middle row elongated parallel to valve length.

Description.—Laterally subquadrate to subrectangular; anterior broadly obliquely rounded, posterior bluntly rounded. Double row of denticles around anterior and posterior, anterior inside row more prominent, posterior outside row more prominent. Valves ornamented with three rows of spines; three spines of middle row elongated parallel to valve length, nearly coalescing; anterior spine separated with slight gap from high muscle node; dorsal row consists of three spines all elongated normal to valve length, anterior two spines form an inverted U with closed end of U slanted towards posterior. Curved riblet running to muscle node from glassy eye tubercle; anterior rim solid in dorsal half, breaks up into about four large spines in the lower half;

ventral row of spines composed of six to eight blunt spines; V-shaped arrangement of riblets connecting short spines located in anterocentral area, V pointed towards posterior, legs of V angled slightly towards anterodorsal area. In dorsal view, left valve overlaps right at cardinal angles; rim and double row of anterior denticles are of equal size; elongation of spines of middle row prominent in dorsal view. In ventral view, interior row of spines at anterior comes farther back upon the ventral surface than does outer row; double row of spines at posterior very prominent in ventral view, inner row much smaller and more numerous, outer row on ventral surface changes to solid ridge that runs to the central depression. Internally, marginal areas rather wide with about 30 to 40 radial canals around anterior and very slight vestibule at anterior; about 15–20 radial canals around posterior. Hinge holamphidont; both teeth of right valve rounded and high, posterior tooth larger; socket behind anterior tooth small; groove leading to posterior tooth very narrow; hinge of left valve complementary; selvage moderately strong, some list grooves inside of selvage; selvage of right valve at outer margin. Muscle scars consist of curved row of four rounded adductor scars, top and bottom scars set forward; frontal scar U-shaped, open toward anterodorsal area.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	7	0.771	0.021	0.750–0.812	2.7
H	7	.429	.021	.400– .462	4.9
Male:					
L	9	.774	.024	.738– .812	3.1
H	9	.402	.027	.375– .425	6.7

Discussion.—*Actinocythereis dawsoni* is smaller than *A. vineyardensis*, and the females are relatively shorter and wider than in that species. The surface between the spines is relatively free of riblets in contrast to *A. vineyardensis.*

Specimens found.— 18.

Occurrence.—Gulf of Maine, Vineyard Sound, and Gulf of St. Lawrence. Pleistocene of Maine and Quebec. In the present study the species was found in the Gulf of Maine, on Browns Bank, and at two localities on the Atlantic Shelf at about 40° N., 70° W.

Repository.—USNM 112700, 112779–112783.

Actinocythereis vineyardensis (Cushman, 1906)

Plate 5, figures 16, 18; plate 11, figure 4

1906. *Cythereis vineyardensis* Cushman, Boston Soc. Nat. History, Proc., v. 32, p. 380, pl. 37, figs. 110–114.

Diagnosis.—Large; small sinuous coalescing riblets connect spines of middle row to those of dorsal and ventral rows.

Description.—Subrectangular to subquadrate in lateral view; anterior broadly, obliquely rounded; posterior bluntly, evenly rounded. Double row of denticles around anterior; interior row more prominent, denticles largest in anteroventural area; strong anterior rim present; rim solid and sharp from eye tubercle halfway around anterior, then breaks up into three to four blade-type spines; posterior denticulate with two rows of denticles, outside row more prominent. Curved riblet runs from eye tubercle to muscle node; muscle node ornate as result of the junction of several riblets. Surface ornamented with three major rows of spines connected by coalescing riblets. In anterocentral area are four small spines with low riblets connecting the posterior two to each other and to anterior two, but anterior two not connected. Ventral row of spines formed by two large spines below muscle node which are oriented with their greatest length parallel to valve length and three large spines behind these which are elongate nearly normal to valve length. Dorsal row made up of three spines; anterior spine complex forms an inverted U with a riblet coming off anterior leg, angling forward and then down, connecting at muscle node with riblet from eye tubercle; two posterior spines blunt, oriented with greatest length normal to length of valve, large gap between anterior spine of median row which is set below other two, and muscle node. In dorsal view, left valve overlaps right at cardinal angles; middle row of spines prominent as are anterior rim and double row of anterior denticles; clump of about four small spines at posterior cardinal angle of left valve. In ventral view, inner row of double row of anterior denticles is composed of many small slightly elongated spines, whereas outer row is composed of much larger blade spines which flare at ends; denticles in the posterior double row are of approximate equal size. Hinge holamphidont; posterior tooth of right valve rather small; anterior tooth large, rounded; 20–25 radial canals around anterior, about 15 in posterior and posteroventral areas; marginal areas rather narrow; vertical row of four adductor scars, second from top set farthest back; lowest set farthest forward; frontal scar not seen. See Cushman (1906) for description of soft parts.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	6	0.887	0.024	0.862–0.925	2.7
H	6	.490	.015	.462– .500	3.1
Male:					
L	2	---------	---------	.888– .912	---------
H	2	---------	---------	.462– .475	---------

Discussion.—These species is closely related to *Actinocythereis dawsoni* (Brady, 1870) from which it can be distinguished by its larger size and small riblets connecting the major spines. *Actinocythereis mundorffi* (Swain, 1951) also possesses the connecting riblets, but they are much better developed and that species is much smaller. *Actinocythereis vineyardensis* is also closely related to the often misidentified *Actinocythereis exanthemata*, the extinct type species of the genus. The differences between them are minor, but consistent. *Actinocytheseis exanthemata* does not possess the riblets connecting the major spine as does *A. vineyardensis* and the shapes of the individual spines, particularly, of the middle row are different, being oriented with the greatest length parallel to valve length.

Brady and Crosskey (1871) describe a species, *Cythere cuspidata*, from Pleistocene deposits on the banks of the Saco River, Maine, which may well be an *Actinocythereis*. It is the same size and has an outline in lateral and dorsal views as *Actinocythereis vineyardensis*. The illustrations of *Cythere cuspidata* are poor and the description minimal. From its locality and what morphological data are available, I suspect that Brady and Crosskey's specimen is conspecific with Cushman's *Cythere vineyardensis* and therefore would have priority. However, I am more sure that my specimens belong to the same species as Cushman's and will use his name until Brady and Crosskey's type specimen can be examined.

Specimens found.—8.

Occurrence.—Known previously from Vineyard Sound. In the present study it was found in the Gulf of Maine, on the Georges Bank, and on the Atlantic Shelf at 40°02′ N., 69°24′ W.

Repository.—USNM, 112698, 112784, 112785.

Genus ACANTHOCYTHEREIS Howe, 1963

Type species, *Acanthocythereis araneosa* Howe, 1963.

Diagnosis.—Elongate subtriangular or subquadrate in lateral view; elliptic in dorsal view; surface spinose and coarsely reticulate; spines may be arranged in rows; eye tubercle well developed; muscle node usually indistinct; marginal areas narrow to moderately wide; radial canals moderately numerous, simple; hinge holamphidont; four adductor muscle scars with single J- or U-shaped antennal scar.

Discussion.—In 1963 Swain erected the genus *Cletocythereis*. He had in his Pleistocene arctic fauna one species which he referred to *Cletocythereis*, *C. noblissimus* Swain, 1963 (=*Cythere dunelmensis* Norman, 1865); however, he selected as the type species *Cythere rastromarginata* Brady, 1880, a tropical species from the Pacific. I have examined Pacific specimens of *Cythere rastromarginata* and consider this species closely related to if not congeneric with the type species of *Hermanites*. *Cletocythereis noblissimus* on the basis of its shape and reticular ornamentation seems, at least tentatively, more closely related to species of the trachyleberidid genus *Acanthocythereis* than to *Cythere rastromarginata*.

Stratigraphic range.—Campanian(?), Paleocene to Recent.

Acanthocythereis? dunelmensis (Norman, 1865)

1865. *Cythere dunelmensis* Norman, British Assoc. Adv. Sci., rept. 34th Mtg., p. 193.

1941. *Cythereis dunelmensis* (Norman). Elofson (partim), Zool. Bidrag från Uppsala, v. 19, p. 296 (gives full synonymy 1865–1941).

1941. Not *Cythereis dunelmensis* (Norman). Tressler, U.S. Geol. Survey, Prof. Paper 196–C, p. 100, pl. 19, fig. 21.

1943. *Cythereis dunelmensis* (Norman). Elofson (partim), Arkiv Zoologi, v. 35A, no. 2, p. 10.

1963. *Cletocythereis noblissimus* Swain, Jour. Paleontology, v. 37, no. 4, p. 824, pl. 98, fig. 5; pl. 99, figs. 15a, b; text fig. 10a.

1965. *Cletocythereis dunelmensis minor* Bassiouni, Dansk Geol. Fören. Medd., v. 15, pt. 4, no. 4, p. 513, pl. 2, fig. 9.

1965. *Cletocythereis dunelmensis dunelmensis* (Norman). Bassiouni idem, pl. 2, fig. 8.

1965. *Cletocythereis elofsoni elofsoni* Bassiouni, idem, p. 514, pl. 2, figs. 4, 5.

Discussion.—Although reported several times from the area of this study, I have not found the species in any of my study-area samples. I have had an opportunity to study specimens of the species found in Recent samples from the Greenland Sea and Beaufort Sea.

Elofson (1941), in his study of the ostracodes of the Skagerrak, found two morphologic types both of which he referred to *Cythereis dunelmensis*, calling one the large form and the other the small form.

Swain (1963) makes no mention of *Cythere dunelmensis* in his discussion of *Cletocythereis noblissimus*, yet the similarity of his illustrations and specimens, which I have examined, with the illustrations of Brady (1868a), Brady, Crosskey, and Robertson (1874), and Elofson (1941) cannot be denied. *Cletocythereis noblissimus* would seem to be a junior synonym of *Cythere dunelmensis* (the large form of Elofson, 1941).

Bassiouni (1965) considers both the large and small forms of Elofson to represent not *Cythere dunelmensis* but a new species which he names *Cletocythereis elofsoni*. Bassiouni divides *C. elofsoni* into two subspecies, *C. elofsoni elofsoni*, the large form Elofson, and *C. elofsoni abbreviata*, the small form of Elofson. *Cletocythereis elofsoni abbreviata* may represent a new species, but *C. elofsoni elofsoni* seems to be only the male of *Cythere dunelmensis*. Bassiouni seems not to have correctly sexed his specimens as all four of his illustrations of *Cletocythereis elofsoni* are of males and the two illustrations of *C. dunelmensis* are of females.

Occurrence.—Greenland Sea, Beaufort Sea, Iceland, Spitzbergen, Franz Josef Land, Kara Sea, Barents Sea, Norwegian Sea, western Baltic Sea, North Sea, several localities off England, Scotland, and Ireland, Shetland Islands, Cumberland Sound, Gulf of St. Lawrence, Gulf of Maine, and Vineyard Sound. Pleistocene of Alaska, Maine, England, Scotland, Ireland, and Denmark.

Genus ROBERTSONITES Swain, 1963

Type species, *Robertsonites gubikensis* Swain, 1963 (=*Cythereis tuberculata* Sars, 1865).

Diagnosis.—Subquadrate to subrectangular in lateral view; anterior broadly rounded; posterior more bluntly, obliquely rounded; surface irregularly pitted or reticulate and nodose; hinge holamphidont; U-shaped frontal muscle scar; four adductor scars.

Stratigraphic range.—Pleistocene to Recent.

Robertsonites tuberculata (Sars, 1865)

Plate 6, figures 1–3

1865. **Cythereis tuberculata** Sars, Vidinsk. Selsk. Christiania, Förh., p. 37.

1871. **?Cythere logani** Brady and Crosskey, Geol. Mag., v. 8, p. 63, pl. 2, figs. 8, 9.

1874. **Cythere logani** Brady and Crosskey. Brady, Crosskey, and Robertson, A monograph of the Post-Tertiary Entomostraca * * *, p. 165, pl. 15, figs. 17, 18.

1878. **Cythere logani** Brady and Crosskey. Brady, *in* Nares, Narrative of a trip to the Polar Sea during 1875–6 * * *, v. 2, No. 7, p. 254.

1906. **Cythereis tuberculata** Sars. Cushman, Boston Soc. Nat. History Proc., v. 32, no. 10, p. 376, pl. 36, figs. 108, 109.

1941. **Cythereis tuberculata** Sars. Elofson, Zool. Bidrag från Uppsala, v. 19, p. 294 (gives full synonymy 1865–1941).

1941. Not **Cythereis tuberculata.** Tressler, U.S. Geol. Survey Prof. Paper 196–C, p. 100, pl. 19, fig. 20.

1943. **Cythereis tuberculata** Sars. Elofson, Arkiv Zoologi v. 35A, no. 2, p. 9.

1963. **Robertsonites gubikensis** Swain, Jour. Paleontology, v. 37, no. 4, p. 821 pl. 98, figs. 8a, b; pl. 99, fig. 12; text fig. 9b.

1963. **Robertsonites tuberculatina** Swain, idem, p. 822, pl. 98, fig. 10; pl. 99, fig. 1; text fig. 9c.

Diagnosis.—Surface reticulate, with smaller reticules or pits inside the larger ones; two prominent nodes posterodorsally and posteroventrally; sulcus behind muscle swelling.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	3	1.117	0.029	1.100–1.150	2.6
H	3	.638	.013	.625–.650	2.0
Male:					
L	4	1.122	.028	1.088–1.150	2.5
H	4	.566	.012	.550–.575	2.1

Discussion.—Blake (1933) reported this species from the Mount Desert region of Maine, and Cushman (1906) reported it from Vineyard Sound. I have not found the species in my material from off New England, although it is a common constituent of my samples from further north. Cushman's (1906) report of *Robertsonites tuberculata* could be based on a misidentification, as he illustrates an antennule having only five podomeres, whereas Sars (1925) shows that the species has six-jointed antennules. The joint between the fourth and fifth podomeres on the antennules of trachyleberidids is not always easily seen, and Cushman's illustration of only five podomeres could easily be an error in observation.

Swain (1963) describes *Robertsonites gubikensis* and *R. tuberculatina;* he makes no comparison of his species with the often described *Cythereis tuberculata* Sars, although he may have been indicating some relationship with the use of the trivial name *tuberculatina.* After comparison of the types of *R. tuberculatina* and *R. gubikensis* with each other and with many specimens of *Cythereis tuberculata* Sars, found in the present study, I can only conclude that Swain's *R. gubikensis* and *R. tuberculatina* are junior synonyms of *R. tuberculata.*

The holotype of *Robertsonites gubikensis* appears to be a female, whereas that of *R. tuberculatina* is the male of the species.

The variability of *R. tuberculata* is great. Brady (1868a, p. 407) states that "there is great variety in the different forms of the carapace * * *." Brady, Crosskey, and Robertson (1874, p. 165) said that *R. tuberculata* "exhibits much variation in outline and in surface-marking, and * * * the tubercular elevations are much more conspicuous in very young than in old specimens, though the contrary holds good with regard to the pitting or excavation of the shell."

Specimens found.—42.

Occurrence.—Baltic Sea, North Sea, Norwegian Sea, many localities in the British Isles, Barents Sea, Franz Josef Land, Spitzbergen, Iceland, Kane Basin, Godhavn Harbor, Hunde Islands, Davis Strait, Holsteinsborg Harbor, Gulf of St. Lawrence, Gulf of Maine, and Vineyard Sound. Pleistocene of England, Scotland, Wales, Ireland, and Alaska. In the present study the species was found in samples from near North Wolstenholme Island, the Vaigat Strait, Frobisher Bay, Kneeland Bay, and Ungava Bay.

Repository.—USNM 112786–112788.

Genus CARINOCYTHEREIS Ruggieri, 1956

Type species, *Cytherina carinata* Roemer, 1838.

Carinocythereis whiteii (Baird, 1850)

1850. *Cythereis whiteii* Baird, * * * British Entomostraca, p. 175, pl. 20, fig. 3.
1868. *Cythere whitei* (Baird). Brady, Linnean Soc., London Trans., v. 26, p. 416, pl. 30, figs. 21–24.
1870. *Cythere? whiteii* (Baird). Brady, Annals and Mag. Nat. History, 4th ser., v. 6, p. 450.
1874. *Cythere whiteii* (Baird). Brady, Crosskey and Robertson, A monograph of the Post-Tertiary Entomostraca * * *, p. 169, pl. 12, figs. 1–3.
1889. *Cythere whitei* (Baird). Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d ser., v. 4, no. 2, p. 169.

Discussion.—This species was identified from the Gulf of St. Lawrence by Brady (1870a). I have not found it in any of my material. Ruggieri (1956) considers *Cythereis whiteii* Baird to belong to his genus *Carinocythereis.*

Occurrence.—Several localities in the British Isles, Shetland Islands, Mediterranean, and Gulf of St. Lawrence. Pleistocene of Ireland.

Subfamily ECHINOCYTHEREIDINAE new subfamily

Diagnosis.—Carapace subovate in lateral view; ovate in dorsal view, widest at middle; anterior broadly rounded, denticulate, posterior obliquely to bluntly rounded to truncate, denticulate; surface concentrically reticulate with or without concentrically arranged spines; eye tubercles well developed; no muscle node; marginal areas of moderate width, inner margin and line of concrescence coincident; radial canals moderately numerous, usually simple; hinge amphidont, terminal teeth smooth; near-vertical row of four adductor muscle scars; two frontal scars; normal canals open. Antennules with six podomeres, setae at anterodistal ends of podomeres very elongate; setae and terminal claws of antennae very elongate; exopodites of antennae moderately developed; chitinous supports in knees of thoracic legs.

Discussion.—The genera of the Echinocythereidinae are distinguished from the Trachyleberidinae by their subovate shape in lateral view, by tumidity in dorsal view, and by the presence of two frontal scars. The shape is somewhat the same as in the Buntoniinae and Cytherettinae, but the genera of these subfamilies possess a single J-shaped antennal scar in addition to other hard and soft-part morphological differences.

Van Morkhoven (1963) considers *Echinocythereis* as a transitional form between the Hemicytheridae and Trachyleberididae. *Echinocythereis* has two antennal muscle scars and chitinous thoracic knee supports, both of which are common in the Hemicytheridae, but it has six-jointed antennules and complex mandibular branchial plates which are trachyleberidid characters. *Echinocythereis* is morphologically intermediate between the two families; however, I believe that the type of antennules and branchial plates are more important taxonomic criteria at the family level than the knee supports or antennal scars. Although *Echinocythereis* is interemediate morphologically, I do not think it is transitional in a phyletic sense. Thus, the double frontal scars and chitinous knee supports of the Echinocythereidinae parallel development of these characters in the Hemicytheridae.

Howe and Laurencich (1958) assign two Cretaceous species to *Echinocythereis.* Although much smaller than Tertiary representatives of the genus, they are very similar in shape and ornamentation. The internal features of these two species are as yet poorly known. No data are available on their muscle scars. Howe and Laurencich's assignation of the Cretaceous taxa to *Echinocythereis* is provisionally accepted. The Cretaceous species of Howe and Laurencich are in need of study to ascertain if they are *Echinocythereis* or, at least, Echinocythereidinae. If they are, then the range of the subfamily is Campanian to Recent.

The following genera are placed in the Echinocythereidinae:

Echinocythereis Puri, 1954, Campanian(?), Paleocene to Recent
Rabilimis n. gen., Pleistocene to Recent
Bosquetina Keij, 1957, Eocene to Recent

Genus ECHINOCYTHEREIS Puri, 1953

Type species, *Cythereis garretti* Howe and McGuirt, 1935 (=*Cythere margaritifera* Brady, 1870).

Diagnosis.—Subovate to quadrate in lateral view; elliptic in dorsal view, widest at or just behind middle; eye tubercle well developed; surface ornamented with concentrically arranged spines and, generally, reticules; hinge holamphidont; two frontal muscle scars; four adductor muscle scars.

Stratigraphic range.—Campanian(?), Paleocene to Recent.

Echinocythereis margaritifera (Brady, 1870)

Plate 6, figures 6, 7, 9

1870. *Cythere margaritifera* Brady, Fonds de la Mer, v. 1, p. 192, pl. 27, figs. 3, 4.
1935. *Cythereis garretti* Howe and McGuirt, *in* Howe and others, Florida Geol. Survey Bull. 13, p. 20, pl. 3, figs. 17–19; pl. 4, figs. 5, 15.
1951. *Buntonia* sp. cf. *B.? garretti* (Howe and McGuirt). Swain, U.S. Geological Survey Prof. Paper 234–A, p. 39, pl. 3, fig. 6; pl. 4, figs. 4–6.
1954. *Echinocythereis garretti* (Howe and McGuirt). Puri, Florida Geol. Survey Bull. 36, p. 260, pl. 12, figs. 2–5; text figs. 9a, b; [1953d].
1958. *Echinocythereis garretti* (Howe and McGuirt). Brown, North Carolina Div. Mineral Resources Bull. 72, p. 65, pl. 6, fig. 12.

1960. *Echinocythereis margaretifera* (Brady). Curtis, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 4, p. 480, pl. 1, fig. 19.

1963. *Echinocythereis garretti* (Howe and McGuirt). Benson and Coleman, Kansas Univ. Paleont. Contr., Arthropoda, art, 2, p. 46, pl. 4, fig. 4, 5; text fig. 30.

Diagnosis.—Quadrate (females) to elongate quadrate (males); thick shelled; spines broad based, and short.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	4	1.006	0.071	0.900–1.050	7.1
H	4	.625	.042	.562–.650	7.7
Male:					
L	2	----------	----------	.875–1.012	----------
H	2	----------	----------	.525–.575	----------

Discussion.—In 1963 I had an opportunity to examine the types of the species described by G. S. Brady (1870b) in "Les Fonds de la Mer." One of the specimens examined was the holotype of *Cythere margaritifera* Brady, 1870, described from off Vera Cruz, Mexico. I compared Recent specimens of an *Echinocythereis* found off the Mississippi Delta with Brady's type and judged them to be conspecific with *Cythere margaritifera*, an identification already correctly made by Curtis (1960). I have since examined specimens of *Cythereis garretti* Howe and McGuirt, 1935, from the type horizon and judge them to be conspecific with *Cythere margaritifera*. Thus, in my opinion, the type species of *Echinocythereis* becomes *Cythere margaritifera* Brady, 1870.

Echinocythereis margaritifera is distinguished from most other species of the genus, particularly those found in North America, both fossil and Recent, by its more quadrate outline in lateral view.

Specimens found.—12.

Occurrence.—Gulf of Mexico, Miocene of North Carolina and Florida. In the present study the species was found on the Georges Bank and at three localities on the Atlantic Shelf at approximately 40° N., 70° W.

Repository.—USNM 112792–112794.

Echinocythereis planisbalis (Ulrich and Bassler, 1904)

Plate 6, figures 4, 5, 8

1904. *Cythere planisbalis* Ulrich and Bassler, Maryland Geol. Survey, Miocene [volume], p. 99, pl. 38, figs. 1–3.

1929. *Cythereis procteri* Blake, Biol. Survey Mount Desert region, pt. 3, p. 13, fig. 6.

1933. *Cythereis procteri* Blake. Blake, idem, pt. 5, p. 239.

1951. *Buntonia? planisbalis* (Ulrich and Bassler). Swain, U.S. Geol. Survey Prof. Paper 234–A, p. 39, pl. 3, figs. 4, 5.

1958. Not *Echinocythereis planisbalis*. Brown, North Carolina Div. Mineral Resources Bull. 72, p. 65, pl. 8, fig. 11.

Diagnosis.—Spinose ventrolateral rib developed in posterior half of valve; one spine particularly well developed at posterior end of rib; tendency for clump of several spines to form at posteroventral angle.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	5	1.022	0.047	0.975–1.100	4.6
H	5	.612	.013	.600–.625	2.1

Discussion.—*Echinocythereis planisbalis* is distinguished from *E. echinata* and other species of the genus with similar carapace shapes by the presence of a short ventrolateral ridge in the posterior part of the valves. On some specimens, such as that illustrated by Swain (1951), the ridge is very pronounced.

Blake (1929, 1933), apparently unaware of the work of Ulrich and Bassler (1904), described the species under the name *Cythereis procteri.*

Specimens found.— 7.

Occurrence.—Gulf of Maine, Miocene of Virginia and North Carolina. In the present study the species was found in samples from the Gulf of Maine.

Repository.—USNM 112789–112791.

Echinocythereis echinata (Sars, 1865)

Plate 6, figures 10, 11

1865. *Cythereis* echinata Sars., Vidensk. Selsk. Christiania, Förh., p. 44.

1941. *Cythereis echinata* Sars. Elofson, Zool. Bidrag från Uppsala, v. 19, p. 295 (gives full synonmy 1865–1941).

1941. *Cythereis echinata* Sars. Tressler, U.S. Geol. Survey Prof. Paper 196–C, p. 100, pl. 19, fig. 24.

1943. *Cythereis echinata* Sars. Elofson, Arkiv Zoologi, v. 35A, no. 2, p. 9.

1952. Not *"Cythereis" echinata* (Sars). Crouch, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 5, pl. 7, fig. 17.

Diagnosis.—Large; very numerous thin elongate spines cover unreticulated surface.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female?:					
L	2	----------	0.017	1.125–1.150	----------
H	2	----------	.022	.650–.662	----------

Speciments found.— 2.

Occurrence.—North Sea, Norwegian Sea, several localities in the central North Atlantic and one in the South Atlantic near Tristan da Cunha. In the present study the species was found on the Stout Swell.

Repository.—USNM 112795, 112796.

Genus RABILIMIS n. gen.

Type species, *Cythere mirabilis* Brady, 1868.

Etymology.—An anagram constructed from letters in the trivial name of the type species.

Diagnosis.—Large; subovate in lateral view; ovate in dorsal view, valves greatly inflated; surface ornamented with concentrically arranged reticulae, pits and ridges; no prominent surface spines; hinge strong holamphidont; two frontal muscle scars; four adductor muscle scars.

Discussion.—*Rabilimis* is similar to but larger and more inflated than *Echinocythereis* and is without the prominent surface spines of that genus. The smallest known species of *Rabilimis*, *R. mirabilis*, is 10 percent larger than the largest known species of *Echinocythereis*, *E. echinata.* The anatomy of *Rabilimis* is like that of *Echinocythereis*, including the chitinous thoracic knee supports. The two genera are very closely related, and *Rabilimis* is most probably descended from *Echinocythereis.*

Rabilimis is proposed for *Cythere mirabilis* Brady, 1868, *Cythere septentrionalis* Brady, 1866, and *Pseudocythereis paramirabilis* Swain, 1963.

Rabilimis is virtually synonymous with *Pseudocythereis* as used by Swain (1963). Skogsberg (1928) described *Pseudocythereis*; the type species, *P. spinifera*, is from off the island of South Georgia. Skogsberg considers the anatomy of *Pseudocythereis*, particularly the thoracic legs, to compare favorably with those of the type species of *Cytheretta*, *C. rubra.* He states that *Pseudocythereis* does not have chitinous supports in the knees of the thoracic legs. Puri (1958b) feels that the hingement and carapace shape of *Pseudocythereis* is similar to *Cytheretta*, and he places *Pseudocythereis* in the Cytherettinae.

Swain (1963) places two new arctic Pleistocene species in *Pseudocythereis*, *P. paramirabilis* and *P. simpsonensis* (=Cythere *septentrionalis* Brady, 1866). By implication Swain also includes *Cythere mirabilis* Brady, 1868, in *Pseudocythereis.* Swain's species and *Cythere mirabilis* are shaped and ornamented similar to *Echinocythereis*, and the anatomy of *Cythere mirabilis* is like that of *Echinocythereis.* The affinity of *Cythere mirabilis* to species of *Echinocythereis* is also noted by van Morkhoven (1963) who places *Cythere mirabilis* in *Echinocythereis.*

The hard parts of *Rabilimis mirabilis* are described by Brady (1868a), Brady, Crosskey, and Robertson (1874), Elofson (1943), and Akatova (1946). Soft parts are described and illustrated by Elofson (1943) and Akatova (1946). *Rabilimis mirabilis* is known from approximately 157° E. to 25° W. (East Siberian Sea to Greenland Sea), and approximately 58° N. to 80° N. (Lewis Island, Scotland to Franz Josef Land). In addition to the localities given by Elofson and Akatova, I have studied specimens of the species found in a sample taken between Shannon Island and Hochstetter Foreland off eastern Greenland.

Rabilimis septentrionalis is known from the Hunde Islands, Disko Bay (Brady, 1866, 1868b), approximately 69° N., 53° W., west Greenland, and off Point Barrow, Alaska (approx. 71° N., 156° W.). *Rabilimis paramirabilis* is also known to occur from off Point Barrow. The genus, therefore, is circumarctic and extends only as far south as 50° N. It occurs in waters where the mean annual temperature is less than 10°C.

Rabilimis mirabilis is known from the Pleistocene of Scotland and England (Brady and others, 1874), and *R. paramirabilis* and *R. septentrionalis* are known from the Pleistocene of Alaska (Swain, 1963).

Stratigraphic range.—Pleistocene to Recent.

Rabilimis septentrionalis (Brady, 1866)

1866. *Cythere septentrionalis* Brady, Zool. Soc. London Trans., v. 5, p. 375, pl. 60, figs. 4a–f.

1889. *Cythere septentrionalis* Brady. Brady and Norman, Royal Dublin Soc. Sci. Trans., 2d ser., v. 4, no. 2, p. 149, pl. 16, figs. 13, 14.

1963. *Pseudocythereis simpsonensis* Swain, Jour. Paleontology, v. 37, no. 4, p. 825, pl. 97, figs. 4, 12, 16, 20; pl. 98, figs. 12a–d; pl. 99, figs. 10a–c; text fig. 12a.

Discussion.—This species was described from the Hunde Islands of southwestern Greenland. I have not identified the species from any of my samples.

Swain (1963) described *Pseudocythereis simpsonensis* and stated that the species "is close to '*Cythere*' *septentrionalis* Brady in outline, hingement and general surface ornamentation, but in that species the concentrate ridges are more prominent marginally and the terminal margins are more spinose." Swain's specimens are abraded and the denticles most probably have been worn off. Brady's (1866) original illustrations do not emphasize the concentric anterior ornamentation as do those of Brady and Norman (1889), yet the specimens came from the same locality and the two sets of illustrations may be based on the same specimen. After examination of Swain's types and specimens of the species found in Recent samples off Point Barrow, Alaska, I can see no justification for separating his *Pseudocythereis simpsonensis* from *Cythere septentrionalis.*

Occurrence.—Reported only from the Hunde Islands and the Pleistocene of Alaska. I have seen the species in Recent samples from off Point Barrow, Alaska.

Subfamily PTERYGOCYTHEREIDINAE Puri, 1957.

Diagnosis.—Subrectangular to subpyriform in lateral view; triangular in dorsal view; valves alate; hinge hemiamphidont to holamphidont; single J-shaped antennal muscle scar; four adductor muscle scars, the dorsal scar sometimes divided.

Discussion.—The strongly alate valves of the Pterygocythereidinae serve to distinguish the subfamily from most other subfamilies of the Trachyleberididae. The Brachycytherinae are similar in being swollen ventrally and are, in some specimens, alate but differ in the type of adductor muscle scars. The Pterygocythereidinae have four adductor scars; the upper scar is usually heart shaped and sometimes divided. The Brachycytherinae generally have both the upper and dorsomedian adductor scars divided.

The following is a list of the Upper Cretaceous and Cenozoic genera that seem referable to the Pterygocythereidinae:

Pterygocythereis Blake, 1933, Eocene to Recent
Pterygocythere Hill, 1954, Turonian to Eocene
Alatacythere Murray and Hussey, 1942, Albian to Oligocene
Incongruellina Ruggieri, 1958, Pliocene to Recent
Ruggieria Keij, 1957, Miocene to Recent
Kingmaina Keij, 1957, Maestrichtian to Eocene

Genus PTERYGOCYTHEREIS Blake, 1933

(=Fimbria Neviani, 1928)

Type species, *Cythereis jonesi* Baird, 1850.

Diagnosis.—Subrectangular in lateral view; valves strongly alate, alae may be broken up into row of spines; hinge holamphidont; dorsal adductor muscle scare may be heart shaped or divided.

Stratigraphic range.—Eocene to Recent.

Pterygocythereis americana

(Ulrich and Bassler, 1904)

Plate 4, figures 14, 15

1904. *Cythereis cornuta* var. *americana* Ulrich and Bassler, Maryland Geol. Survey, Miocene [volume], p. 122, pl. 37, figs. 29–33.

1904. *Cythereis alaris* Ulrich and Bassler, idem., p. 123, pl. 38, figs. 34–36.

1929. *Cythereis inexpectatus* Blake, Biol. Survey Mount Desert region, pt. 3, p. 12, fig. 7.

1933. *Cythereis* (*Pterygocythereis*) *inexpectata* Blake. Blake, idem, pt. 5, p. 240.

1935. Not *Cythereis* (*Pterygocythereis*) *cornuta* var. *americana* Ulrich and Bassler. Howe and others, Florida Geol. Survey Bull. 13, p. 26, pl. 2, figs. 19, 21–24.

1946. Not *Cythereis* (*Pterygocythereis*) *cornuta* var. *americana* Ulrich and Bassler. Van den Bold, Contributions to the study of Ostracoda * * *, p. 100, pl. 10, figs. 17a, b.

1948. Not *Cythereis* (*Pterygocythereis*) *cornuta* var. *americana* Ulrich and Bassler. Swain, Maryland Dept. Geology, Mines and Water Resources, Bull. 2, p. 206, pl. 13, fig. 4.

1950. *Pterygocythereis americana* (Ulrich and Bassler). Van den Bold, Jour. Paleontology, v. 24, no. 1, p. 83.

1951. ?*Pterygocythereis cornuta americana* (Ulrich and Bassler). Swain, U.S. Geol. Survey Prof. Paper 234–A, p. 41.

1953. *Pterygocythereis americana* (Ulrich and Bassler). Malkin, Jour. Paleontology, v. 27, no. 6, p. 795, pl. 80, fig. 26–29.

1954. *Pterygocythereis americana* (Ulrich and Bassler). Hill, Jour. Paleontology, v. 28, no. 6, p. 814, pl. 99, fig. 7a.

1954. *Pterygocythereis cornuta americana* (Ulrich and Bassler). Puri (partim), Florida Geol. Survey Bull 36, p. 261, pl. 13, fig. 1, [1953d].

1957. *Pterygocythereis americana* (Ulrich and Bassler). McLean, Bull. Am. Paleontology, v. 37, no. 167, p. 80, pl. 9, figs. 5a–d, 6a–e.

1960. ?*Pterygocythereis* cf. *P. americana* (Ulrich and Bassler). Curtis, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 4, pl. 1, fig. 33.

1963. *Pterygocythereis* sp. aff. *P. americana* (Ulrich and Bassler). Benson and Coleman (partim), Kansas Univ., Paleont. Contr., Arthropoda, art. 2, p. 22, pl. 5, fig. 1; text fig. 10.

1965. *Pterygocythereis americana* (Ulrich and Bassler). Pooser, Kansas Univ. Paleont. Contr., Arthropoda, art. 8, p. 34, pl. 13, figs. 3, 7, 11–14; pl. 14, fig. 12.

Diagnosis.—Subrectangular in lateral view; fluted, divided, dorsal crest; spine at posterior cardinal angle of left valve.

Measurements in mm.—

	N	*M*	*Sd*	*OR*	*V*
Female:					
L	6	1.096	0.034	1.050–1.125	3.1
H	5	.585	.024	.550– .612	4.1
Male:					
L	4	1.172	.065	1.075–1.212	5.5
H	4	.562	.037	.512– .600	6.5

Discussion.—At least three species of *Pterygocythereis* in Oligocene to Recent deposits of the United States and Caribbean area have been referred to *P. americana.*

The first report subsequent to Ulrich and Bassler (1904) was by Howe and others (1935) who placed forms from the Miocene of Florida in the species. In 1946 van den Bold placed forms from the Miocene of Cuba and Guatemala in the species. In 1950 van den Bold reported *P. americana* from the Miocene of Venezuela. In this paper he questionably removes his 1946 specimens and those of Howe and others (1935) from the species because they do not have the fluted divided dorsal crest described by Ulrich and Bassler (1904).

Swain (1948) places a form from the subsurface Miocene of Maryland in *P. americana.* However, Swain's specimen does not seem to have the dorsolateral crest, and Hill (1954) places Swain's form in his new species *P. howei.* Hill does not include the specimens of Howe and others (1935) in *P. howei*, but they seem to be conspecific. Hill (1954) considers the identifications of *P. americana* by van den Bold (1950) and Malkin (1953) as correct. The species seems to have also been correctly identified by McLean (1957) and Pooser (1965) who illustrate specimens from the Neogene of Virginia and South Carolina, respectively. McLean states that *Cythereis alaris* Ulrich and Bassler, 1904, is a juvenile and very probably a synonym of *Pterygocythereis americana.*

Butler (1963) points out that most of what Puri (1953d) illustrates as *P. americana* from the Neogene of Florida is actually *P. howei* Hill. Curtis (1960) illustrates an uncrested form from the Recent off Louisiana as *Pterygocythere* sp., and a juvenile as *Pterygocythereis* cf. *P. americana.* Benson and Coleman (1963) refer crested and uncrested forms to *P.* aff. *P. americana.* The uncrested forms of Curtis and Benson and Coleman probably represent an undescribed species, whereas the crested forms probably are *P. americana.*

In 1929 Blake described the species *Cythereis inexpectata* from the Gulf of Maine, and later referred the species to his genus *Pterygocythereis.* Blake was apparently unaware of the work of Ulrich and Bassler (1904). My specimens of *P. inexpectata*, some of which were collected from the general area of Blake's localities, have been compared with the types of *P. americana* and judged to be conspecific.

Material studied.—25 specimens.

Occurrence.—Previously known from the Gulf of Maine and Gulf of Mexico and the Neogene of the Atlantic Coastal Plain, Florida, and Venezuela. In the present study the species was found in samples from the Gulf of Maine and at the edge of the Atlantic Shelf north of Hudson Canyon.

Repository.—USNM 112767, 112768.

Subfamily CYTHERETTINAE Triebel, 1952

Diagnosis.—Carapace generally large; surface smooth to reticulate or ribbed; hinge very strong holamphidont; inner lamella extremely wide, inner margin sinuous; most anterior radial canals initiate in area of small anterior vestibule; single antennal scar; four adductor muscle scars.

Discussion.—The following genera are considered to belong to the Cytherettinae.

Cytheretta Muller, 1894, Eocene to Recent
Flexus Neviani, 1928, Oligocene to Miocene
Paracytheretta Triebel, 1941, Senonian to Paleocene
Protocytheretta Puri, 1958, Oligocene to Recent
Neocytheretta van Morkhoven, 1963, Miocene to Recent
Pseudocythereis Skogsberg, 1928, Recent

Genus CYTHERETTA Muller, 1894

(=Pseudocytheretta Cushman, 1906; Cylindrus Neviani, 1928; Prionocytheretta Mehes, 1941)

Type species, *Cytheretta rubra* Mueller, 1894 (=*Cytherina subradiosa* Roemer, 1838).

Diagnosis.—Carapace ovate to elongate ovate in lateral view; posterior upturned; left valve overlaps right strongly at cardinal angles; hinge strong holamphidont; inner lamella extremely broad; inner margin sinuous; single J-shaped antennal scar; four adductor scars; first thoracic legs of males asymmetrical.

Discussion.—*Cytheretta* has a troubled history. Three names seem to have been proposed for the genus; one (*Cylindrus*) is a homonym. Three names are available for the type species.

The genus and type species, *Cytheretta rubra*, were described by Mueller (1894) from the Gulf of Naples. Both the soft and hard parts are described and illustrated. On Mueller's plate 8, *Cytheretta rubra* is represented by four illustrations. Two of these, figures 13 and 16, are lateral views, and they seem to be of two species. The soft parts of a male and female, and an internal view of a male left valve are illustrated on Mueller's plate 39. The male valve on plate 39 would seem to belong to the same species as that of figure 16 on plate 8. I assume that the male soft parts are also of this species. Van Morkhoven (1963) also recognizes that Mueller had two species and points out that *Ilyobates? judaea* Brady, 1868, from the Mediterranean may be a senior synonym. Brady's illustrations do seem to be of the same species as shown on Mueller's plate 8, figure 16, and plate 39, figure 24. Ruggieri (1950) synonymizes *Cytheretta rubra* with *Cytherina subradiosa* Roemer, 1838, a species originally described from the Pliocene of Italy. Puri (1958b) describes and illustrates *Cytherina subradiosa* from the Recent of the Adriatic Sea. At least part of what Puri illustrates as *Cytherina subradiosa* seems to be the same species as part of what Mueller illustrates (pl. 8, fig. 16; pl. 39, fig. 24, and probably the male soft parts on pl. 39) as *Cytheretta rubra.*

The soft parts of *Cytheretta subradiosa* (=*Cytheretta rubra* (part) and *Ilyobates? judaea*) are well illustrated by Mueller. The salient anatomical characters emphasized by Mueller are the three-jointed exopodite of the second antennae, absence of a seta on the posterior border of the protopodite of the first thoracic legs, and asymmetry of the first pair of thoracic legs in the male. The asymmetry is not particularly strong.

Cushman (1906) described the genus *Pseudocytheretta;* the type species, *P. edwardsi* Cushman, is from Vineyard Sound and Buzzards Bay. The shell and most anatomical characters are said to be virtually the same as in *Cytheretta*, but *Pseudocytheretta* is said to differ by having very strong asymmetry of the first thoracic legs in the males. The last joint of the first right leg is elongated and greatly broadened on the inner border. This asymmetry is really very pronounced when compared with that shown in Mueller's illustration for *Cytheretta subradiosa.*

Blake (1929) describes a species from the Gulf of Maine that also shows this asymmetry. Blake does not recognize Cushman's genus and places his species in *Cytheretta* without comment, probably following Mueller (1912) who considered *Pseudocytheretta* to be a synonym of *Cytheretta* because it can not be distinguished on shell structure. Puri (1952) states that from the standpoint of paleontology Mueller's conclusions are sound. This may be a practical solution for paleontologists but perhaps not logically sound. Many paleontologists have been critical of neontologists for not recognizing taxonomically useful shell characters when the anatomies of groups of species, genera, or higher taxa are similar. If the anatomical difference between *Cytheretta* and *Pseudocytheretta* is such to warrant their recognition as separate taxa, then it seems inconsistent for paleontologists not to recognize anatomically distinguished genera which unfortunately cannot be distinguished by hard parts alone, particularly when many genera are recognized by paleontologists which neontologists claim cannot be recognized by soft parts.

The question is how taxonomically important is the difference in the magnitude of asymmetry in *Cytheretta* and *Pseudocytheretta.* The fact that both Mueller and Blake, neontologists, considered the two genera synonymous seems to indicate that the anatomical differences is not of generic importance. Unfortunately, *Pseudocytheretta edwardsi*, *Cytheretta subradiosa* (=*C. rubra*) and *Cytheretta tracyi* Blake, 1929, seem to be the only three species of *Cytheretta* for which the soft parts have been described.

As far as the carapace is concerned, *Cytheretta subradiosa* and *Pseudocytheretta edwardsi* are very similar. They differ in the amount of overlap of the left valve over the right at the posterior cardinal angle, that of *P. edwardsi* being greater and therefore showing a slightly greater posterior upswing. Both species are virtually without surface ornamentation, though on some specimens of *P. edwardsi* the normal pore pits tend to be alined longitudinally. *Pseudocytheretta edwardsi* is more than 30 percent larger than *Cytheretta subradiosa.* Further, the average specimen of *Cytheretta subradiosa* is 25 percent smaller than the average of all the smallest measurements given for several species of *Cytheretta* by Puri (1952, 1958b), and the largest measurement given for what appears to be a true representative of *C. subradiosa* is 0.794 mm (Puri, 1958b)—the larger specimens illustrated by Puri also have a different carapace shape and may not be conspecific with the smaller ones—and this is nearly 8 percent smaller than the lowest measurement I could find for a Neogene *Cytheretta.* Size, in general, is a poor taxonomic criterion to use in ostracodes, particularly at the generic level; and I do not advocate its use here. However, the fact that the specimens of Neogene *Cytheretta* described by Puri (1952) in general bear a closer resemblance to *Pseudocytheretta edwardsi* than to *Cytheretta subradiosa*, in addition to being approximately the same size, certainly calls for an investigation of the living species assigned to *Cytheretta* to see if strong first thoracic leg asymmetry is concomitant with larger size. It is known to hold for at least two species, *Pseudocytheretta edwardsi* and *Cytheretta tracyi.*

Stratigraphic range.—Eocene to Recent.

Cytheretta edwardsi (Cushman, 1906)

1906. *Pseudocytheretta edwardsi* Cushman, Boston Soc. Nat. History Proc., v. 32, p. 382, pl. 38, figs. 119–132.

1958. *Cytheretta edwardsi* (Cushman). Puri, Gulf Coast Assoc. Geol. Socs. Trans., v. 8, p. 187, pl. 2, figs. 6–11.

1963. Not *Cytheretta edwardsi* (Cushman). Swain, Jour. Paleontology, v. 37, no. 4, p. 832, pl. 95, fig. 11; pl. 99, figs. 13a–c; text figs. 9a, 13b.

Diagnosis.—Highest at posterior; surface essentially smooth except for small pits at normal pore canal exits.

Measurements.—Two adult made specimens measure 1.275 and 1.325 mm in length and 0.625 and 0.650 mm in height.

Discussion.—Puri (1958b) has described and illlustrated specimens of the species from samples taken at the original stations of Cushman (1906). Swain (1963) reports *Cytheretta edwardsi* from the Pleistocene of Alaska. However, his specimens have a very different carapace shape than *Cytheretta edwardsi*, being relatively much higher at the anterior. Swain's specimens probably represent a new species.

Material studied.—Two adult males and several juveniles (Recent), plus many adults and juveniles found in Pleistocene samples taken from the subsurface at Sandy Hook, N.J.

Occurrence.—Previously known from Vineyard Sound and Buzzards Bay. In the present study the species was found in a sample from off Lower New York Bay. Also known from subsurface Pleistocene deposits at Sandy Hook, N.J.

Repository.—USNM 112799.

Cytheretta tracyi Blake, 1929

1929. *Cytheretta tracyi* Blake, Biol. Survey Mount Desert region, pt. 3, p. 18, fig. 9.
1933. *Cytheretta tracyi Blake.* Blake, idem, pt. 5, p. 233.

Discussion.—Blake (1929) described this species from near Mount Desert Island, Maine. I have not found the species in my samples. Blake distinguishes *Cytheretta tracyi* from *C. edwardsi* by the more acute posterior cardinal angle and shallower "depression in the inner shell margin below the adductor muscle."

Subfamily Indeterminate
Genus Indeterminate

Cythereis phalaropi Cushman, 1906

1906. *Cythereis phalaropi* Cushman, Boston Soc. Nat. History Proc. v. 32, no. 10, p. 378, pl. 35, figs. 86–94; pl. 36, figs. 95, 96.

Discussion.—I have not been able to modernize the taxonomy of *Cythereis phalaropi* described by Cushman (1906). No specimens were found that I could refer to the species. The soft parts are well illustrated, but the illustrations of the carapace are minimal. The soft parts are trachyleberidid.

Occurrence.—Known only from Buzzards Bay.

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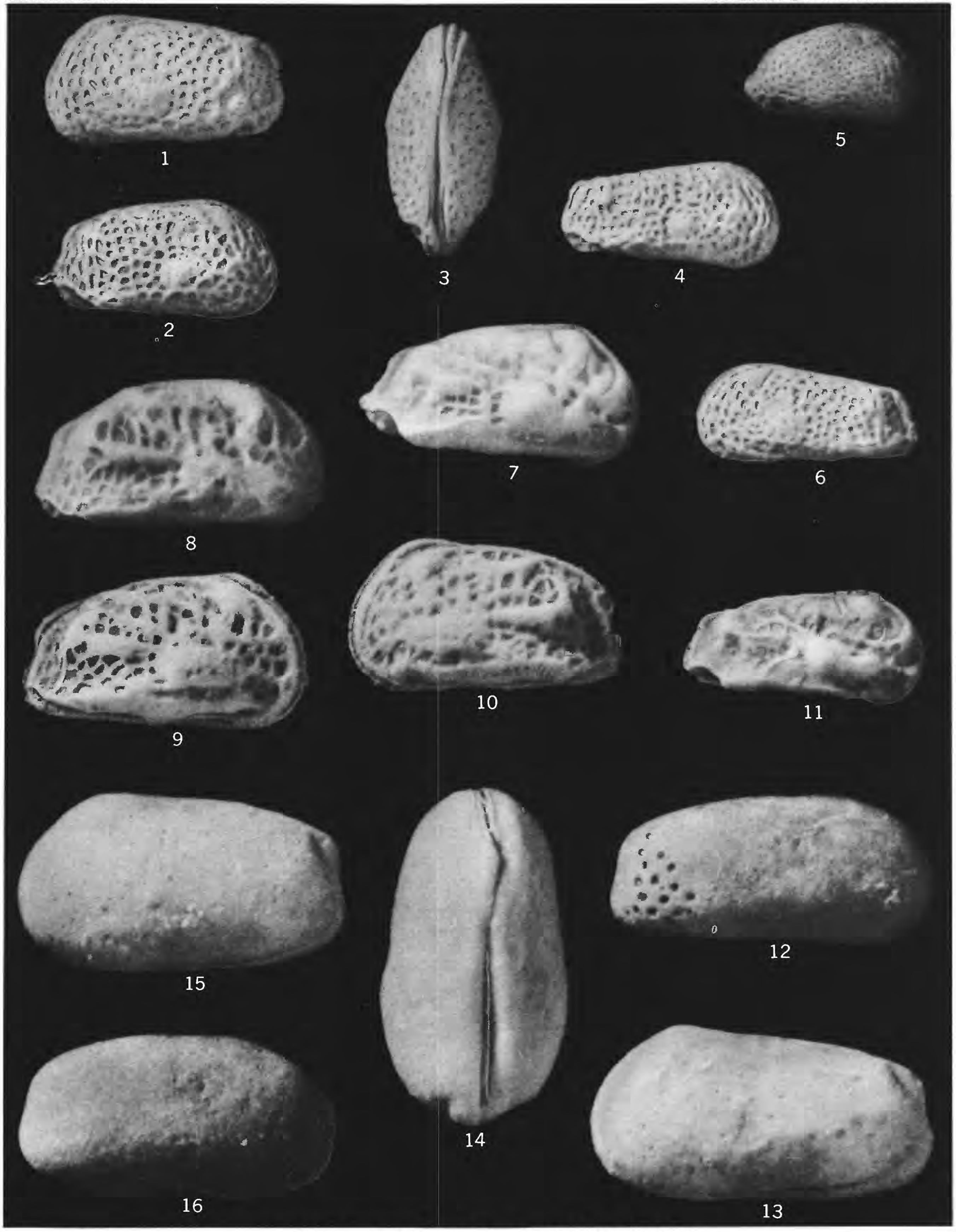

NEREINA, *AURILA*, AND *NORMANICYTHERE*

PLATE 2

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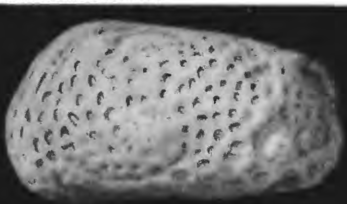
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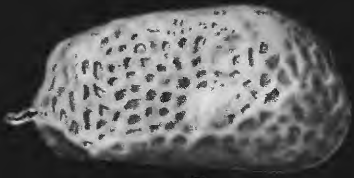
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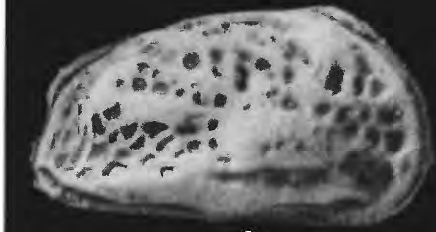
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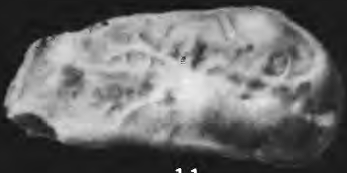
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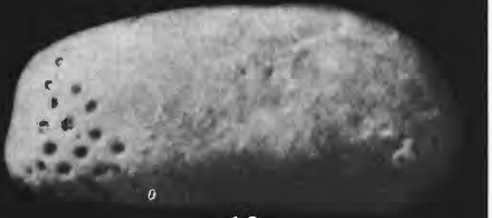
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NEREINA, *AURILA*, AND *NORMANICYTHERE*

PLATE 2

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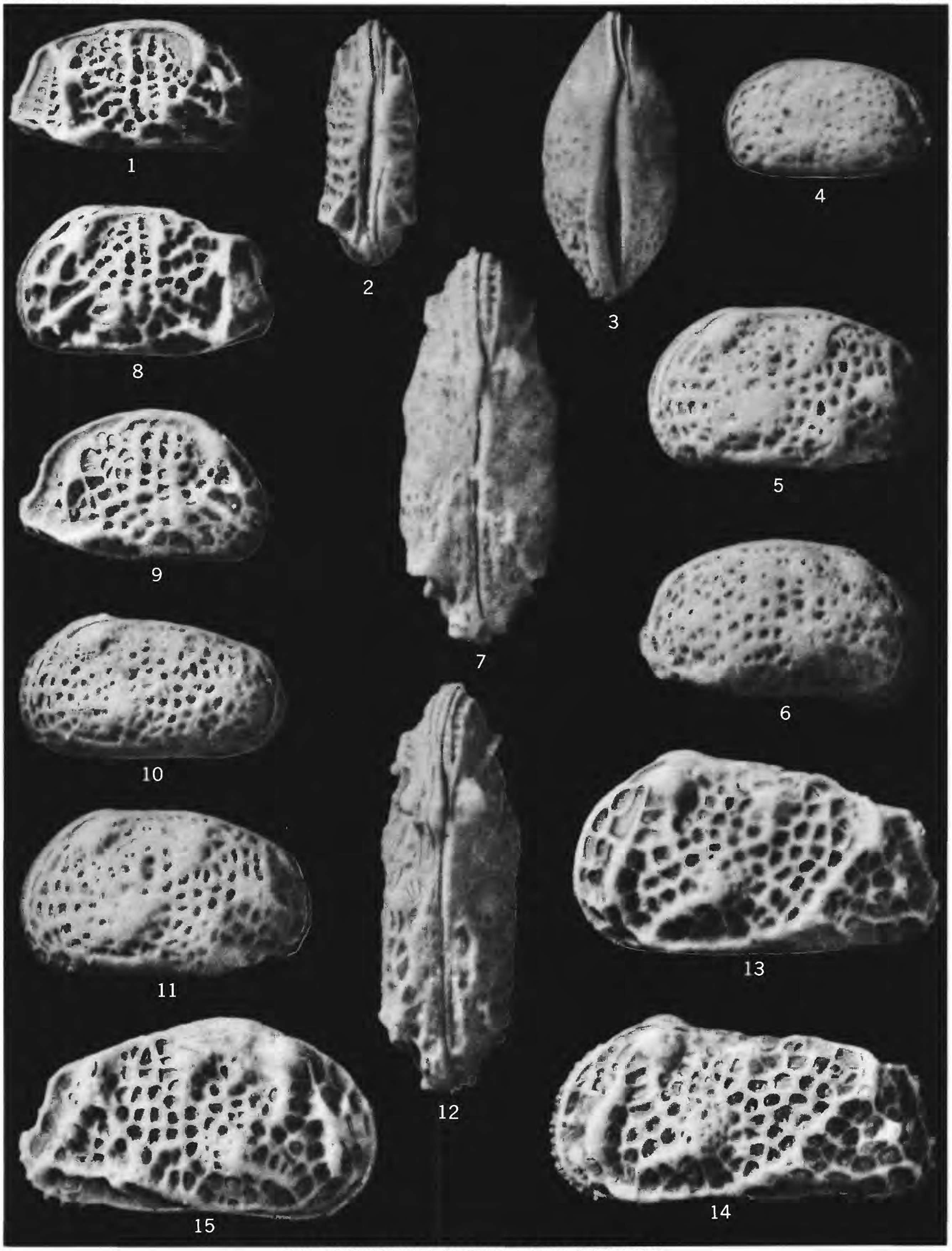

BAFFINICYTHERE AND *HEMICYTHERE*

PLATE 3

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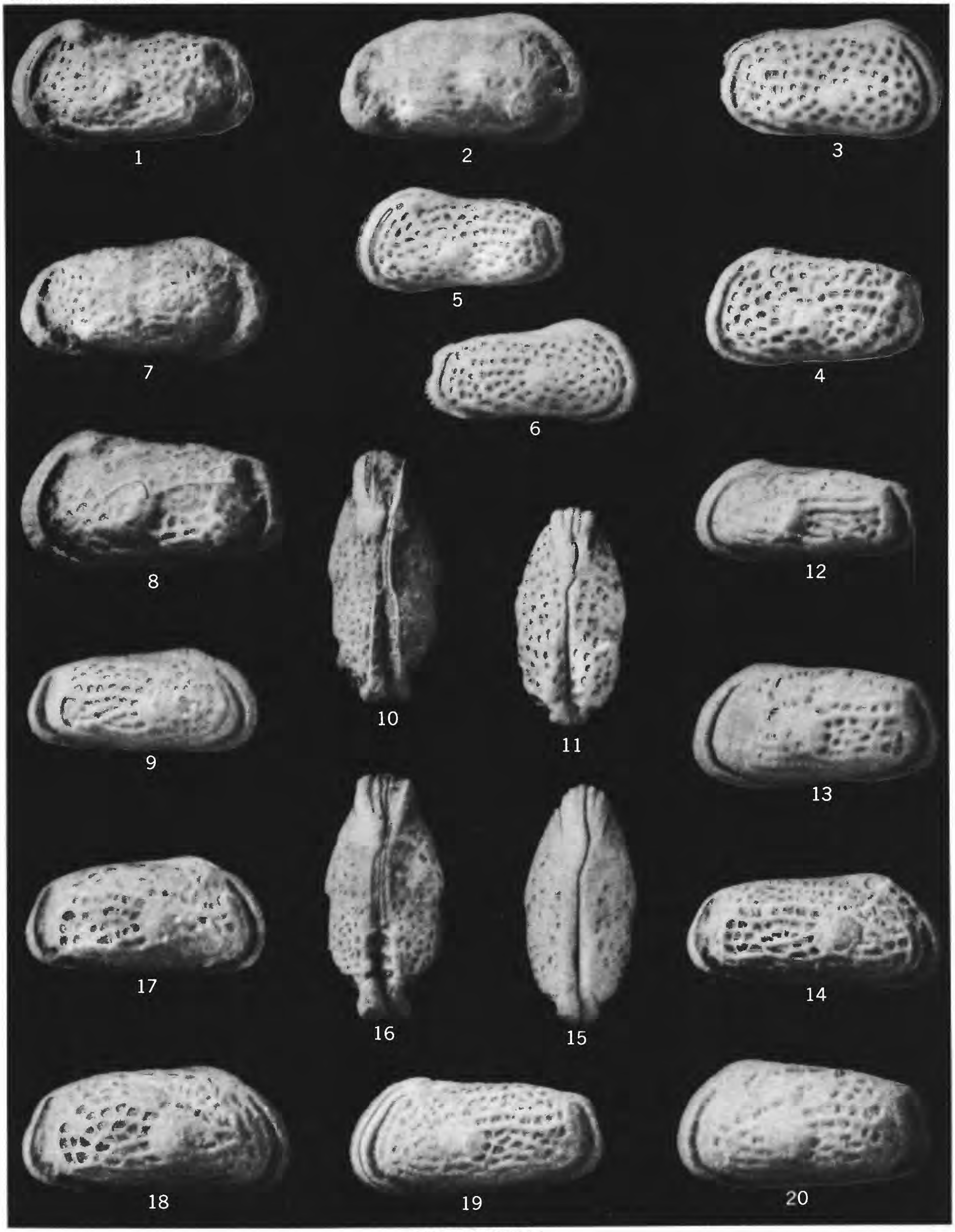

MUELLERINA

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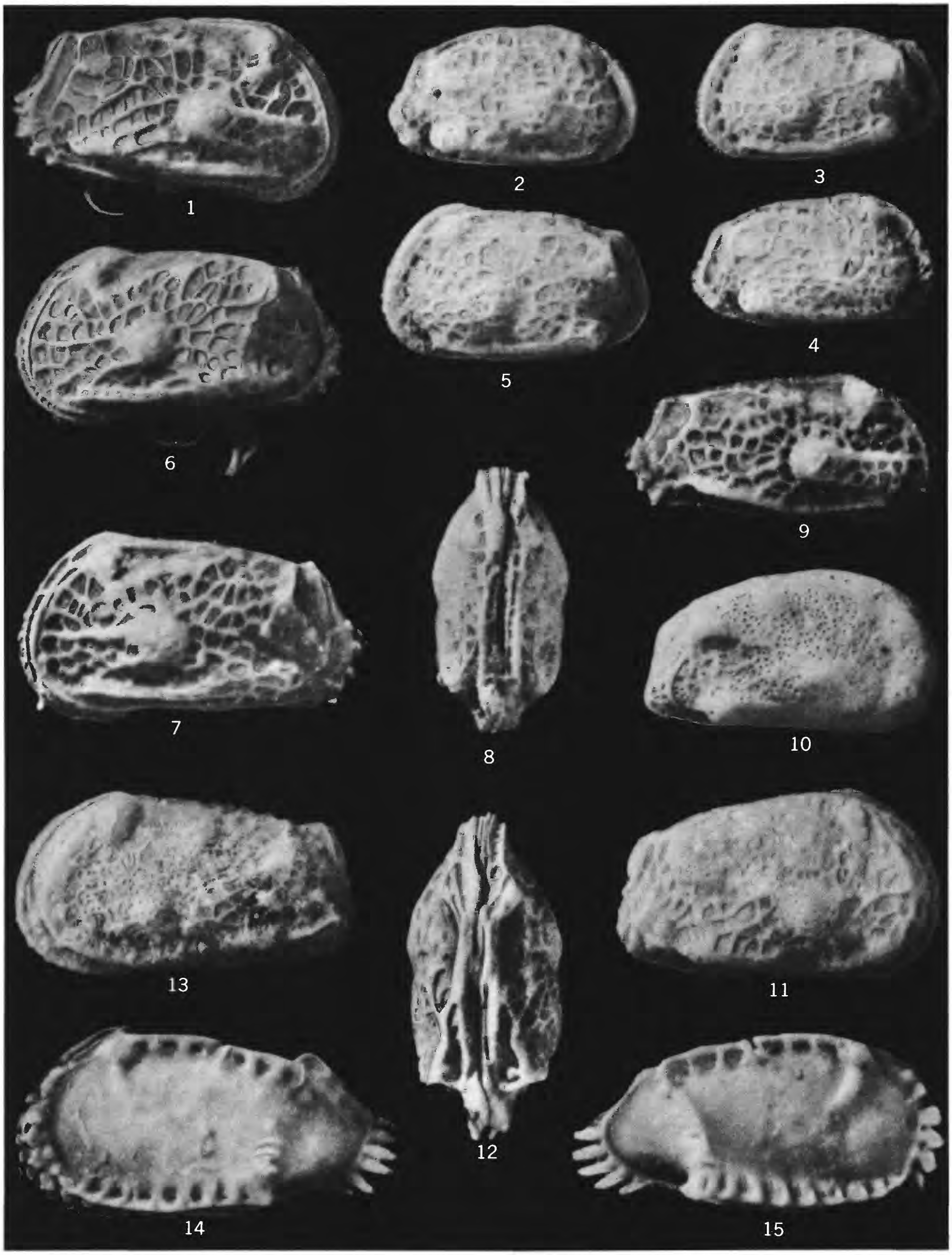

PATAGONACYTHERE, *THAEROCYTHERE*, *ELOFSONELLA*, AND *PTERYGOCYTHEREIS*

PLATE 5

[All figures × 60]

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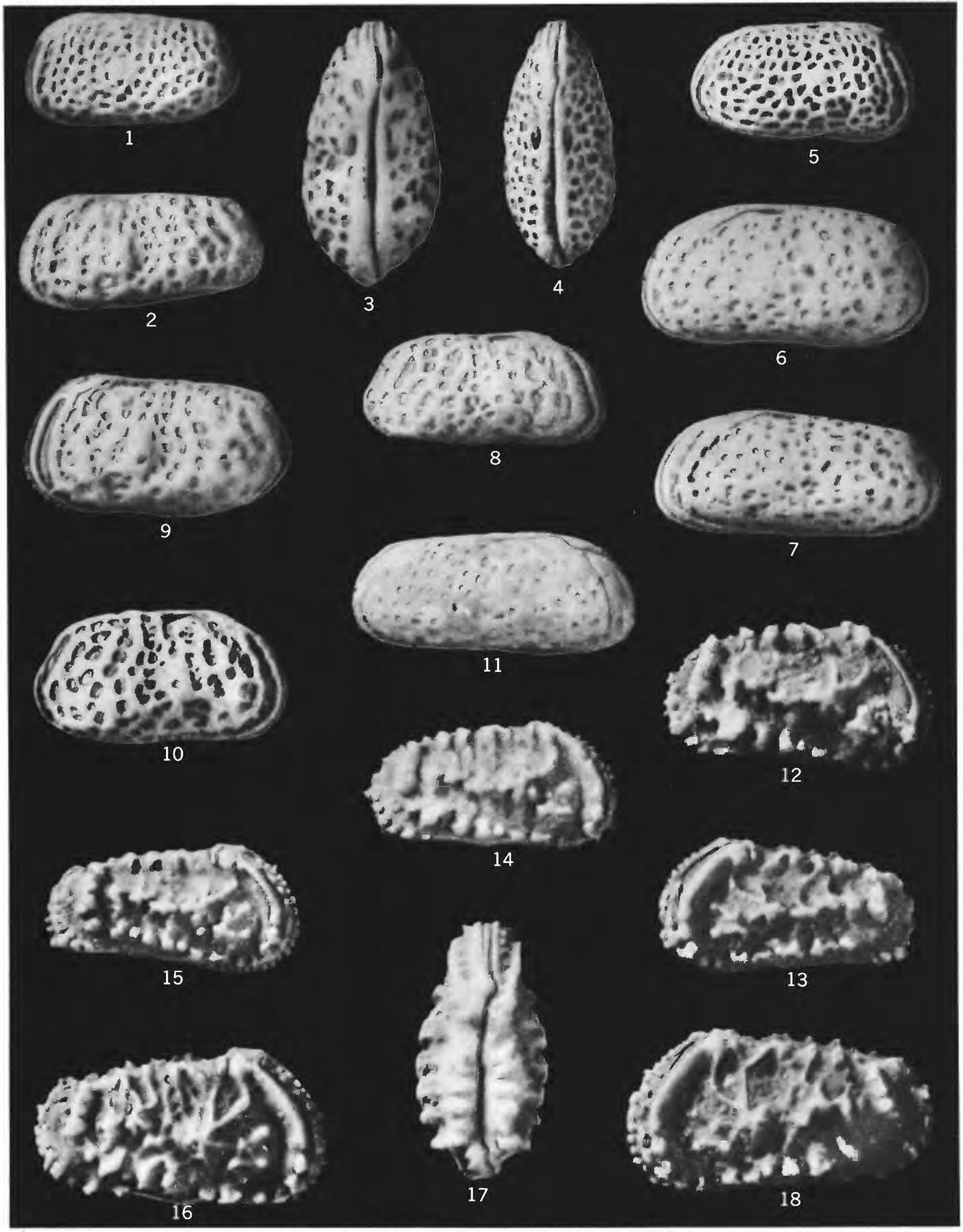
  18. Lateral view carapace, female. Sample 30. USNM 112785.



BENSONOCYTHERE AND *ACTINOCYTHEREIS*

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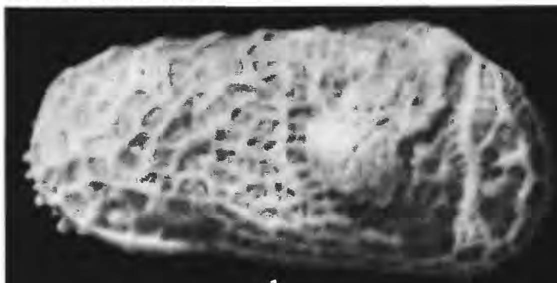
11. Lateral view left valve. Sample 35. USNM 112796.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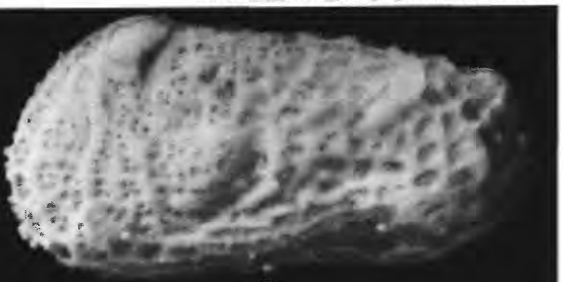
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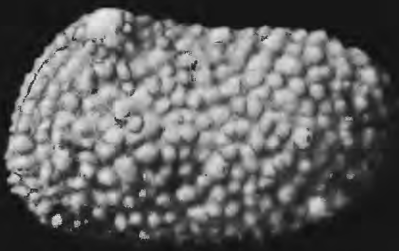
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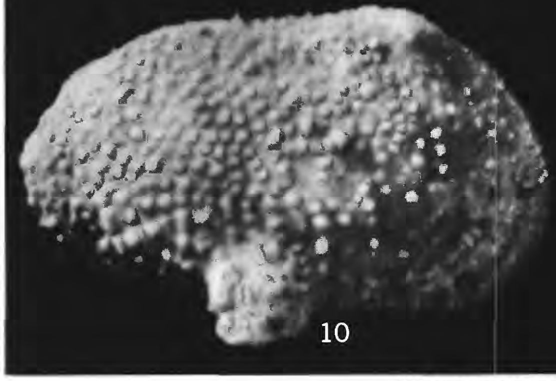
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ROBERTSONITES AND *ECHINOCYTHEREIS*

PLATE 7

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7. Antennule, female. Sample 42. USNM 112681. × 640.

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6. Interior of right valve, female. Sample 30. USNM 112685. × 115.
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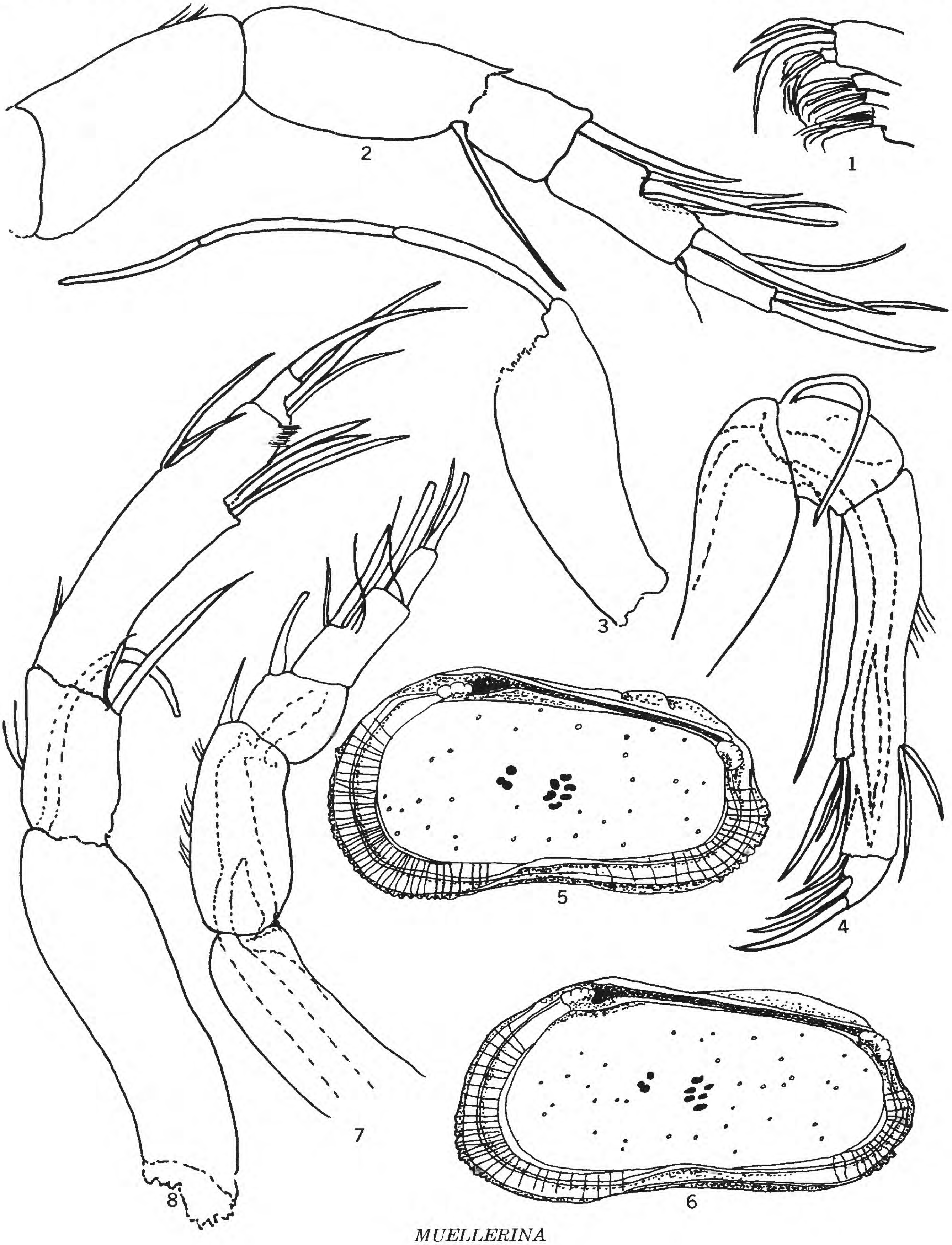

MUELLERINA

PLATE 8

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2. Exopodite of maxilla, female. Sample 17. USNM 112686. × 350.
3. Antenna, female. Sample 17. USNM 112686. × 270.
4. Second? thoracic leg, female. Sample 17. USNM 112686. × 300.
5. Cutting edge of mandible, female. Sample 17. USNM 112686. × 600.
6. Antennule, female. Sample 17. USNM 112686. × 240.
7. Knee of third thoracic leg, female, showing chitinous supports. Sample 17. USNM 112686. × 390.
8. Interior of right valve, female. Sample 31. USNM 112688. × 115.

BAFFINICYTHERE

PLATE 9

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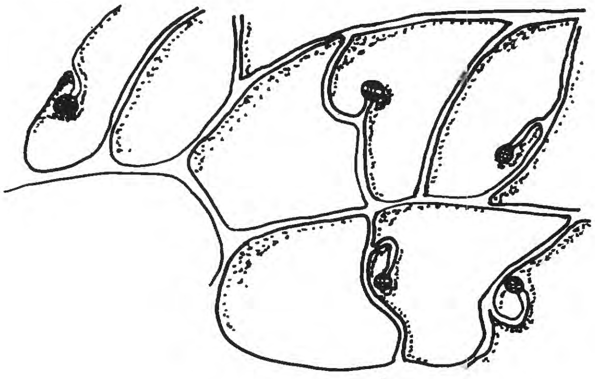
1. Detail of surface ornament, female. Sample 17. USNM 112689. × 440.
3. Antennule, female. Sample 17. USNM 112689. × 300.
5. Antenna, female. Sample 17. USNM 112689. × 390.
6. Interior of right valve, female. Sample 17. USNM 112690. ×115.

2. *Baffinicythere emarginata* (Sars, 1865) (p. 17).
Interior of right valve, female. Sample 31. USNM 112691. × 115.

4. *Thaerocythere crenulata* (Sars, 1865) (p. 25).
Interior of right valve, female. Sample 34. USNM 112692. × 115.



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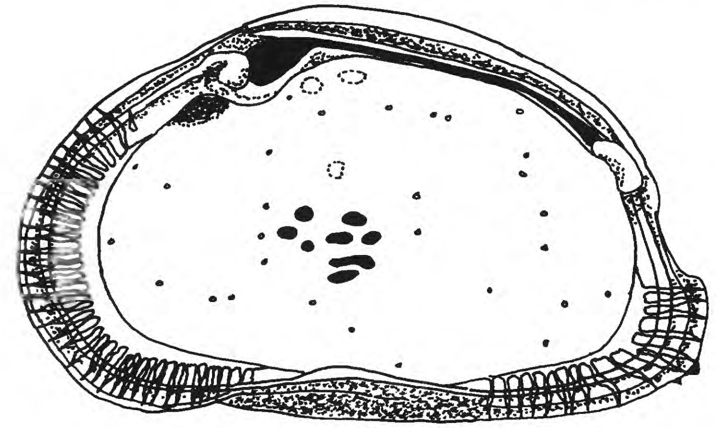

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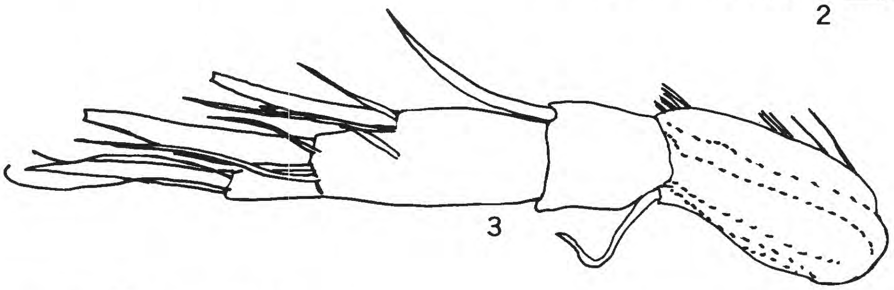

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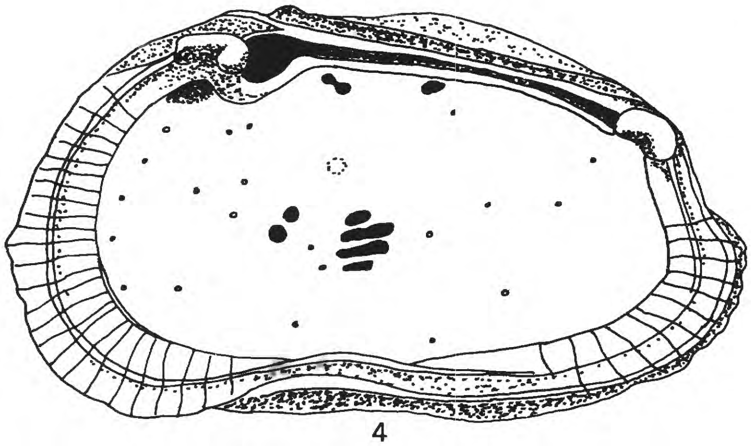

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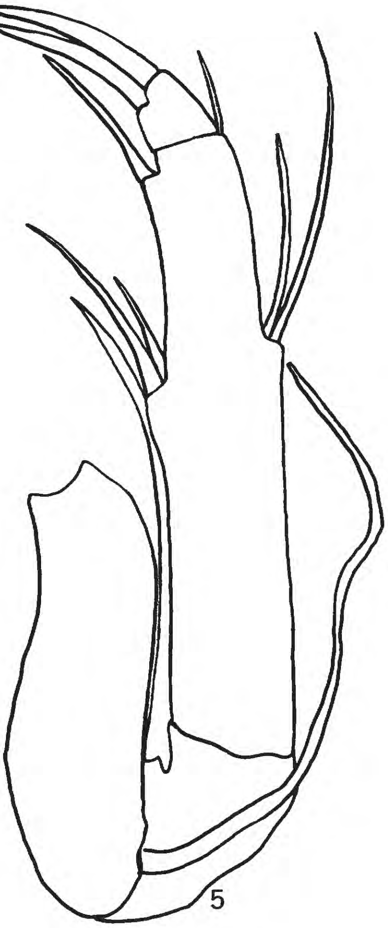

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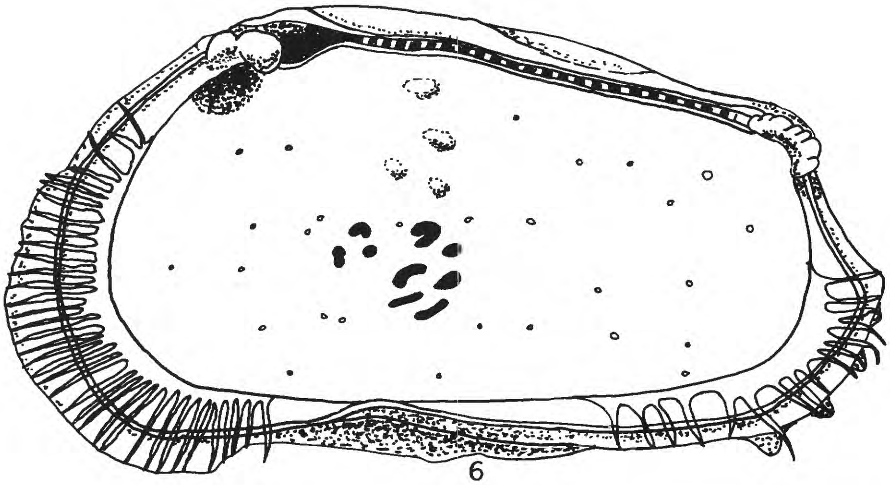

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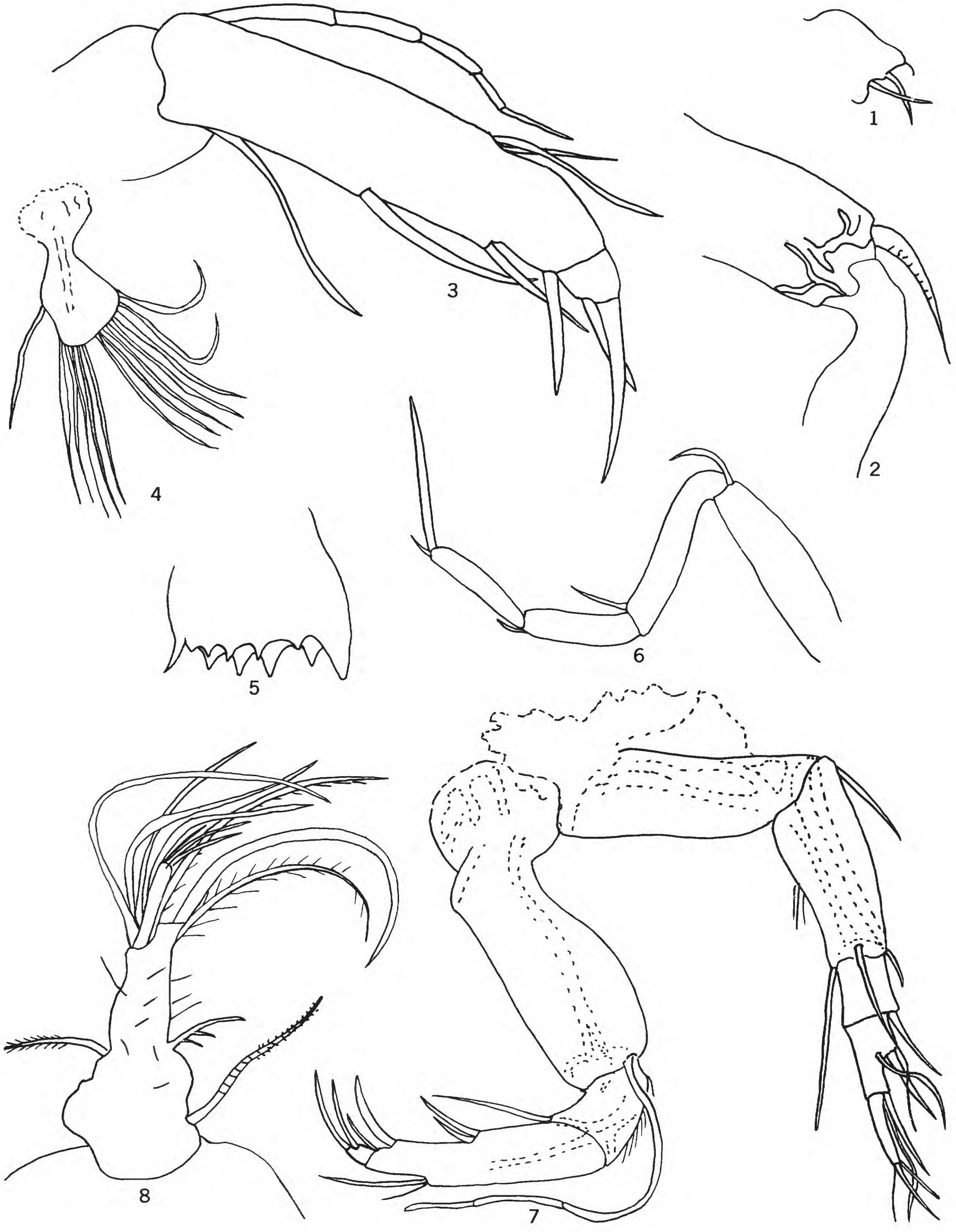
BAFFINICYTHERE, THAEROCYTHERE, AND PATAGONACYTHERE

PLATE 10

FIGURES 1–8. *Bensonocythere whitei* (Swain, 1951) (p. 27).

1. Furca, female. Sample 42. USNM 112693. × 250.
2. Knee of thoracic leg, female, showing chitinous supports. Sample 42. USNM 112693. × 400.
3. Antenna, male. Sample 42. USNM 112694. × 300.
4. Exopodite of maxilla, female. Sample 42. USNM 112693. × 170.
5. Cutting edge of mandible, male. Sample 42. USNM 122694. × 650.
6. Third thoracic leg, female. Sample 42. USNM 112693. × 250.
7. Antenule and antenna, female. Sample 42. USNM 112693. × 320.
8. Endopodite and exopodite of mandible, male. Sample 42. USNM 122694. × 300.



BENSONOCYTHERE

PLATE 11

FIGURES 1, 2. *Bensonocythere whitei* (Swain, 1951) (p. 27).

1. Antennal and adductor muscle scars (composited from more than one specimen). × 300.
2. Interior of right valve, female. Sample 42. USNM 112696. × 115.

3. *Bensonocythere americana* n. sp. (p. 28).
Interior of left valve, female. Sample 42. USNM 112697. × 115.

4. *Actinocythereis vineyardensis* (Cushman, 1906) (p. 33).
Interior of right valve, female. Sample 47. USNM 112698. × 115.

5, 8. *Nereina angulata* (Sars, 1868) (p. 19).

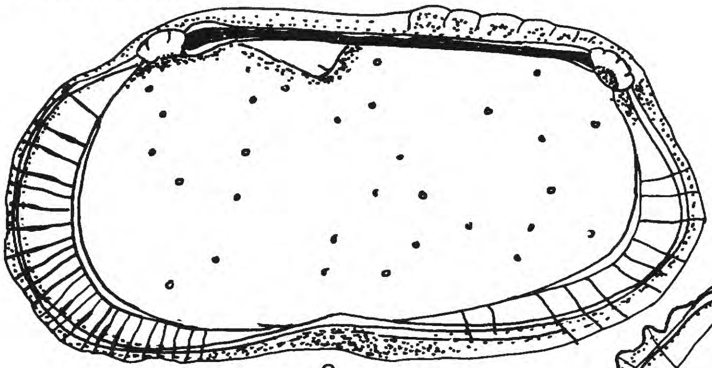
5. Interior of left valve, female. Sample 8. USNM 112699. × 115.
8. Antennal and adductor muscle scars (composited from more than one specimen). × 300.

6. *Actinocythereis dawsoni* (Brady, 1870) (p. 1870) (p. 32).
Interior of right valve, male. Sample 30. USNM 112700. × 115.

7. *Nereina finmarchica* (Sars, 1865) (p. 18).
Interior of left valve, female. Sample 42. USNM 112701. × 115.

9. *Bensonocythere arenicola* (Cushman, 1906) (p. 29).
Interior of right valve, female (note body muscles attached to dorsal muscle platform). Sample 40. USNM 112702.

1



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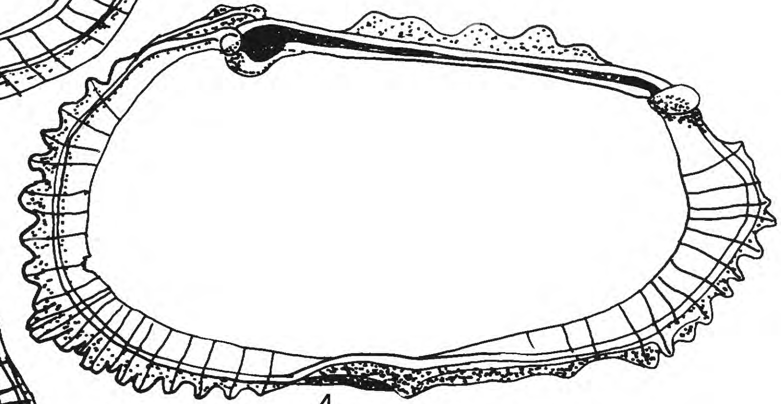

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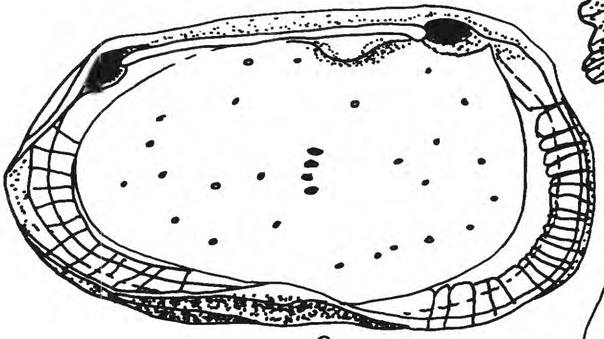

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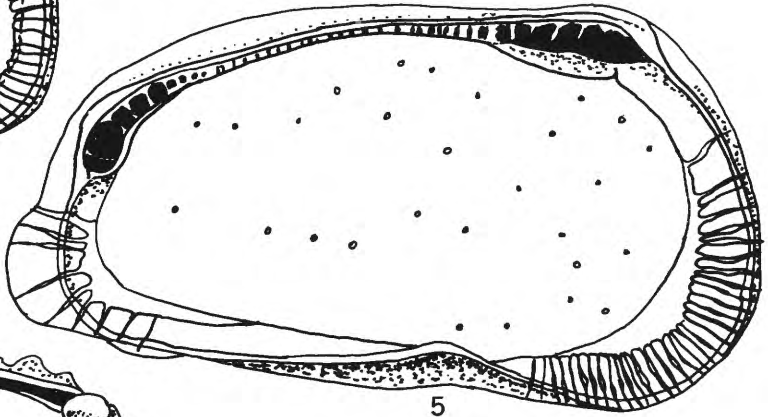

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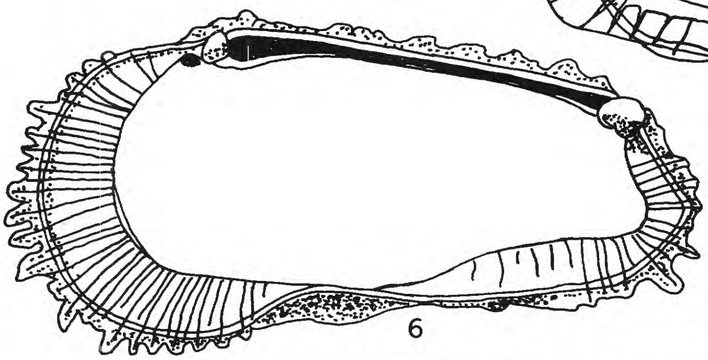

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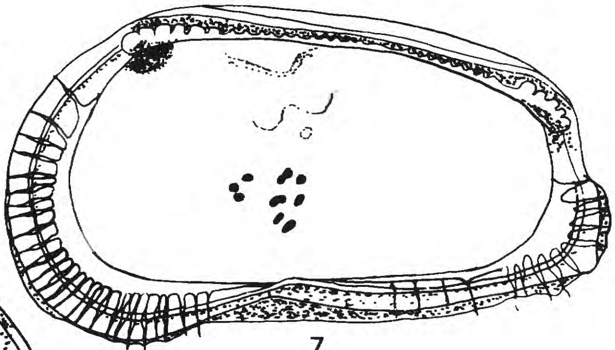

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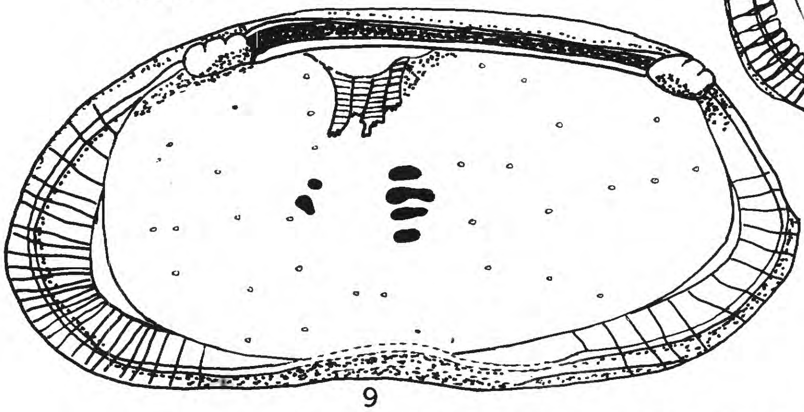

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BENSONOCYTHERE, ACTINOCYTHEREIS, AND *NEREINA*