Systematic Paleontology of Quaternary Ostracode Assemblages from the Gulf of Alaska, Part 1: Families Cytherellidae, Bairdiidae, Cytheridae, Leptocytheridae, Limnocytheridae, Eucytheridae, Krithidae, Cushmanideidae

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Systematic Paleontology of Quaternary Ostracode Assemblages from the Gulf of Alaska, Part 1: Families Cytherellidae, Bairdiidae, Cytheridae, Leptocytheridae, Limnocytheridae, Eucytheridae, Krithidae, Cushmanideidae

By ELISABETH M. BROUWERS

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CONTENTS

	Page
Abstract	1
Introduction	1
Study area	2
Depth zones	2
Systematic paleontology	3
Cytherella sp. A.	3
Neonesidea sitkagi n. sp.	3
Cythere valentinei	12
Cythere alveolivalva	13
Cytheromorpha eskerensis n. sp.	13
Cytheromorpha sp. C.	15
Cytheromorpha grandwashensis n. sp.	15
Cytheromorpha knikensis	16
Cytheromorpha molniai n. sp.	17
Schizocythere sp. A	18
Palmenella limicola	19
Acuminocythere crescentensis	20
Munseyella melzeri n. sp.	22
Munseyella ristveti n. sp.	22
Systematic paleontology—Continued	
Pectocythere sp. G	24
Pectocythere sp. A	24
Pectocythere janae n. sp.	24
Pectocythere kiklukhensis n. sp.	25
Pectocythere marincovichi n. sp.	26
Pectocythere parkerae	27
Pectocythere tsiuensis n. sp.	29
Cluthia cluthae	30
Cluthia foresteri n. sp.	31
Limnocythere friabilis	33
Limnocythere inopinata	33
Limnocythere itasca	33
Limnocythere staplini	33
Eucythere argus	34
Krithe burkholderi n. sp.	35
Krithe adelspergi n. sp.	36
Pontocythere dahlgrenensis n. sp.	37
Pontocythere jefferiesensis n. sp.	39
Acknowledgments	40
References cited	40

ILLUSTRATIONS

[Plates follow references cited]

		Page
PLATES 1–13.	Quaternary ostracodes from the Gulf of Alaska.	
FIGURE 1.	Map showing region studied in the Gulf of Alaska	2
2.	Map showing sample localities in the Gulf of Alaska	3
3–39.	Plots of:	
3.	Length versus height for *Neonesidea sitkagi* n. sp.	6
4.	Length versus height for *Cythere valentinei* Tsukagoshi and Ikeya, 1987	12
5.	Abundance versus water depth for *Cythere valentinei* Tsukagochi and Ikeya, 1987	12
6.	Length versus height for *Cythere alveolivalva* Smith, 1952	13
7.	Abundance versus water depth for *Cythere alveolivalva* Smith, 1952	13
8.	Length versus height for *Cytheromorpha eskerensis* n. sp.	14
9.	Length versus height for *Cytheromorpha grandwashensis* n. sp.	16
10.	Abundance versus water depth for *Cytheromorpha grandwashensis* n. sp.	16
11.	Length versus height for *Cytheromorpha knikensis* Forester and Brouwers, 1985	17
12.	Abundance versus water depth for *Cytheromorpha knikensis* Forester and Brouwers, 1985	17
13.	Length versus height for *Cytheromorpha molniai* n. sp.	18
14.	Abundance versus water depth for *Cytheromorpha molniai* n. sp.	18
15.	Length versus height for *Palmenella limicola* (Norman, 1865)	19

16. Abundance versus water depth for *Palmenella limicola* (Norman, 1865) 20
17. Length versus height for *Acuminocythere crescentensis* Swain and Gilby, 1974 21
18. Length versus height for *Munseyella melzeri* n. sp. 22
19. Abundance versus water depth for *Munseyella melzeri* n. sp. 23
20. Length versus height for *Munseyella ristveti* n. sp. 23
21. Length versus height for *Pectocythere janae* n. sp. 25
22. Abundance versus water depth for *Pectocythere janae* n. sp. 25
23. Length versus height for *Pectocythere kiklukhensis* n. sp. 26
24. Length versus height for *Pectocythere marincovichi* n. sp. 27
25. Length versus height for *Pectocythere parkerae* Swain and Gilby, 1974 28
26. Abundance versus water depth for *Pectocythere parkerae* Swain and Gilby, 1974 28
27. Length versus height for *Pectocythere tsiuensis* n. sp. 29
28. Abundance versus water depth for *Pectocythere tsiuensis* n. sp. 30
29. Length versus height for *Cluthia cluthae* (Brady, Crosskey, and Robertson, 1874) 31
30. Length versus height for *Cluthia foresteri* n. sp. 32
31. Abundance versus water depth for *Cluthia foresteri* n. sp. 32
32. Length versus height for *Eucythere argus* (Sars, 1866) 34
33. Abundance versus water depth for *Eucythere argus* (Sars, 1866) 35
34. Length versus height for *Krithe burkholderi* n. sp. 35
35. Length versus height for *Krithe adelspergi* n. sp. 36
36. Abundance versus water depth for *Krithe adelspergi* n. sp. 37
37. Length versus height for *Pontocythere dahlgrenensis* n. sp. 38
38. Abundance versus water depth for *Pontocythere dahlgrenensis* n. sp. 38
39. Length versus height for *Pontocythere jefferiesensis* n. sp. 39

TABLES

Page

TABLE 1. Latitude, longitude, and water depth of samples considered in this report 4
2. Occurrence of the thirty-two ostracode species in the 220 bottom-grab samples collected during three cruises in the Gulf of Alaska 7

METRIC CONVERSION FACTORS

For readers who wish to convert measurements from the metric system of units to U.S. customary units, the conversion factors are listed below.

SI unit	Multiply by	U.S. customary unit
micrometer	3.937×10^{-5}	inch
millimeter (mm)	3.937×10^{-2}	inch
meter (m)	3.281×10^{0}	foot
gram (g)	3.5×10^{-2}	ounce
kilogram (kg)	2.205×10^{0}	pound

SYSTEMATIC PALEONTOLOGY OF QUATERNARY OSTRACODE ASSEMBLAGES FROM THE GULF OF ALASKA, PART 1: FAMILIES CYTHERELLIDAE, BAIRDIIDAE, CYTHERIDAE, LEPTOCYTHERIDAE, LIMNOCYTHERIDAE, EUCYTHERIDAE, KRITHIDAE, CUSHMANIDEIDAE

By ELISABETH M. BROUWERS

ABSTRACT

Thirty-two species of podocopid ostracodes are reported from Quaternary sediments of the Gulf of Alaska continental shelf. Fifteen new species are described (*Neonesidea sitkagi, Cytheromorpha eskerensis, C. grandwashensis, C. molniai, Munseyella melzeri, M. ristveti, Pectocythere janae, P. kiklukhensis, P. marincovichi, P. tsiuensis, Cluthia foresteri, Krithe burkholderi, K. adelspergi, Pontocythere dahlgrenensis, P. jefferiesensis*), twelve previously described species are illustrated, and five species are placed in open nomenclature.

INTRODUCTION

The Gulf of Alaska is an important tectonic and climatic transition region in the North Pacific Basin. Tectonically, the Pacific and North American plates converge along the Gulf of Alaska, where the Pacific oceanic plate is being subducted under the North American continental plate. Plate interaction shifts from dextral strike-slip faulting along southeast Alaska to thrust faulting along the Aleutian Islands, and the Gulf of Alaska forms a poorly understood tectonic transition zone (Lahr and Plafker, 1980; Perez and Jacob, 1980). Effects of the resultant plate deformation can be traced across the continental shelf and slope of the Gulf and include such offshore features as shallow and deep fault zones, linear fold belts, and structural highs (Plafker, 1967; Bruns and Plafker, 1976; Carlson and Molnia, 1977). The offshore structural deformation directly affects faunal composition in two ways: (1) The "normal" bathymetric trend of gradually increasing water depths and correlative depth assemblages proceeding from onshore to offshore is altered by structural highs (submarine banks and island platforms) and lows (sea valleys): and (2) fossil sediments of the lower Miocene to Holocene Yakataga Formation and of upper Pleistocene glaciomarine units are exposed, which results in a thanatocoenosis that consists of mixed fossil and modern species.

The Gulf of Alaska forms a large part of the cold-temperate Aleutian Zoogeographic Province, which has its northern boundary at the Aleutian Islands and its southern boundary at about lat 53° N. The combination of latitudinal position, coastal morphology, and ocean currents of the Gulf result in a relatively warm maritime climate. The Gulf of Alaska is a climatic transition zone between the mild- and warm-temperate provinces of the North Pacific and the subfrigid and frigid provinces of the Bering Sea and Arctic Ocean.

The faunal composition in the Gulf of Alaska is a product of the complex climatic and tectonic history during the late Neogene, which has included (1) latitudinally shifting climatic zones and faunal migrations in response to major glacial advances; (2) species dispersal along isotherms; and (3) local massive habitat changes in water temperature, salinity, sediment supply, and nutrients related to both tectonic and climatic events.

The modern ostracode fauna of the Gulf is poorly known. Understanding the living taxa is important because the modern microfauna is the standard of comparison for the Neogene sediments. The objective of

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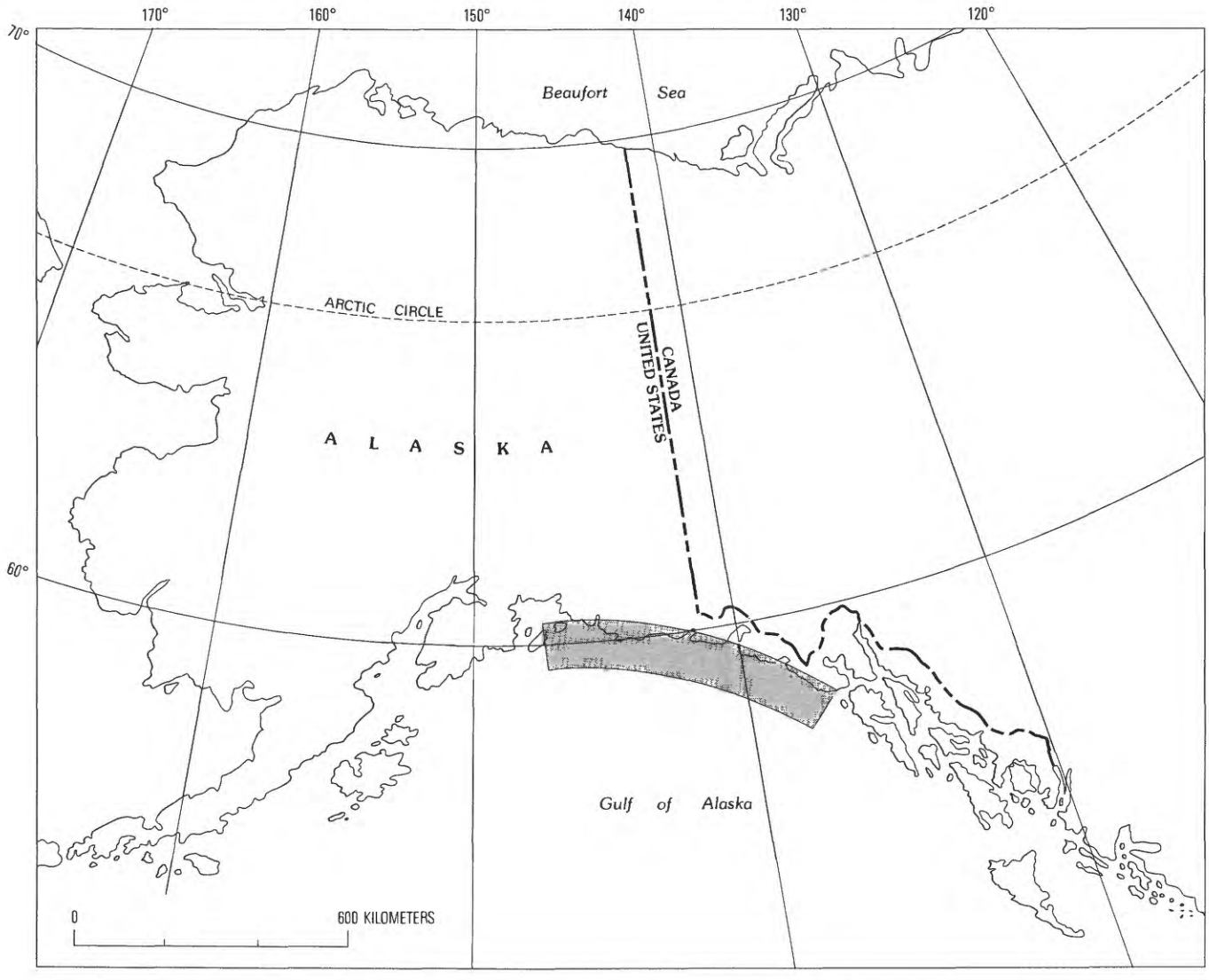

FIGURE 1.—Map showing region (shaded) studied in the Gulf of Alaska.

this study is to document the distribution and relative abundance of the ostracode species representing eight families that occur in sediments of the Gulf.

STUDY AREA

This report is based on 220 bottom-grab samples collected during three cruises (EGAL–75–KC, DC1–79–EG, DC2–80–EG) to the northeast Gulf of Alaska (figs. 1, 2; table 1). Most of the samples are from the continental shelf and were taken in water depths ranging from 20 m to 311 m. The Van Veen sampler that was used took a large volume of bottom sediment, which provided large residues for examination. Micropaleontological subsamples ranged from 200 g to 1 kg (wet weight), depending on the size of the initial sample. Samples were washed on a 200-mesh sieve (75 micrometers) and examined down to and including material from the 80-mesh sieve (180 micrometers). All adult and juvenile specimens have been identified to species and have been counted (Brouwers, 1981, 1982a, b, 1983). Table 2 shows the occurrence of species in the sample.

DEPTH ZONES

Brouwers (1988) recognized five ostracode assemblages in the Gulf of Alaska on the basis of taxonomic composition. Each assemblage is characterized by a unique combination of species diversity, abundance, dominant taxa, representative species, equitability distribution of taxa, percentage of living individuals, and abundance and composition of associated fauna and flora.

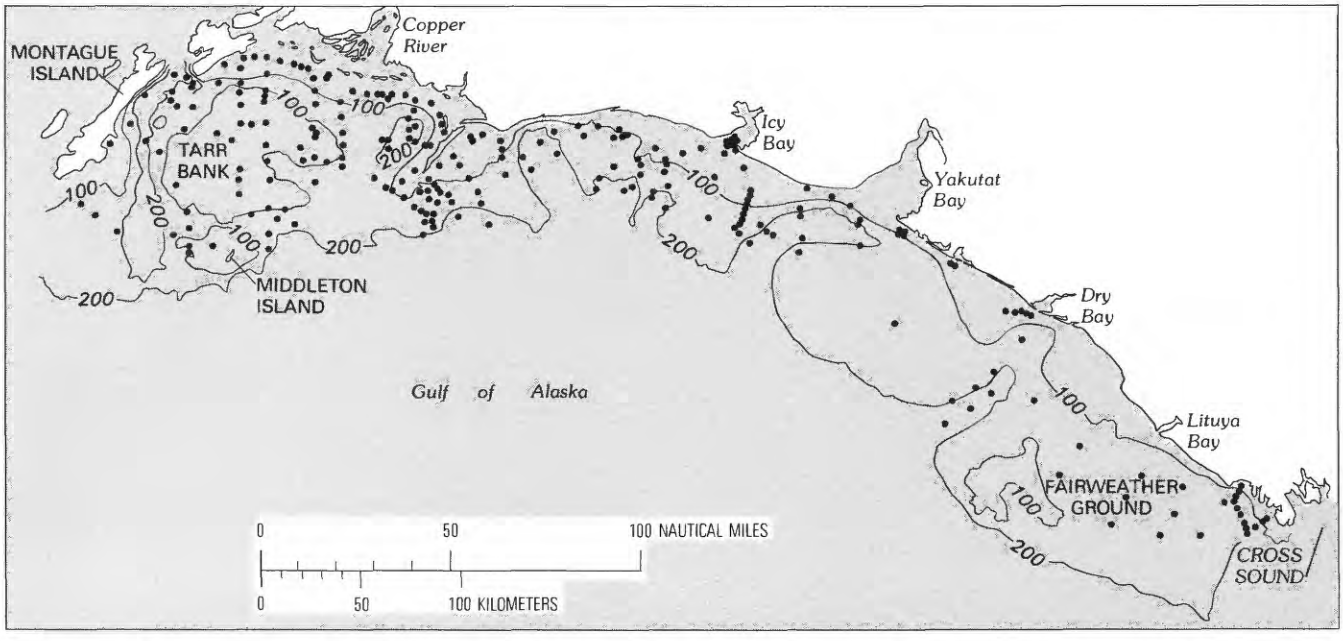

FIGURE 2.—Map showing sample localities in the Gulf of Alaska. Dots, sample localities. Bathymetric contours in meters.

Four assemblages represent Holocene depth biofacies; one assemblage consists of fossil specimens and does not correspond to a modern habitat or depth zone. Assemblage I occurs in the inner sublittoral zone (from shoreline to about 50 m). Assemblage II occurs in the middle sublittoral zone (from about 50 m to 100 m). Assemblage III occurs in the outer sublittoral zone (from about 100 m to 200 m). Assemblage IV occurs in the upper bathyal zone (from about 200 m to 350 m). Assemblage V does not correspond to a modern habitat or depth zone; it consists of taxa that occur only as fossils. The occurrence of each species described in this report is tabulated in terms of these five assemblages.

SYSTEMATIC PALEONTOLOGY

All illustrated specimens were deposited in the U.S. National Museum of Natural History (USNM). Note that one carapace is counted as two valves. An asterisk (*) next to the assemblage type (in the occurrence section of each species) indicates that some of the specimens in the depth assemblage contain soft parts.

Class OSTRACODA Latreille, 1806
Order PODOCOPIDA G.W. Mueller, 1894
Suborder PLATYCOPA Sars, 1866
Family CYTHERELLIDAE Sars, 1866
Genus CYTHERELLA Jones, 1849

Type species.—*Cytherina ovata* Roemer, 1840. (Type by subsequent designation.)

Cytherella sp. A

Plate 1, figure 1

Cytherella sp. A Brouwers, 1982b, p. 45; Brouwers, 1983.

Distribution.—Pleistocene: Gulf of Alaska. Sample EGAL–75–KC–130 is from submarine outcrops of the Yakataga Formation adjacent to Kanak and Wingham Islands. The *Cytherella* specimen is believed to have weathered out and been transported by the prevailing west-flowing longshore current.

Material.—One juvenile valve.

Illustrated specimen.—USNM 408110, left valve (pl. 1, fig. 1), locality EGAL–75–KC–130, length 0.55 mm, height 0.30 mm.

Suborder PODOCOPA Sars, 1866
Superfamily BAIRDIACEA Sars, 1866
Family BAIRDIIDAE Sars, 1888
Subfamily BAIRDIINAE Sars, 1888
Genus NEONESIDEA Maddocks, 1969

Type species.—*Triebelina schulzi* Hartmann, 1962. (Type by subsequent designation.)

Neonesidea sitkagi n. sp.

Plate 1, figure 2; plate 2, figure 1

Bairdia sp. A Brouwers, 1981, p. 8; Brouwers, 1982a, p. 66; Brouwers, 1982b, p. 8; Brouwers, 1983.

TABLE 1.—*Latitude, longitude, and water depth of samples considered in this report*

Sample No.	Latitude (°N)	Longitude (°W)	Water depth (meters)
Cruise EGAL–75–KC			
4	59° 39.3′	147° 40.1′	unknown
6	59° 32.3′	147° 21.1′	143
11	59° 55.9′	147° 25.4′	49
16	59° 45.2′	146° 49.4′	91
17	59° 38.1′	146° 43.5′	97
18	59° 33.5′	146° 32.4′	113
20	59° 28.5′	146° 41.8′	88
22	59° 27.2′	146° 41.1′	106
24	60° 01.2′	147° 15.0′	143
26	59° 56.6′	147° 06.1′	205
32	59° 28.7′	146° 29.1′	53
39	59° 28.0′	145° 59.7′	148
41	60° 09.1′	147° 07.2′	212
46	60° 00.0′	146° 45.5′	126
52A	59° 59.0′	146° 27.5′	71
53	60° 07.7′	146° 52.8′	156
54	60° 06.1′	146° 49.4′	112
55	60° 14.5′	146° 50.6′	220
58	60° 13.8′	146° 44.3′	221
59B	60° 11.8′	146° 41.5′	183
63B	60° 01.8′	146° 14.6′	64
66	59° 46.6′	146° 15.9′	75
68A	59° 42.6′	146° 15.0′	81
69	60° 16.6′	146° 14.6′	49
70	60° 12.6′	146° 15.3′	108
71	60° 10.1′	146° 15.0′	84
72	60° 15.3′	146° 00.8′	90
73	60° 10.5′	146° 01.4′	95
74	60° 09.2′	146° 01.5′	90
75	60° 07.4′	146° 02.3′	84
76	60° 02.0′	146° 00.5′	77
77	59° 56.0′	146° 01.5′	86
78	59° 51.6′	146° 00.9′	101
80	59° 46.7′	145° 59.5′	91
83	59° 39.0′	145° 59.5′	91
84	59° 32.2′	145° 59.5′	157
86	60° 14.0′	145° 34.5′	48
87	60° 06.9′	145° 34.4′	126
88	59° 59.2′	145° 34.0′	88
89	59° 58.5′	145° 34.2′	84
90	59° 52.6′	145° 34.5′	88
91	59° 50.5′	145° 39.6′	97
92	59° 45.9′	145° 34.5′	119
94	60° 07.7′	145° 21.0′	97
95	60° 03.3′	145° 19.8′	132
96	59° 59.2′	145° 19.3′	119
97	59° 55.7′	145° 19.5′	101
98	59° 52.5′	145° 19.8′	101
99	59° 50.4′	145° 20.6′	110
103	60° 09.4′	144° 58.2′	35
104	60° 08.1′	144° 54.9′	53
105	59° 57.1′	144° 55.4′	183
106	59° 57.0′	144° 57.4′	192

TABLE 1.—*Latitude, longitude, and water depth of samples considered in this report*—Continued

Sample No.	Latitude (°N)	Longitude (°W)	Water depth (meters)
Cruise EGAL–75–KC—Continued			
107	59° 46.5′	145° 03.2′	185
108	59° 44.2′	144° 56.2′	192
109	59° 43.4′	144° 52.7′	102
110	59° 41.5′	144° 47.2′	97
111	59° 38.9′	144° 41.0′	148
112	59° 37.6′	144° 37.0′	145
113	59° 34.9′	144° 30.0′	139
115	59° 46.0′	144° 47.7′	64
117	59° 43.0′	144° 38.1′	119
118	59° 40.7′	144° 33.3′	137
120	59° 48.8′	144° 41.0′	66
122A	59° 55.6′	144° 31.4′	55
123	59° 56.7′	144° 40.2′	210
124A	59° 57.5′	144° 43.2′	234
127	60° 02.8′	144° 43.5′	210
128	60° 00.6′	144° 40.0′	227
129	60° 04.9′	144° 40.4′	146
130	60° 07.8′	144° 39.5′	31
132	60° 07.1′	144° 31.2′	20
134	59° 59.0′	144° 24.0′	20
138	59° 38.2′	145° 50.4′	168
141	60° 06.8′	146° 14.5′	71
144U	59° 57.3′	146° 19.6′	64
145	59° 37.4′	146° 09.0′	101
146	59° 35.6′	145° 54.8′	143
147	59° 34.2′	145° 45.7′	165
149	60° 03.2′	145° 34.5′	104
150	60° 10.4′	145° 34.5′	104
153	60° 12.5′	146° 27.0′	137
154	59° 51.4′	145° 28.5′	95
155	59° 55.2′	145° 42.0′	82
157	60° 01.4′	146° 08.5′	73
158	60° 06.0′	146° 40.5′	117
159	60° 10.2′	146° 52.1′	165
161	60° 17.4′	146° 23.7′	22
162	60° 19.2′	146° 13.2′	24
164B	60° 19.5′	146° 00.0′	22
165	60° 18.3′	145° 53.5′	33
166	60° 17.7′	145° 45.6′	20
170A	60° 16.9′	145° 42.0′	20
170B	60° 16.9′	145° 42.0′	20
174	60° 09.6′	145° 06.4′	35
175	60° 09.4′	145° 00.0′	33
176	60° 10.0′	144° 48.0′	31
179A	60° 14.8′	145° 27.1′	18
180	60° 09.1′	144° 44.7′	26
181	60° 01.0′	144° 24.0′	33
183	59° 55.5′	144° 34.6′	91
184	59° 54.8′	144° 54.6′	188
202	59° 31.4′	144° 36.6′	187
205	59° 37.0′	144° 35.3′	145
209	59° 35.1′	144° 31.7′	139
210	59° 36.9′	144° 30.5′	146

TABLE 1.—*Latitude, longitude, and water depth of samples considered in this report*—Continued

Sample No.	Latitude (°N)	Longitude (°W)	Water depth (meters)
Cruise EGAL–75–KC—Continued			
211	59° 40.1′	144° 28.4′	146
212	59° 46.4′	144° 33.1′	91
213	59° 44.7′	144° 30.2′	113
214	59° 43.7′	144° 28.6′	55
215	59° 42.9′	144° 27.0′	134
216	59° 42.1′	144° 23.0′	152
217	59° 39.8′	144° 21.2′	154
221	59° 50.1′	144° 27.4′	29
223	59° 52.4′	144° 18.7′	51
224	59° 50.0′	144° 16.0′	64
232	59° 57.3′	144° 09.9′	49
233	59° 51.6′	143° 53.3′	106
237	59° 51.7′	143° 42.5′	225
239	59° 55.6′	143° 32.4′	252
246	59° 41.9′	142° 55.8′	198
247	59° 52.2′	143° 20.3′	214
249	59° 58.4′	143° 23.0′	152
251	59° 44.5′	142° 54.0′	188
256	59° 48.2′	142° 46.2′	190
257	59° 57.3′	142° 46.5′	119
258	59° 57.5′	142° 41.2′	108
259	59° 58.1′	142° 38.2′	91
260	60° 00.0′	142° 43.0′	88
263	59° 50.8′	142° 31.0′	95
264	59° 49.5′	142° 30.0′	134
265	59° 46.2′	142° 29.9′	181
268	59° 40.7′	142° 21.6′	174
282	59° 54.5′	142° 20.0′	82
283	59° 51.0′	142° 14.5′	84
284	59° 50.0′	142° 14.2′	86
285	59° 47.4′	142° 14.4′	115
286	59° 43.0′	142° 13.1′	157
288	59° 36.0′	142° 13.7′	238
289	59° 53.1′	142° 03.8′	55
290	59° 54.6′	141° 52.3′	31
294	59° 48.7′	141° 25.0′	29
296	59° 45.5′	141° 43.5′	49
297	59° 32.9′	141° 46.7′	165
306	59° 30.4′	141° 30.0′	161
307	59° 28.9′	141° 27.8′	165
308	59° 25.8′	141° 21.1′	201
312	59° 31.7′	141° 14.3′	156
313	59° 29.5′	141° 11.0′	256
314	59° 28.5′	141° 06.3′	311
316	59° 22.8′	140° 51.7′	163
317	59° 27.2′	140° 49.4′	274
319	59° 33.8′	140° 50.5′	247
320	59° 36.4′	140° 50.5′	163
324	59° 32.3′	140° 14.0′	192
325	59° 29.0′	140° 14.1′	241
326	59° 24.6′	140° 14.5′	183
328	59° 43.2′	144° 33.6′	134
330	59° 58.2′	144° 02.8′	24
331	59° 56.1′	143° 53.4′	66
332	59° 54.3′	143° 53.2′	73
333	59° 47.1′	143° 51.5′	128
338	60° 01.0′	143° 09.3′	101
339	60° 00.8′	142° 56.6′	102
341	59° 57.7′	143° 04.7′	137
360	59° 39.7′	140° 31.1′	48
422	59° 55.8′	141° 35.6′	68
428	59° 54.7′	141° 30.1′	49
Cruise DC1–79–EG			
1	59° 05.0′	138° 39.9′	77
5	58° 52.1′	138° 58.6′	205
6	58° 46.8′	138° 59.7′	220
7	58° 48.2′	139° 07.9′	188
9	58° 43.1′	139° 10.3′	240
10	58° 44.9′	139° 19.1′	183
12	58° 39.0′	139° 22.3′	251
13	58° 45.2′	138° 38.4′	108
17	58° 26.4′	138° 26.4′	123
23	58° 26.0′	137° 48.3′	167
24	58° 20.7′	137° 55.7′	156
28	58° 11.2′	137° 39.1′	161
29	58° 16.4′	137° 32.5′	154
30B	58° 23.0′	137° 27.9′	196
31B	58° 18.6′	137° 08.2′	154
32B	58° 10.9′	137° 19.8′	121
36	58° 21.7′	137° 00.7′	111
40	58° 17.2′	137° 01.8′	186
41	58° 15.7′	137° 00.4′	187
42	58° 13.6′	136° 58.9′	174
43	58° 12.1′	136° 57.9′	185
45	58° 14.6′	136° 47.8′	119
46	58° 13.7′	136° 50.1′	93
47	58° 12.6′	136° 53.2′	133
Cruise DC2–80–EG			
18	59° 07.0′	138° 48.3′	44
24	59° 07.0′	138° 44.0′	42
27	59° 07.0′	138° 44.0′	43
41	59° 06.89′	138° 43.0′	40
48	59° 06.9′	138° 42.6′	37
60	59° 28.5′	139° 48.0′	58
62	59° 28.5′	139° 48.4′	64
63	59° 28.2′	139° 48.9′	62
67	59° 28.0′	139° 49.3′	82
70	59° 28.9′	139° 49.8′	98
73	59° 27.7′	139° 50.2′	104
82	59° 28.2′	139° 48.4′	74
86	59° 27.5′	139° 50.5′	110
89	59° 28.6′	139° 48.2′	55
94	59° 26.3′	139° 36.0′	20
97	59° 41.8′	141° 20.1′	60

TABLE 1.—*Latitude, longitude, and water depth of samples considered in this report*—Continued

Sample No.	Latitude (°N)	Longitude (°W)	Water depth (meters)
Cruise DC2–80–EG—Continued			
99	59° 41.0′	141° 20.7′	60
167	59° 40.1′	141° 21.6′	68
168	59° 40.1′	141° 21.6′	68
169	59° 39.2′	141° 22.1′	73
170	59° 38.1′	141° 22.5′	84
174	59° 37.2′	141° 23.1′	91
180	59° 35.2′	141° 24.5′	111
183	59° 34.4′	141° 25.1′	121
186	59° 33.3′	141° 25.3′	132
189	59° 32.5′	141° 26.4′	139
192	59° 31.2′	141° 26.8′	150
195	59° 36.5′	140° 19.2′	82
Miscellaneous sample			
BFM–1	60° 17.0′	148° 21.0′	20

Diagnosis.—Distinguished by its small size, posterior and anteroventral flanges, fine punctae, narrow inner lamella, posteroventral denticles, and weak caudal process.

Description.—Adult valves trapezoidal in lateral view. Dorsal margin broadly curved, with anterodorsum forming nearly a straight line to middle of anterior margin. Anterior margin acutely curved, forming distinct obtuse angle with anterodorsal margin, curving sharply to venter. Ventral margin sinuous, with broad, shallow concavity. Dorsal and ventral margins converge to form an elongate posterior margin. Blunt caudal process with distinct flange that bears ventral denticles and small dorsal crenulations. Anteroventral margin with narrow smooth flange. Greatest length through caudal process; greatest height through anterior hinge element.

Valve surface covered with fine punctation. Hirsute surface on living specimens due to presence of numerous, long, pronounced setae exiting from normal and radial pore canals. One hundred twenty simple-type normal pores evenly distributed over surface.

Inner margin and line of concrescence coincide throughout. Inner lamella of even width throughout, follows valve outline. Radial pores not visible.

Hingement adont; right valve hinge is a simple, heavy median bar.

Eight adductor muscle scars occur in four horizontal rows. The dorsal row consists of one ovoid scar; the dorsomedian row consists of an elongate scar; the ventromedian row consists of four alternating ovoid scars; and the ventral row consists of two ellipsoidal scars.

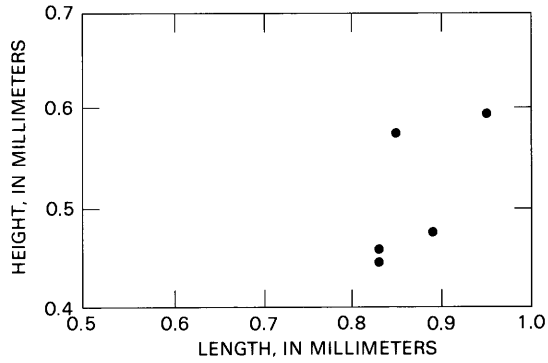

FIGURE 3.—Plot of length versus height for *Neonesidea sitkagi* n. sp.

Measurements.—X–Y plot based on five specimens (fig. 3).

Comparisons.—*Neonesidea sitkagi* differs from *N. simuvillosa* (Swain, 1967) (Holocene; Baja California and Nicaragua) by its large size; flattened, straight anterodorsal margin; straight venter; and low valve shape. *N. sitkagi* differs from *N. phlegeri* (McKenzie and Swain, 1967) (Quaternary; southern California and Baja California) by its long, low valve shape; small size; marginal flanges; narrow inner lamella; and lack of an upturned valve margin at the concavity. *N. sitkagi* differs from *N. mutsuensis* (Ishizaki, 1971) (Holocene; northern Japan) by its less robust shell; marginal flanges; long, low valve shape; less arched dorsum; and fine punctation pattern. *N. sitkagi* differs from *N. oligodentata* (Kajiyama, 1913) (Miocene and Holocene; northern Japan) by its long, low valve shape; less pronounced caudal process; less developed concavity; and narrow inner lamella.

Remarks.—*Neonesidea* species are restricted to shallow water (less than 100 m) and characteristically occur as epifaunal assemblages on marine algae, grasses, sponges, and to a lesser extent, detrital accumulations and associated sandy sediments (Maddocks, 1969). The genus has a worldwide distribution, chiefly in tropical and subtropical areas. *Neonesidea* lives in temperate regions of the North Pacific, as documented by Ishizaki (1971), Kajiyama (1913), and Hanai and others (1977).

Most of the shallow regions of the Gulf of Alaska can be characterized as cold, muddy, and turbid, with a high influx of glacial meltwater and "flour." I observed no sample of modern sediment dredged up during cruise DC2–80–EG that contained marine algae, grasses, or living filter feeders. The life habits of *Neonesidea* species suggest that the presence of *N. sitkagi* in sample DC2–80–EG–195 represents a fossil occurrence. Other occurrences of *N. sitkagi* (samples from cruise EGAL–75–KC) coincide with regions of the continental shelf where Pliocene and Pleistocene sediments of the

TABLE 2.—*Occurrence of the thirty-two ostracode species in the 220 bottom-grab samples collected during three cruises in the Gulf of Alaska*

[Samples are from cruises in the Gulf of Alaska (EGAL–75–KC, DC1–79–EG, DC2–80–EG); in addition, there is one miscellaneous sample (MISC.). Sample numbers are listed across the top of the table]

	EGAL–75–KC																																													
	4	6	11	16	17	18	20	22	24	26	32	39	41	46	52A	53	54	55	58	59B	63B	66	68A	69	70	71	72	73	74	75	76	77	78	80	83	84	86	87	88	89	90	91	92	94	95
Cytherella sp. A																																														
Neonesidea sitkagi			X								X			X																															
Cythere lutea			X		X	X				X		X			X								X																						
Cythere alveolivalva			X							X							X		X				X																						
Cytheromorpha eskerensis																																														
Cytheromorpha sp. C																																														
Cytheromorpha grandwashensis			X											X			X		X				X													X									
Cytheromorpha knikensis																						X	X			X				X															
Cytheromorpha molniai			X							X		X	X	X			X	X	X												X		X			X									
Schizocythere sp. A											X																																			
Palmenella limicola	X	X	X		X	X		X	X	X				X		X	X	X					X	X	X	X	X	X	X	X		X	X	X			X	X				X	X	X	X
Acuminocythere crescentensis			X		X					X					X	X							X	X											X										
Munseyella melzeri				X	X	X				X			X	X	X	X										X		X			X							X	X		X	X			
Munseyella ristveti																													X			X										X			
Pectocythere sp. G																																	X												
Pectocythere sp. A																																													
Pectocythere janae			X				X				X	X	X		X	X		X		X	X	X	X	X		X	X				X			X			X								
Pectocythere kiklukhensis												X			X					X																										
Pectocythere marincovichi															X																															
Pectocythere parkerae							X				X			X	X		X				X	X									X			X	X				X							
Pectocythere tsiuensis			X															X					X																							
Cluthia cluthae																											X												X							
Cluthia foresteri			X													X	X																X				X						X		
Limnocythere friabilis																X																														
Limnocythere inopinata																																														
Limnocythere itasca																																														
Limnocythere staplini																																														
Eucythere argus																																														
Krithe burkholderi	X	X									X				X																															
Krithe adelspergi				X					X																										X		X							X	
Pontocythere dahlgrenensis			X																																											
Pontocythere jefferiesensis																																														

TABLE 2.—*Occurrence of the thirty-two ostracode species in the 220 bottom-grab samples collected during three cruises in the Gulf of Alaska*–Continued

EGAL–75–KC

	96	97	98	99	103	104	105	106	107	108	109	110	111	112	113	115	117	118	120	122A	123	124A	127	128	129	130	132	134	138	141	144U	145	146	147	149	150	153	154	155	157	158	159	161	162	164B
Cytherella sp. A																									X																				
Neonesidea sitkagi																																							X		X			
Cythere lutea										X					X				X				X				X																	
Cythere alveolivalva										X					X			X	X				X			X	X			X									X			X	X	
Cytheromorpha eskerensis																																												
Cytheromorpha sp. C																																												
Cytheromorpha grandwashensis										X					X																							X		X		X	
Cytheromorpha knikensis										X					X			X	X				X						X	X						X		X	X		X		X	X
Cytheromorpha molniai										X	X													X			X		X	X									X					
Schizocythere sp. A																																							X					
Palmenella limicola	X	X	X	X		X			X	X	X	X	X	X	X	X	X		X		X							X	X		X	X	X	X	X	X	X		X		X			
Acuminocythere crescentensis										X					X														X	X									X		X			
Munseyella melzeri		X	X	X							X	X	X															X						X		X		X		X				
Munseyella ristveti												X					X														X		X	X	X		X			X				
Pectocythere sp. G																																												
Pectocythere sp. A																																												
Pectocythere janae					X				X	X					X	X		X						X					X	X						X			X		X			
Pectocythere kiklukhensis																													X	X									X		X			
Pectocythere marincovichi																														X														
Pectocythere parkerae								X	X	X					X														X	X					X			X						
Pectocythere tsiuensis				X											X	X		X						X		X	X															X	
Cluthia cluthae			X			X													X																	X		X						
Cluthia foresteri				X		X	X					X							X	X			X												X	X								
Limnocythere friabilis																																												
Limnocythere inopinata																																												
Limnocythere itasca																																												
Limnocythere staplini																																												
Eucythere argus																		X																										
Krithe burkholderi														X																														
Krithe adelspergi	X					X	X															X	X																					
Pontocythere dahlgrenensis																			X				X																					
Pontocythere jefferiesensis																											X																	

EGAL–75–KC

	165	166	170A	170B	174	175	176	179A	180	181	183	184	202	205	209	210	211	212	213	214	215	216	217	221	223	224	232	233	237	239	246	247	249	251	256	257	258	259	260	263	264	265	268	282	283
Cytherella sp. A																																													
Neonesidea sitkagi																																													
Cythere lutea																	X						X																						
Cythere alveolivalva									X								X						X																						
Cytheromorpha eskerensis																																													
Cytheromorpha sp. C																																													
Cytheromorpha grandwashensis																							X																						
Cytheromorpha knikensis	X	X		X		X			X														X													X									
Cytheromorpha molniai						X			X								X						X			X									X								X	
Schizocythere sp. A																																													
Palmenella limicola									X	X	X		X		X	X	X	X	X	X			X		X		X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X
Acuminocythere crescentensis									X		X																																		
Munseyella melzeri												X	X	X	X					X															X	X	X		X	X		X		
Munseyella ristveti															X					X																									
Pectocythere sp. G																																													
Pectocythere sp. A																																													
Pectocythere janae	X			X					X		X						X	X					X	X	X		X								X	X							X	X
Pectocythere kiklukhensis																																													
Pectocythere marincovichi																																													
Pectocythere parkerae																		X					X																				X	X
Pectocythere tsiuensis	X		X	X	X		X	X	X	X							X						X	X		X										X									
Cluthia cluthae										X																																			
Cluthia foresteri															X													X																	
Limnocythere friabilis																																													
Limnocythere inopinata																																													
Limnocythere itasca																																													
Limnocythere staplini																																													
Eucythere argus	X																																												
Krithe burkholderi															X																														
Krithe adelspergi														X								X												X				X				X			
Pontocythere dahlgrenensis									X																																				
Pontocythere jefferiesensis																																													

TABLE 2.—*Occurrence of the thirty-two ostracode species in the 220 bottom-grab samples collected during three cruises in the Gulf of Alaska*—Continued

	EGAL-75-KC																															DC1-79-EG										
	284	285	286	288	289	290	294	296	297	306	307	308	312	313	314	316	317	319	320	324	325	326	328	330	331	332	333	338	339	341	360	422	428	1	5	6	7	9	10	12	13	17	23	24
Cytherella sp. A																																												
Neonesidea sitkagi																																												
Cythere lutea																																X		X										
Cythere alveolivalva																																												
Cytheromorpha eskerensis	X																							X																				
Cytheromorpha sp. C																																												
Cytheromorpha grandwashensis							X																					X																
Cytheromorpha knikensis																															X	X												
Cytheromorpha molniai		X																	X						X																			
Schizocythere sp. A																																												
Palmenella limicola	X		X	X	X			X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X					X	X	X	X	X	X	X			X	X
Acuminocythere crescentensis																																												
Munseyella melzeri	X								X													X							X										X					
Munseyella ristveti																													X															
Pectocythere sp. G																																												
Pectocythere sp. A																																												
Pectocythere janae	X				X			X										X							X		X	X						X										
Pectocythere kiklukhensis																																												
Pectocythere marincovichi																																												
Pectocythere parkerae	X				X																	X																		X	X		
Pectocythere tsiuensis					X	X	X	X															X	X			X			X														
Cluthia cluthae																																												
Cluthia foresteri																								X					X									X						
Limnocythere friabilis																																												
Limnocythere inopinata																																												
Limnocythere itasca																																												
Limnocythere staplini																																		X										
Eucythere argus																																		X				X						
Krithe burkhalderi																																												
Krithe adelspergi				X				X	X	X	X		X		X		X				X															X		X						
Pontocythere dahlgrenensis																																						X						
Pontocythere jefferiesensis																																												

	DC1-79-EG													DC2-80-EG																											MISC.
	28	29	30B	31B	32B	36	40	41	42	43	45	46	47	18	24	27	42	48	60	62	63	67	70	73	82	86	89	94	97	99	167	168	169	170	174	180	183	186	189	192	195	BFM-1
Cytherella sp. A																																										
Neonesidea sitkagi																																										
Cythere lutea										X	X							X		X	X										X									X		
Cythere alveolivalva																				X	X			X																X		
Cytheromorpha eskerensis																	X							X																		
Cytheromorpha sp. C															X																											
Cytheromorpha grandwashensis																				X	X		X		X					X	X	X								X		
Cytheromorpha knikensis															X			X		X	X		X	X	X			X	X	X			X							X		
Cytheromorpha molniai										X	X	X		X																												
Schizocythere sp. A																																										
Palmenella limicola	X	X	X	X		X	X	X		X	X									X	X		X	X	X	X	X	X			X											X
Acuminocythere crescentensis											X	X																														
Munseyella melzeri				X																																	X	X			
Munseyella ristveti																																					X	X			
Pectocythere sp. G											X																														
Pectocythere sp. A											X																														
Pectocythere janae					X				X	X	X	X						X	X	X	X		X	X	X	X	X	X		X	X	X	X	X						X	
Pectocythere kiklukhensis																																										
Pectocythere marincovichi																																										
Pectocythere parkerae											X	X									X																			X		
Pectocythere tsiuensis														X	X	X			X	X	X		X	X	X	X		X	X	X		X								X		
Cluthia cluthae											X																															
Cluthia foresteri								X			X	X									X		X		X		X							X	X	X	X	X	X	X		
Limnocythere friabilis																																										
Limnocythere inopinata																X																										
Limnocythere itasca																							X																			
Limnocythere staplini																																										
Eucythere argus																			X	X	X	X		X	X															X		
Krithe burkholderi																																										
Krithe adelspergi																																							X			
Pontocythere dahlgrenensis												X																														
Pontocythere jefferiesensis																					X																					

upper part of the Yakataga Formation crop out on submarine banks. These submarine plat forms are swept clean of muds by scouring bottom currents; rare *N. sitkagi* are living in this habitat, as evidenced by the presence of sensory seta on some valves. *N. sitkagi* specimens with more corroded and sediment-infilled valves are presumably weathering out of the subcropping Yakataga Formation and represent fossil occurrences.

Occurrence.—Assemblages I*, II*, V.

Distribution.—Pleistocene and Holocene: Gulf of Alaska, Cook Inlet, Kodiak Shelf, Pribilof Islands. Inner to middle sublittoral.

Material.—Six adult valves, seven juvenile valves.

Type specimens.—Holotype: USNM 408111, right valve (pl. 1, fig. 2), locality EGAL–75–KC–157, length 0.83 mm, height 0.46 mm.

Paratypes: USNM 408112, left valve (pl. 2, fig. 1), locality EGAL–75–KC–159, length 0.83 mm, height 0.45 mm. USNM 408113, left valve, locality EGAL–75–KC–159, length 0.85 mm, height 0.58 mm.

Etymology.—After Sitkagi Bluffs, the terminal moraine of Malaspina Glacier, southeast Alaska.

Superfamily CYTHERACEA Baird, 1850

Family CYTHERIDAE Baird, 185

Subfamily CYTHERINAE Baird, 1850

Tribe CYTHERINI Baird, 1850

Genus CYTHERE O.F. Mueller, 1785

Type species.—*Cythere lutea* O.F. Mueller, 1785. (Type by original designation.)

Cythere valentinei Tsukagoshi and Ikeya, 1987

Plate 1, figures 3, 4; plate 2, figures 2–11

Cythere valentinei Tsukagoshi and Ikeya, 1987, p. 217–218, figs. 5n, 10–2a–d.
Cythere sp. B Valentine, 1976, pl. 12, figs. 9, 13.
Cythere cf. C. lutea Swain, 1969, p. 461, pl. 1, fig. 11.
Cythere alveolivalva Swain, 1969 (partim), p. 462, pl. 7, figs. 1a, 1b.
Cythere lutea Swain and Gilby, 1974, p. 284, pl. 2, figs. 7a, 7b; text-figs. 12a–j.
Cythere sp. A Brouwers, 1981, p. 8; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1982c, p. 3; Brouwers, 1983.

Diagnosis.—Distinguished by its squared, quadrate shape; subdued ornament ridges; numerous, small, ovoid pits; weak caudal process; anterior and posterior margins each with three elongate depressions separated by low ridges; and both sieve- and simple-type normal pores.

Measurements.—X–Y plot based on 25 specimens (fig. 4).

Comparisons.—*Cythere valentinei* Tsukagoshi and Ikeya, 1987 differs from *C. uranipponica* Hanai, 1959

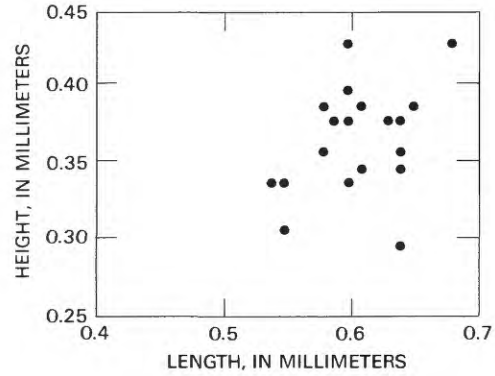

FIGURE 4.—Plot of length versus height for *Cythere valentinei* Tsukagoshi and Ikeya, 1987.

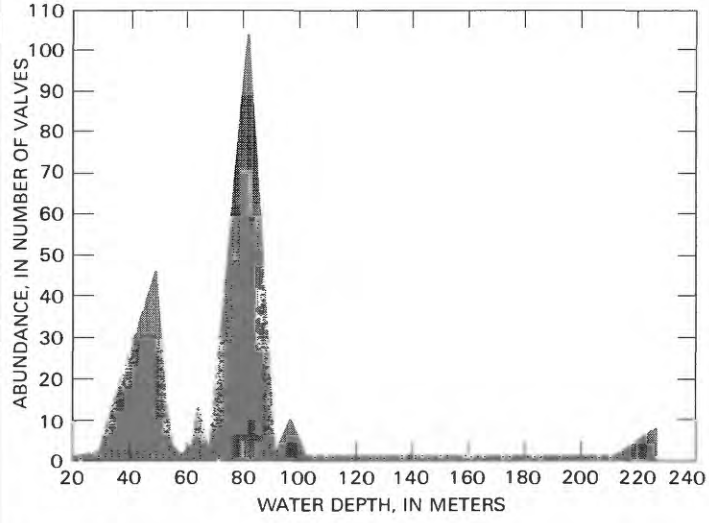

FIGURE 5.—Plot of abundance versus water depth for *Cythere valentinei* Tsukagochi and Ikeya, 1987.

(Miocene through Holocene; northern Japan) by its weak, subdued ornament ridges; a straight, less concave posterodorsal margin; a less arched dorsum; and smaller, more numerous pits. *Cythere valentinei* differs from *C. nishinipponica* Okubo, 1976 (Holocene; Inland Sea of Japan) by its low, quadrate valve shape; less pronounced, high caudal process; weak, subdued ornament ridges; and smaller, more numerous pits. *Cythere valentinei* differs from *C. lutea* O.F. Mueller, 1785 in having fewer, larger ornament pits, a narrower marginal rim, and stronger ridges along the margins.

Occurrence.—Assemblages II, III, V.

Distribution.—Pleistocene and Holocene: central California to southern Canada, Gulf of Alaska. Sublittoral (fig. 5).

Material.—Thirty-five adult valves, 196 juvenile valves.

Illustrated specimens.—USNM 408114, left valve (pl. 1, fig, 3), locality DC2–80–EG–195, length 0.61 mm,

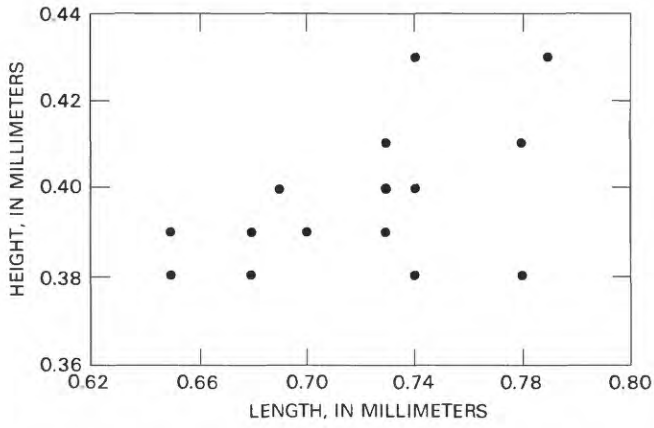

FIGURE 6.—Plot of length versus height for *Cythere alveolivalva* Smith, 1952.

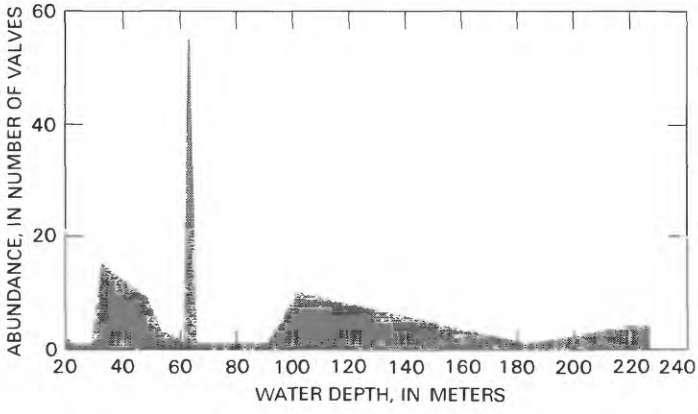

FIGURE 7.—Plot of abundance versus water depth for *Cythere alveolivalva* Smith, 1952.

height 0.39 mm. USNM 408115, right valve (pl. 1, fig. 4), locality DC2–80–EG–195, length 0.64 mm, height 0.38 mm. USNM 408116, left valve (pl. 2, fig. 2), locality DC2–80–EG–195, length 0.60 mm, height 0.40 mm. USNM 408117, right valve (pl. 2, fig. 3), locality DC2–80–EG–195, length 0.58 mm, height 0.39 mm. USNM 408118, left valve (pl. 2, figs. 4, 9), locality DC2–80–EG–195, length 0.60 mm, height 0.43 mm. USNM 408119, right valve (pl. 2, figs. 5, 6), locality DC2–80–EG–195, length 0.59 mm, height 0.38 mm. USNM 408120, right valve (pl. 2, figs. 7, 10), locality EGAL–75–KC–37, length 0.64 mm, height 0.35 mm. USNM 408121, left valve (pl. 2, figs. 8, 11), locality DC2–80–EG–195, length 0.64 mm, height 0.30 mm.

Cythere alveolivalva Smith, 1952

Plate 1, figure 5; plate 2, figures 12–17; plate 3, figures 1–3

Cythere alveolivalva Smith, 1952, p. 23–24, pl. 4, figs. 1–10.
Cythere uncifalcata Smith, 1952, p. 26–28, pl. 5, figs. 1–7 (=juvenile instar of *C. alveolivalva*).
Cythere alveolivalva Smith. Swain, 1969 (partim), p. 462, pl. 4, figs. 12a, 12b; pl. 9, figs. 4a, 4b; Schornikov, 1974, p. 142–143, pl. 1, fig. 2; text-fig. 3; Tsukagoshi and Ikeya, 1987, p. 204, 206, figs. 4a, 5a, 6–1a, 6–1b.
Not *Cythere alveolivalva* Smith. Swain, 1969 (partim), p. 462, pl. 7, figs. 1a, 1b (=*Cythere maia*).
Cythere sp. A Swain, 1969, p. 461, pl. 1, figs. 12a, 12b.
Cythere sp. A Valentine, 1976, p. 22, pl. 12, figs. 15, 16.
Cythere aff. *C. alveolivalva* Smith. Brouwers, 1981, p. 8; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1983.

Diagnosis.—Distinguished by its squared, quadrate valve shape; strong ventral concavity; posteroventral marginal flange; predominantly smooth valve surface with fine marginal punctation; and lack of vestibules.

Measurements.—X–Y plot based on 18 specimens (fig. 6).

Comparisons.—*Cythere alveolivalva* Smith, 1952 is distinguished from *C. golikovi* Schornikov, 1974 (Holocene; Kurile Islands) by its quadrate shape; strong concavity; fine marginal punctation; pronounced caudal process; strong, high accommodation groove; and lack of anterior vestibule.

Occurrence.—Assemblages I, II, V.

Distribution.—Pleistocene and Holocene: Gulf of Alaska, Vancouver Island, Puget Sound, northern California, Kurile Islands. Inner to middle sublittoral (fig. 7).

Material.—Twenty-nine adult valves, 111 juvenile valves.

Illustrated specimens.—USNM 408122, right valve (pl. 1, fig. 5), locality EGAL–75–KC–11, length 0.73 mm, height 0.40 mm. USNM 408123, left valve (pl. 2, fig. 12), locality EGAL–75–KC–11, length 0.73 mm, height 0.40 mm. USNM 408124, right valve (pl. 2, fig. 13; pl. 3, fig. 1), locality EGAL–75–KC–11, length 0.68 mm, height 0.38 mm. USNM 408125, left valve (pl. 2, fig. 14), locality EGAL–75–KC–63, length 0.78 mm, height 0.38 mm. USNM 408126, right valve (pl. 2, fig. 15; pl. 3, fig. 2), locality DC2–80–EG–195, length 0.78 mm, height 0.41 mm. USNM 408127, left valve (pl. 2, figs. 16, 17), locality EGAL–75–KC–37, length 0.65 mm, height 0.38 mm. USNM 408128, left valve (pl. 3, fig. 3), locality EGAL–75–KC–37, length 0.78 mm, height 0.38 mm.

Genus CYTHEROMORPHA Hirschmann, 1909

Type species.—*Cythere fuscata* Brady, 1869. (Type by subsequent designation.)

Cytheromorpha eskerensis n. sp.

Plate 1, figures 6, 7; plate 3, figures 4–9

Cytheromorpha sp. D Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1983.

Diagnosis.—Distinguished by its straight dorsum; evenly curved, equal-sized anterior and posterior ends;

long, low valve outline; strong marginal rim or flange; subtle ventral concavity; moderately developed anterior and posterior marginal ridges; and smooth valve surface with small marginal pitting.

Description.—Adult valves elongate, subrectangular in lateral view. Dorsal margin straight; anterior margin broadly curved; ventral margin gently arched, with broad, shallow concavity; posterior margin truncated and blunt, with obtuse posterodorsal cardinal angle. Left valve similar to right, but with weak posterodorsal cardinal angle. Greatest length through midline of valve; greatest height through anterior hinge element. Pronounced dimorphism: males significantly longer, slightly lower than females.

Valve surface predominantly smooth, with marginal ornamentation. Three to four low ridges parallel the anterior and posterior margins, with some interconnecting ridges. Ovoid pits of various sizes occur along valve margin, most adjacent to anterior and posterior. Oblique anterodorsal sulcus. Weak median sulcus proceeds from dorsal margin to median valve. Smooth flat flange rims the anterior, ventral, and posterior margins. One hundred nine to one hundred eleven normal pores are distributed over the valve, most located anterodorsal. Normal pores sieve-type; sieve plate continuous with valve surface.

Inner margin and line of concrescence coincide at posterior and venter; moderate, arcuate anterior vestibule. Inner lamella widest at anterior and of even width and somewhat more narrow at posterior and venter. Well-developed selvage. Twelve to twenty-one radial pores, most anterior; pores are straight, short, and simple.

Left valve hinge consists of anterior complex with anterior rounded tooth, median quadrate socket, and posterior triangular tooth; smooth median bar; and posterior complex with anterior trapezoidal socket, large ovoid median tooth, and posterior squared socket. Anterior socket open to valve interior along ventral side. Median bar formed by enfolding of dorsal edge of valve.

Four adductor muscle scars form a slightly arcuate row. Dorsal scar is ovoid; dorsomedian scar is ovoid, with slightly inflated anterior end; ventromedian scar is elongate, with large, posterior end; ventral scar is semicircular. Frontal scar split into larger, dumbbell-shaped posterior scar and small, ovoid anterior scar. Pronounced, deep, ovoid fulcral point with prominent dorsal rim. Two adjacent mandibular scars located posteroventral of frontal scars; anterior scar is trapezoid-shaped and posterior scar is ovoid. Dorsal scars are numerous, large, elongate in shape. Several large dorsal scars just below the hinge occur on raised platforms.

Measurements.—X–Y plot based on 10 specimens (fig. 8).

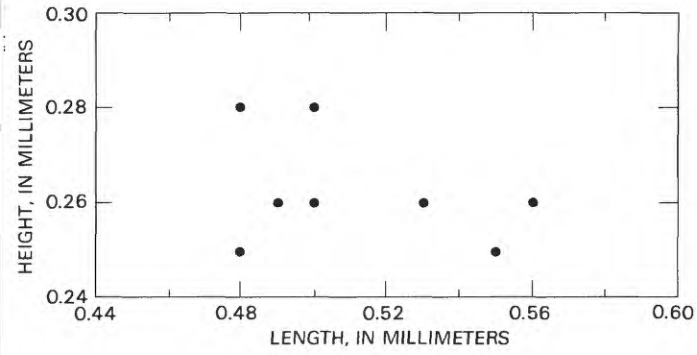

FIGURE 8.—Plot of length versus height for *Cytheromorpha eskerensis* n. sp.

Comparisons.—*Cytheromorpha eskerensis* is distinguished from *C. knikensis* Forester and Brouwers, 1985 (Quaternary; Gulf of Alaska) by its straight dorsal and ventral margins, evenly curved anterior and posterior margins, weakly pitted ornament consisting of small marginal pits, marginal ridges, and weak internal expression of sieve pores. *C. eskerensis* is distinguished from *C. acupunctata* (Brady, 1880) (Holocene; northern Japan) by its straight dorsal margin; subtle ventral concavity; even-sized, evenly curved anterior and posterior margins; and small marginal pits. *C. eskerensis* differs from *Cytheromorpha* sp. A of Valentine (1976) (middle Pliocene through Holocene; northern California, Oregon, Washington) by its straight dorsum; long, low valve shape; strong marginal rim; and marginal ornament pitting. *C. eskerensis* is differentiated from *Cytheromorpha* sp. B of Valentine (1976) (upper Pliocene through Holocene; northern California, Oregon, Washington) by its straight dorsum; long, low valve shape; and strong marginal ridges.

Occurrence.—Assemblages II*, III.

Distribution.—Pleistocene through Holocene: Gulf of Alaska. Middle to outer sublittoral.

Material.—Seven hundred nineteen adult valves.

Type specimens.—Holotype: USNM 408129, female left valve (pl. 1, fig. 6), locality DC2–80–EG–82, length 0.48 mm, height 0.25 mm.

Paratypes: USNM 408130, male left valve (pl. 1, fig. 7), locality DC2–80–EG–82, length 0.53 mm, height 0.26 mm. USNM 408131, male left valve (pl. 3, figs. 4, 8), locality EGAL–75–KC–284, length 0.55 mm, height 0.25 mm. USNM 408132, male right valve (pl. 3, fig. 5), locality EGAL–75–KC–284, length 0.53 mm, height 0.26 mm. USNM 408133, male left valve (pl. 3, figs. 6, 7), locality EGAL–75–KC–115, length 0.56 mm, height 0.26 mm. USNM 408134, female left valve (pl. 3, fig. 9), locality EGAL–75–KC–115, length 0.49 mm, height 0.26 mm.

Etymology.—After Esker Stream, which flows from Atrevida Glacier into Disenchantment Bay, southeast Alaska.

Cytheromorpha sp. C

Plate 1, figure 8

Cytheromorpha sp. C Brouwers, 1982a, p. 11; Brouwers, 1983.

Diagnosis.—Distinguished by weak posterodorsal cardinal angle and lack of an anterodorsal cardinal angle; broad, shallow concavity; lack of ornamentation; small, numerous sieve pores; wide inner lamella with continuous, arcuate vestibule; and wide posterior marginal rim.

Occurrence.—Assemblage II.

Distribution.—Holocene: eastern Gulf of Alaska. Middle sublittoral.

Material.—One adult valve.

Illustrated specimen.—USNM 408135, female left valve (pl. 1, fig. 8), locality DC2–80–EG–27, length 0.54 mm, height 0.30 mm.

Cytheromorpha grandwashensis n. sp.

Plate 1, figure 9; pl. 3, figs. 10–17; plate 4, figures 1–7

Leptocythere sp. Swain, 1969, p. 469, pl. 7, figs. 8a, b; pl. 9, fig. 1.
Cytheromorpha sp. E Brouwers, 1981, p. 9; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1983.

Diagnosis.—Distinguished by large size; quadrate valve shape; broad, shallow concavity; and weak marginal ornament consisting of fine ridges and small pitting.

Description.—Adult valves elongate, subquadrate in lateral view. Dorsal margin straight; anterior margin smoothly curved; ventral margin with pronounced concavity; posterior margin truncated, with obtuse posterodorsal cardinal angle. Left valve similar to right, but with more posterior-converging dorsum and weak posterodorsal cardinal angle. Greatest length through midline of valve; greatest height through anterior hinge element. Pronounced dimorphism: males significantly longer, slightly lower than females, with less convergent posterior.

Valve surface predominantly smooth, with marginal ornamentation. Two to three thin, low ridges parallel the anterior and posterior margins, with some interconnecting ridges. Secondary fine pitting along valve outline. Two subtle, oblique sulci along dorsal margin; one sulcus located medially and one at anterodorsal corner. Anterior, ventral, and posterior margins rimmed by smooth, flat flange. About 92 normal pores distributed over valve, most anterodorsal; smooth flat rim around normal pores. Pores along anterior and posterior marginal ridges are prominently rimmed. Normal pores sieve-type; sieve plate continuous with valve surface; central setal opening.

Inner margin and line of concrescence do not coincide. Thin, arcuate posterior vestibule continuous with shallow ventral vestibule; anterior vestibule moderately deep and crescentic. Inner lamella widest at anterior and of even width and narrower at venter and posterior. Well-developed selvage. About 39 radial pores, one false radial pore, most anterior; pores are straight, short, and simple.

Left valve hinge consists of anterior complex with anterior triangular tooth, small median ovoid socket, and large ellipsoidal posterior tooth; smooth median groove; and posterior tripartite complex with anterior squared tooth, large ovoid median socket, and posterior squared tooth. Posterior socket has thickened dorsal rim but is open to valve interior along ventral side. Anterior tripartite complex has large thickened ventral region.

Four adductor muscle scars form slightly arcuate row. Dorsal scar is circular; dorsomedian scar is kidney-shaped; ventromedian scar is elongate, with inflated posterior; and ventral scar is crescentic. Frontal scar split into larger, subcylindrical posterior scar and small, ovoid, anterior scar. Pronounced, deep, ovoid fulcral point with prominent anterodorsal rim. Two adjacent mandibular scars located anteroventral of frontal scar. Numerous, large, irregularly shaped dorsal muscle scars.

Measurements.—X–Y plot based on 15 specimens (fig. 9).

Comparisons.—*Cytheromorpha grandwashensis* differs from *C. acupunctata* (Brady, 1880) (Holocene; northern Japan) by its broad, shallow concavity; quadrate shape with no posterior convergence; simple radial pores; large vestibular space; and predominantly smooth valve surface, with fine marginal ridges and pits. *C. grandwashensis* is similar to *Cytheromorpha* sp. A of Valentine (1976) (middle Pliocene through Holocene; northern California, Oregon, Washington) in valve ornament but differs by its straight dorsum; shallow ventral concavity; and long, low valve shape of the males, especially posterior. *C. grandwashensis* differs from *Cytheromorpha* sp. B of Valentine (1976) (upper Pliocene through Holocene; northern California, Oregon, Washington) by its shallow concavity; long, low valve shape; lack of overall valve ornament pitting; and lack of strong anterior marginal flange. *C. grandwashensis* differs from *C. molniai* (Quaternary; Gulf of Alaska) by its quadrate valve shape, with proportionally greater valve height relative to length; smooth valve surface, with fine, subtle marginal ornament; and much larger size. *C. grandwashensis* differs from *C. eskerensis*

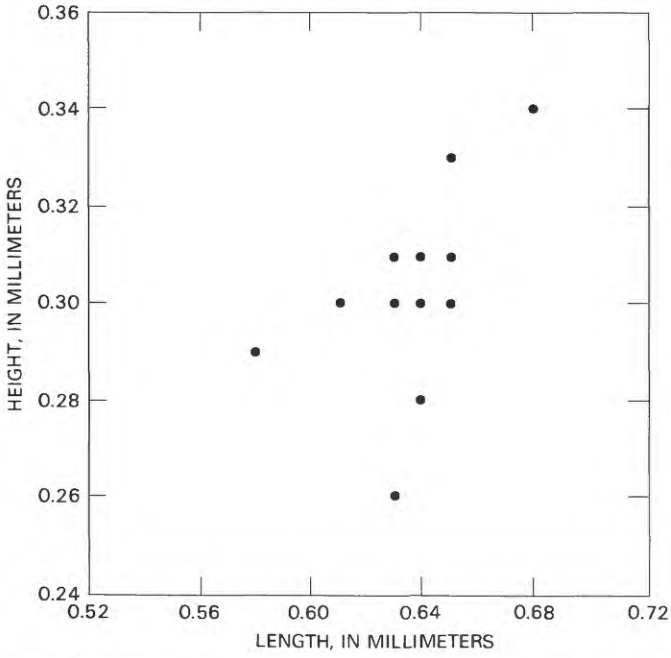

FIGURE 9.—Plot of length versus height for *Cytheromorpha grandwashensis* n. sp.

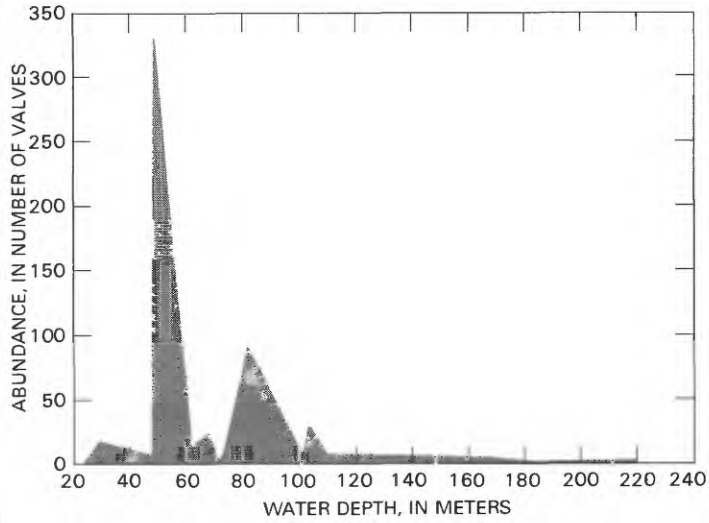

FIGURE 10.—Plot of abundance versus water depth for *Cytheromorpha grandwashensis* n. sp.

(Quaternary; Alaska) by its large valve with a low shape; weak posterodorsal cardinal angle; smooth valve surface; weak marginal ridges; large vestibular space; and more numerous radial pores.

Occurrence.—Assemblages II*, III*.

Distribution.—Pleistocene(?), Holocene: Gulf of Alaska, Cook Inlet, Kodiak shelf, Washington, Oregon. Middle to outer sublittoral (fig. 10).

Material.—Five hundred fifteen adult valves, 101 juvenile valves.

Type specimens.—Holotype: USNM 408136, male left valve (pl. 1, fig. 9), locality DC2–80–EG–195, length 0.63 mm, height 0.31 mm.

Paratypes: USNM 408137, male left valve (pl. 3, fig. 10; pl. 4, fig. 3), locality DC2–80–EG–195, length 0.64 mm, height 0.30 mm. USNM 408138, male right valve (pl. 3, figs. 11, 17), locality DC2–80–EG–195, length 0.65 mm, height 0.31 mm. USNM 408139, male right valve (pl. 3, fig. 12; pl. 4, fig. 1), locality DC2–80–EG–195, length 0.61 mm, height 0.30 mm. USNM 408140, male left valve (pl. 3, fig. 13), locality EGAL–75–KC–52A, length 0.65 mm, height 0.33 mm. USNM 408141, male right valve (pl. 3, figs. 14, 16), locality EGAL–75–KC–11, length 0.68 mm, height 0.34 mm. USNM 408142, female left valve (pl. 3, fig. 15), locality DC2–80–EG–195, length 0.58 mm, height 0.29 mm. USNM 408143, male left valve (pl. 4, figs. 2, 6), locality DC2–80–EG–195, length 0.64 mm, height 0.28 mm. USNM 408144, male right valve (pl. 4, fig. 4), locality EGAL–75–KC–52A, length 0.63 mm, height 0.26 mm. USNM 408145, male left valve (pl. 4, figs. 5, 7), locality EGAL–75–KC–11, length 0.65 mm, height 0.30 mm.

Etymology.—After Grand Wash River, a major stream that flows from eastern Malaspina Glacier into Yakutat Bay.

Cytheromorpha knikensis Forester and Brouwers, 1985

Plate 1, figures 10, 11; plate 4, figures 8–17

Cytheromorpha knikensis Forester and Brouwers, 1985, p. 357–362, figs. 5.1–5.8, 6.3–6.6, 7.1, 7.2.

Cytheromorpha sp. B Brouwers, 1981, p. 9; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 11; Brouwers, 1983.

Diagnosis.—Characterized by large U-shaped sulcus extending from anterodorsal corner to midline, then curving up along adductor row; numerous, large sieve pores; well-developed reticulation forming small ovoid pits; elongate, subrectangular valve shape; and moderate sexual dimorphism.

Measurements.—X–Y plot based on 13 specimens (fig. 11).

Occurrence.—Assemblages II*, III*.

Remarks.—*Cytheromorpha knikensis* is described and illustrated in Forester and Brouwers (1985), which also provides the detailed ecological habitat, including water depth, temperature, and salinity conditions for the taxon.

Distribution.—Pleistocene(?), Holocene: Gulf of Alaska, Prince William Sound. Sublittoral (fig. 12).

Material.—Four hundred fifty adult valves, 120 juvenile valves.

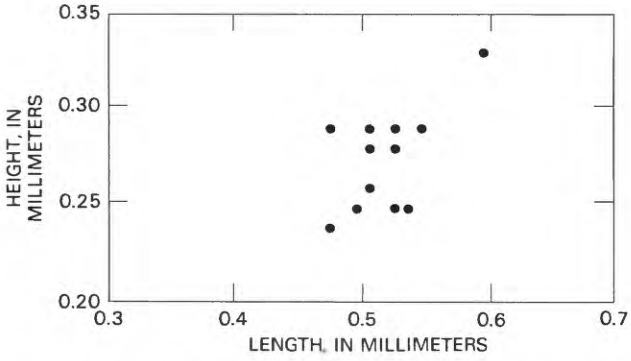

FIGURE 11.—Plot of length versus height for *Cytheromorpha knikensis* Forester and Brouwers, 1985.

Illustrated specimens.—USNM 408146, female right valve (pl. 1, fig. 10), locality DC2–80–EG–195, length 0.51 mm, height 0.28 mm. USNM 408147, female left valve (pl. 1, fig. 11), locality DC2–80–EG–195, length 0.50 mm, height 0.25 mm. USNM 408148, female right valve (pl. 4, figs. 8, 11), locality EGAL–75–KC–69, length 0.53 mm, height 0.29 mm. USNM 408149, female left valve (pl. 4, figs. 9, 10, 14), locality DC2–80–EG–73, length 0.51 mm, height 0.29 mm. USNM 408150, male left valve (pl. 4, fig. 12), locality DC2–80–EG–73, length 0.55 mm, height 0.29 mm. USNM 408151, female left valve (pl. 4, figs. 13, 16), locality EGAL–75–KC–59B, length 0.48 mm, height 0.29 mm. USNM 408152, male left valve (pl. 4, fig. 15), locality EGAL–75–KC–69, length 0.60 mm, height 0.33 mm. USNM 408153, female left valve (pl. 4, fig. 17), locality EGAL–75–KC–115, length 0.48 mm, height 0.24 mm.

Cytheromorpha molniai n. sp.

Plate 1, figures 12. 13; plate 5, figures 1–8

Cytheromorpha sp. A Brouwers, 1981, p. 9; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1983.

Diagnosis.—Characterized by long, low valve shape; prominent anterior marginal flange; convergent posterior end; and concentric marginal ornament ridges and pits.

Description.—Adult valves elongate, subrectangular in lateral view. Dorsal margin straight; anterior margin broadly curved; ventral margin gently arched, with broad, shallow concavity; posterior margin truncated. Left valve similar to right, but with more obtuse posterodorsal cardinal angle. Greatest length through midline of valve; greatest height through anterior hinge element. Pronounced dimorphism: males significantly longer, slightly lower than females, with less posterior convergence of dorsum and venter.

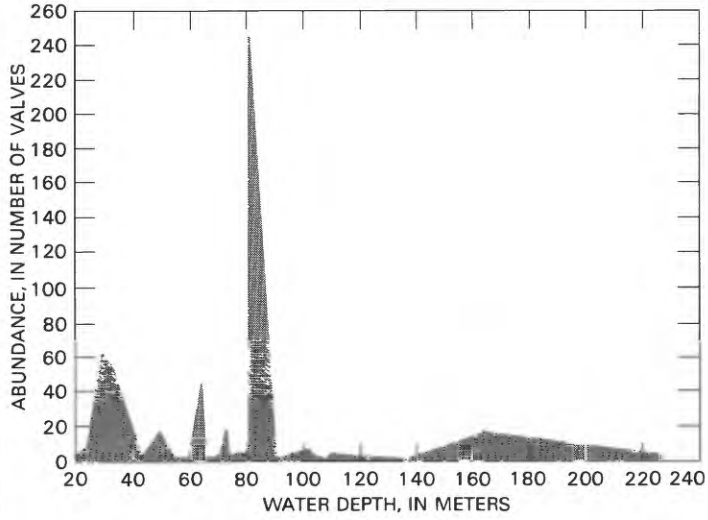

FIGURE 12.—Plot of abundance versus water depth for *Cytheromorpha knikensis* Forester and Brouwers, 1985.

Valve surface varies from predominantly smooth to predominantly pitted. Three or four low ridges trend parallel to anterior and posterior margins, with small interconnecting ridges. All specimens have ovoid pits concentrated near anterior and posterior margins; pits tend to align in rows concentric to margin. Individuals range from those with smooth median region and marginal pitting (pl. 5, figs. 1, 2, 4) to those with pitting that covers the entire valve (pl. 5, fig. 5). Pits are various sizes, tending to be very small at median region of valve. Oblique anterodorsal sulcus. Weak median sulcus extends from dorsal margin to median valve. Anterior and posterior margins rimmed by smooth, flat flange; flange is larger at anterior. One hundred twenty to one hundred twenty-eight normal pores scattered over valve, most anterodorsal. Normal pores sieve-type; subcentral setal opening. Sieve plate not discrete; edge of the sieve pore is continuous with the valve surface. Normal pores occur within ornament pits.

Inner margin and line of concrescence do not coincide. Shallow, arcuate posterior and ventral vestibules, forming continuous vestibular space to concavity. Moderately deep, arcuate anterior vestibule. Inner lamella widest at anterior, narrower and of even width at posterior and venter. Well-developed selvage. Twenty-five to thirty radial pores, most anterior; pores are straight and simple.

Right valve hinge consists of anterior tooth-socket pair, a finely crenulate median groove that thickens and enlarges terminally, and an elongate posterior tooth.

Four adductor muscle scars form a slightly arcuate row. Dorsal scar is ellipsoidal; dorsomedian scar is sub-

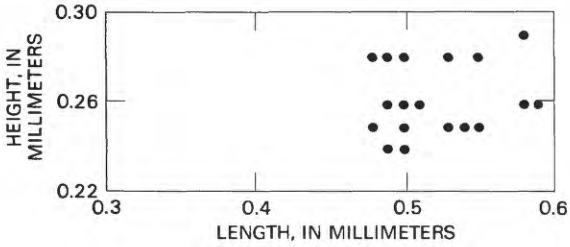

FIGURE 13.—Plot of length versus height for *Cytheromorpha molniai* n. sp.

quadrate, with inflated posterior; ventromedian scar is elongate, with expanded posterior half; ventral scar is ellipsoidal. Frontal scar split into larger, kidney-shaped, posterior scar and small, ovoid, anterior scar. Subtle gumdrop-shaped fulcral point with prominent dorsal rim. Two adjacent mandibular scars located posteroventral of frontal scars. Dorsal scars numerous, most along hinge line.

Measurements.—X–Y plot based on 21 specimens (fig. 13).

Comparisons.—*Cytheromorpha molniai* differs from *C. eskerensis* (Quaternary; Gulf of Alaska) by its few radial pores, different number and arrangement of normal pores, weak posterodorsal cardinal angle, weak marginal ridged ornament, and different arrangement of marginal pits. *C. molniai* differs from *C. grandwashensis* (Quaternary; Gulf of Alaska) by its small size, convergent posterior, offset rather than centrally placed concavity, large anterior marginal flange, and ornament pattern of moderate-sized pits and marginal ridges. *C. molniai* differs from *Cytheromorpha* sp. A of Valentine (1976) (middle Pliocene through Holocene; northern California, Oregon, Washington) by its large, low marginal valve shape; shallow, broad ventral concavity; prominent anterior marginal flange; and strong marginal ornament. *C. molniai* differs from *Cytheromorpha* sp. B of Valentine (1976) (upper Pliocene through Holocene; northern California, Oregon, Washington) by its long, low valve shape; convergent posterior; and concentrically organized, strong marginal ornament pits and ridges.

Occurrence.—Assemblages I, II, III, V.

Distribution.—Pleistocene, Holocene: Gulf of Alaska, Cook Inlet, Kodiak Shelf. Sublittoral (fig. 14).

Material.—One hundred sixty-three adult valves, 85 juvenile valves.

Type specimens.—Holotype: USNM 408154, male right valve (pl. 1, fig. 12), locality EGAL–75–KC–11, length 0.58 mm, height 0.26 mm.

Paratypes: USNM 408155, male left valve (pl. 1, fig. 13), locality EGAL–75–KC–11, length 0.55 mm, height 0.25 mm. USNM 408156, male left valve (pl. 5, fig. 1), locality EGAL–75–KC–60, length 0.54 mm, height 0.25 mm. USNM 408157, female left valve (pl. 5, fig. 2), locality EGAL–75–KC–11, length 0.53 mm, height 0.28 mm. USNM 408158, female right valve (pl. 5, fig. 3), locality EGAL–75–KC–11, length 0.55 mm, height 0.28 mm. USNM 408159, male left valve (pl. 5, figs. 4, 6), locality EGAL–75–KC–11, length 0.58 mm, height 0.29 mm. USNM 408160, female left valve (pl. 5, fig. 5), locality EGAL–75–KC–60, length 0.49 mm, height 0.24 mm. USNM 408161, male left valve (pl. 5, figs. 7, 8), locality EGAL–75–KC–11, length 0.59 mm, height 0.26 mm.

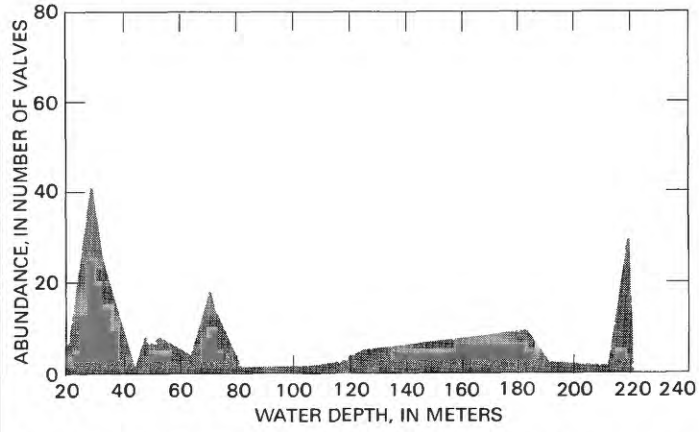

FIGURE 14.—Plot of abundance versus water depth for *Cytheromorpha molniai* n. sp.

Etymology.—After B.F. Molnia, Chief Scientist of the three oceanographic cruises from which samples analyzed for this report were obtained.

Tribe SCHIZOCYTHERINI Mandelstam, 1909

Genus SCHIZOCYTHERE Triebel, 1950

Type species.—*Schizocythere hollandica* Triebel, 1950.

(Type by original designation.)

Schizocythere sp. A

Plate 1, figure 14; plate 5, figures 10, 11

Schizocythere sp. A Brouwers, 1981, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1982c, p. 2, 3; Brouwers, 1983.

Diagnosis.—Characterized by an obliquely inclined dorsal margin; medial caudal process; four radially oriented ridges extending from muscle tubercle to dorsum; two strong, short horizontal ridges at anteromedian and posteromedian; strong, V-shaped posterior ridge; and strong anterior marginal ridge.

Occurrence.—Assemblage V.

Distribution.—Pleistocene through Holocene: Gulf of Alaska, Cook Inlet, Kodiak Shelf, North Aleutian shelf, Norton Sound, Pribilof Islands, Chukchi Sea. Inner to middle sublittoral.

Material.—One adult valve, two juvenile valves.

Illustrated specimens.—USNM 408162, right valve (pl. 1, fig. 14), locality EGAL–75–KC–157, length 0.68 mm, height 0.40 mm. USNM 408163, juvenile left valve (A–1) (pl. 5, figs. 10, 11), locality EGAL–75–KC–39, length 0.55 mm, height 0.40 mm.

Tribe PALJENBORCHELLINI Deroo, 1960

Genus PALMENELLA Hirschmann, 1916

Type species.—*Cythereis limicola* Norman, 1865. (Type by subsequent designation.)

Palmenella limicola (Norman, 1865)

Plate 1, figure 15; plate 4, figures 9, 12, 17; plate 6, figure 1

Cythereis limicola Norman, 1865, p. 20–21, pl. 6, figs. 1–4.
Cythereis limicola Norman. Brady, 1867, p. 193.
Cythere limicola (Norman). Brady, 1867, p. 208; Norman, 1867, p. 198; Brady, 1868a, p. 405, pl. 31, figs. 38, 41; Brady, 1868b, p. 30; Brady and Crosskey, 1871, p. 61; Brady and Robertson, 1872, p. 68; Brady, Crosskey, and Robertson, 1874, p. 153, pl. 13, figs. 16, 17; Robertson, 1875, p. 123; Brady and Robertson, 1876, p. 186; Robertson, 1883, p. 28; Malcolmson, 1886, p. 633; Brady and Norman, 1889, p. 145, pl. 14, figs. 25–27; Norman, 1891, p. 111; Sars, 1891, p. 19, 71; Brady and Norman, 1896, p. 732; Vanhoffen, 1897, p. 292; Scott, 1899, p. 84; Andersson, 1901, p. 363; Brady, 1902, p. 99; Norman, 1902, p. 484; Norman, 1905, p. 146; Scott, 1906, p. 281; Norman and Brady, 1909, p. 102; Ostenfield and Wesenberg-Lund, 1909, p. 113; Mueller, 1912, p. 377; Stephensen, 1913, p. 357; Kindle and Whittaker, 1918, p. 250.
Kyphocythere limicola (Norman). Sars, 1925, p. 181–182, pl. 82; Klie, 1929, p. 21; Mueller, 1931, p. 28; Klie, 1938, p. 172–173.
Palmenella limicola (Norman). Hirschmann, 1916, p. 582–594, figs. 8–27; Elofson, 1941, p. 277–278; Schafer, 1953, p. 384; Lange, 1956, p. 81; Swain, 1963, p. 830–831, pl. 99, figs. 3a–d; text-fig. 9d; Lev, 1969, pl. 1, fig. 10; pl. 5, fig. 4; Lev, 1970, p. 353; Hanai, 1970, p. 705, text-figs. 6B, 7G–H, 18; Lev, 1972, p. 15; Neale and Howe, 1975, p. 426, pl. 5, figs. 7, 8; Siddiqui and Grigg, 1975, pl. 2, figs. 14; Rosenfeld, 1977, p. 15, pl. 1, figs. 1–4; Lord, 1980, p. 234, pl. 3, fig. 6; Cronin, 1981, p. 412, pl. 11, figs. 1, 2, 4; Brouwers, 1982c, p. 4; Ishizaki and Matoba, 1985, pl. 5, figs. 16, 17; McDougall, Brouwers, and Smith, 1986, pl. 13, fig. 8; Tabuki, 1986, p. 49; Cronin and Ikeya, 1987, p. 86, pl. 2, fig. 17; Cronin, 1988, p. 129.
Leptocythere limicola (Norman). Yassini, 1969, p. 36–37.
Cythere nodosa Sars, 1866, p. 34.
Cythere aureolata Brady, 1867, p. 381, pl. 62, fig. 2.
Cythere complexa Brady, 1867, p. 310.
Palmenella americana Blake, 1929, p. 12, fig. 5; Blake, 1933, p. 237.

Diagnosis.—Characterized by three strong tubercles along dorsal half of valve, anteroventral marginal denticles, fine secondary pitting, strong U-shaped sulcus at anterodorsum, lack of vestibule, and irregular dorsal margin.

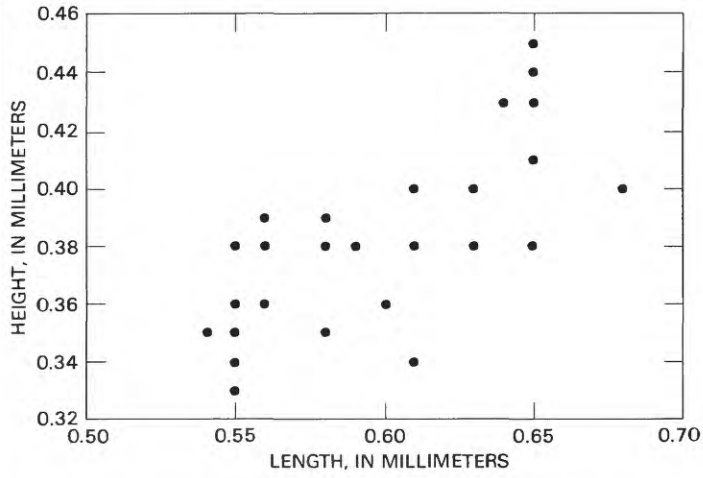

FIGURE 15.—Plot of length versus height for *Palmenella limicola* (Norman, 1865).

Measurements.—X–Y plot based on 33 specimens (fig. 15).

Comparisons.—*Palmenella limicola* (Norman, 1865) differs from *P. californica* Triebel, 1957 (upper Pliocene through Holocene; central and southern California) by its weakly developed L-shaped ridge along the anterior and ventral margins; fine-scale secondary ornament pitting, strong anterodorsal cardinal angle, anteroventral marginal denticles, strong U-shaped sulcus in anterodorsal region, lack of vestibular space, irregular dorsal margin, and evenly curved anterior margin.

Remarks.—Comparison of *Palmenella limicola* specimens from the Gulf of Alaska to *P. limicola* s.s. from the northeast Atlantic (as illustrated by Lord, 1980) shows similar development and arrangement of ornament tubercles, anterior marginal flange, and anterior ornament; specimens from Alaska show a more squared lateral outline, weaker anterior ridge, and fine-scale pitting rather than reticulate ornament. Comparison of *P. limicola* to *P. californica* (as illustrated in Valentine, 1976; Cronin and others, 1983) shows similar finely pitted ornament, ventral ridge, and marginal denticles; *P. limicola* differs from *P. californica* by its weak to almost nonexistent ornament ridges and three strong tubercles. Specimens of *Palmenella limicola* from Japan (Cronin and Ikeya, 1987) more closely resemble the finely pitted specimens from Alaska than *P. limicola* s.s. from the North Atlantic.

P. limicola is represented by a large number of specimens in the Gulf of Alaska material, and the population contains a high degree of intraspecific variation in valve shape, size, and particularly ornamentation pattern. The intraspecific variability encompasses features of *P. limicola* s.s. and *P. californica*. Specimens within

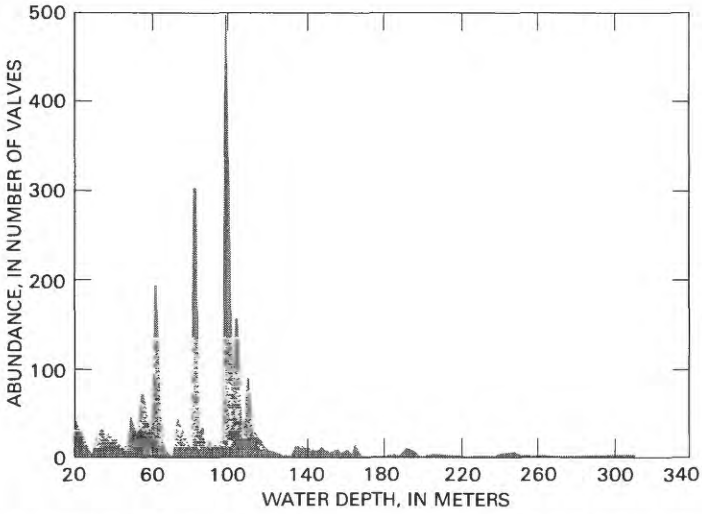

FIGURE 16.—Plot of abundance versus water depth for *Palmenella limicola* (Norman, 1865).

the overall *P. limicola* population variously show affinities with either *P. limicola* s.s. or *P. californica*. Plate 5 illustrates this variability: plate 5, figure 13, shows the reticulate ornament pattern of *P. limicola* s.s., and plate 5, figures 14 and 15, show the finely pitted ornament pattern of *P. californica*. Plate 5, figure 16, shows a third morphotype, which is different from the pit or ridge types. Specimens of *P. limicola* s.l. in the Gulf of Alaska form an intermediate population between the two species endpoints and are sited in a median geographic and climatic region. In my opinion, *Palmenella* forms a species cline or species complex that ranges from *P. limicola* in the Atlantic to *P. californica* in the Pacific.

Occurrence.—Assemblages II*, III*, IV.

Distribution.—Pliocene: Japan; Pleistocene through Holocene: Japan, Gulf of Alaska, Cook Inlet, Pribilof Islands, Norton Sound, Chukchi Sea, Beaufort Sea, north Atlantic. Sublittoral, upper bathyal (fig. 16).

Material.—Nine hundred eleven adult valves, 1,227 juvenile valves.

Illustrated specimens.—USNM 408164, left valve (pl. 1, fig. 15), locality DC2–80–EG–67, length 0.64 mm, height 0.43 mm. USNM 408165, male right valve (pl. 5, figs, 9, 14), locality DC2–80–EG–63, length 0.61 mm, height 0.40 mm. USNM 408166, male left valve (pl. 5, fig. 13), locality DC2–80–EG–63, length 0.58 mm, height 0.38 mm. USNM 408167, female right valve (pl. 5, figs. 12, 16), locality DC2–80–EG–63, length 0.65 mm, height 0.43 mm. USNM 408168, female left valve (pl. 5, fig. 15), locality DC2–80– EG–63, length 0.65 mm, height 0.43 mm. USNM 408169, female right valve (pl. 5, fig. 17), locality DC2–80–EG–67, length 0.63 mm, height 0.40 mm. USNM 408170, female left valve (pl. 6, fig. 1), locality DC2–80–EG–63, length 0.65 mm, height 0.41 mm.

Genus ACUMINOCYTHERE Swain and Gilby, 1974

Type species.—*Acuminocythere crescentensis* Swain and Gilby, 1974.
(Type by monotypy.)

Remarks.—Hanai (1970) examined taxonomically important morphologic features (ornament, eye spots, normal pore canals, central muscle scars, hingement, soft parts) of seven genera in the subfamily Schizocytherinae, including *Palmenella*, *Paijenborchella*, *Neomonoceratina*, *Schizocythere*, *Amphicytherura*, *Sulcostocythere*, and *Eopaijenborchella*. Hanai recognized that "*Paijenborchella*" of Hazel (in Addicott, 1966) represented a distinct monotypic group belonging to *Paijenborchella* s.l. and occupying the mild- to cold-temperate climatic zones of the eastern Pacific. Swain and Gilby (1974) subsequently erected the monospecific genus *Acuminocythere* for "*Paijenborchella*."

Acuminocythere crescentensis Swain and Gilby, 1974

Plate 6, figures 2–8; plate 7, figure 1

Acuminocythere crescentensis Swain and Gilby, 1974, p. 285, 287, pl. 2, figs. 11, 12; text-fig. 38b.
Acuminocythere crescentensis Swain and Gilby. Brouwers, 1982c, p. 3.
Urocythere? sp. B Swain, 1969, p. 465, pl. 4, figs. 3a–d, 4a–b; pl. 9, fig. 10; pl. 11, figs. 9a–c.
"*Paijenborchella*" sp. Hazel, *in* Addicott, 1966, p. C5; Hanai, 1970, p. 706, pl. 107, fig. 4; text-figs. 8A–C, 9, 10C′, 10C, 10G, 11C, 11G, 11L, 12C, 13C, 13E, 13G, 13G′.
"*Paijenborchella*" sp. A Valentine, 1976, pl. 13, figs. 8, 11.
Acuminocythere sp. A Brouwers, 1981, p. 8; Brouwers, 1982b, p. 8; Brouwers, 1983.

Diagnosis.—Characterized by smooth valve surface, straight dorsal margin, and evenly curved caudal process and posterior margin.

Description.—Adult valves ellipsoidal in lateral view. Dorsal margin broadly curved; anterior margin smoothly curved, with maximum width ventral of midline; ventral margin with slight concavity; posterior margin produced, forming short, blunt caudal process. Greatest length through caudal process; greatest height through anterior hinge element. Females differ from males in being shorter, higher in lateral view, and somewhat wider at posterior.

Valve surface smooth except along posterior, where a pattern of small punctae is present. Broad ridge overhangs ventral margin. Two ovoid depressions at anteroventral corner. Fifty-five sieve-type normal pores evenly distributed over valve.

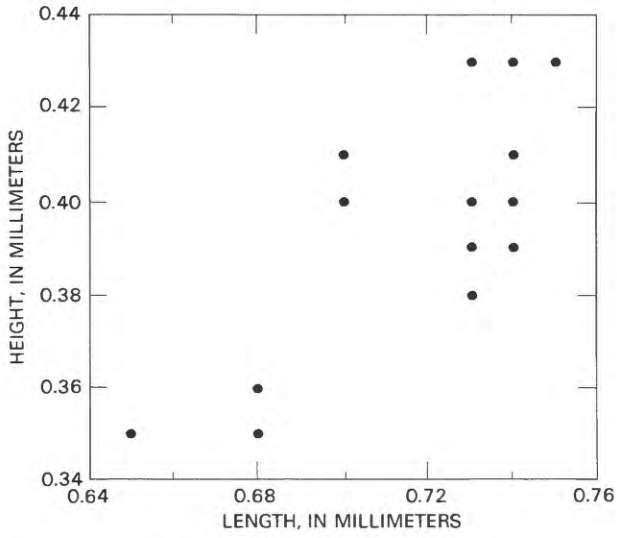

FIGURE 17.—Plot of length versus height for *Acuminocythere crescentensis* Swain and Gilby, 1974.

Inner margin and line of concrescence coincide ventrally and posteriorly; arcuate anterior vestibule. Inner lamella widest at posterior. Moderately developed selvage.

Left valve hinge consists of anterior bifid tooth; large quadrate anteromedian socket with anterior and ventral rim; crenulate median groove; and very large, platform-like posterior crenulate tooth. Hingement in right valve complementary, showing strongly developed ventral rims for terminal sockets. Hingement very strong, thickly calcified. Dorsal margin of left valve curved over to receive right valve margin as an accommodation ridge.

Vertical row of four adductor muscle scars, consisting of subtriangular dorsal scar, two median ovoid scars, and circular ventral scar. Prominent ovoid fulcral point, often with dorsal rim. Single, ovoid frontal scar with enlarged dorsal half. Dorsal muscle scars are large and form deep impressions.

Measurements.—X–Y plot based on 14 specimens (fig. 17).

Comparisons.—*Acuminocythere crescentensis* Swain and Gilby, 1974 differs from "*Paijenborchella*" sp. B of Valentine, 1976 (Form 1, pl. 13, figs. 4, 5; see remarks below) (Holocene; northern California) by its less inclined anterodorsal margin, lack of eye tubercle, and lack of surface ornamentation. *A. crescentensis* differs from "*Paijenborchella*" sp. B of Valentine, 1976 (Form 2, pl. 13, fig. 7) (middle and upper Pliocene; south-central California) by its more subdued caudal process, straight dorsal margin, lack of marginal denticles, and smooth valve surface.

Remarks.—Valentine (1976) illustrated two species of "*Paijenborchella*": "*P.*" sp. A (pl. 13, figs. 8, 11) and "*P.*" sp. B (pl. 13, figs. 4, 5, 7). "*P.*" sp. A, herein formally synonymized with *A. crescentensis*, was reported by Valentine (1976) as living in warm-temperate to mild-temperate climates of central California, Oregon, and Washington, and as a fossil occurrence from the Pliocene Foxen Mudstone, south-central California. "*P.*" sp. B was reported as living in cooler warm temperate to mild temperate climates of northern California and as a fossil from the Pliocene Foxen Mudstone and the upper Pliocene Careaga Sandstone, in south-central California. On the basis of (1) the illustrations of Valentine (1976), (2) topotype material from the Careaga Sandstone which I have examined, and (3) the disparate stratigraphic occurrences of the two illustrated forms, I believe that Valentine's "*P.*" sp. B represents two distinct species, which I refer to as Form 1 and Form 2. Form 1 is illustrated by Valentine (1976) on his plate 13, figures 4 and 5, and Form 2 is illustrated on his plate 13, figure 7. Swain (1969) illustrated Valentine's "*P.*" sp. B Form 1 in his plate 4, figure 2, as *Urocythere?* sp. A, with a Holocene occurrence from northern California; Valentine listed a modern occurrence from Soquel Cove, central California for his illustrated specimen of Form 1. The illustrated specimen of "*P.*" sp. B Form 2 (Valentine, 1976) is from the upper Pliocene Careaga Sandstone. I am placing both of the "*P.*" sp. B species (Form 1 and Form 2) in *Acuminocythere*. The genus as I interpret it contains one described species (*A. crescentensis* Swain and Gilby, 1974) and two undescribed species ("*P.*" sp. B Form 1 and "*P.*" sp. B Form 2).

Occurrence.—Assemblages III, V.

Distribution.—Middle Pliocene through Holocene: central and northern California. Pleistocene through Holocene: Puget Sound, Oregon, Gulf of Alaska, Cook Inlet, Kodiak Shelf. Sublittoral.

Material.—Fifteen adult valves, 117 juvenile valves.

Illustrated specimens.—USNM 408171, left valve (pl. 7, fig. 1), locality EGAL–75–KC–141, length 0.70 mm, height 0.40 mm. USNM 408172, male left valve (pl. 6, figs. 2, 3, 6), locality EGAL–75–KC–52A, length 0.68 mm, height 0.35 mm. USNM 408173, female right valve (pl. 6, fig. 4), locality EGAL–75–KC–52A, length 0.73 mm, height 0.38 mm. USNM 408174, female left valve (pl. 6, fig. 5), locality EGAL–75–KC–52A, length 0.74 mm, height 0.39 mm. USNM 408175, female left valve (pl. 6, figs. 7, 8), locality EGAL–75–KC–52A, length 0.65 mm, height 0.35 mm.

Tribe PECTOCYTHERINI Hanai, 1957

Genus MUNSEYELLA van den Bold, 1957

Type species.—*Toulminia hyalokystis* Munsey, 1953. (Type by subsequent designation.)

Munseyella melzeri n. sp.

Plate 6, figures 9–15; plate 7, figures 2, 3

Munseyella sp. A Brouwers, 1981, p. 11; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

Diagnosis.—Characterized by weak ornament ridges, four ridges radiating from median valve to dorsum, V-shaped ridge in anteromedian region, robust posterior marginal denticles, and convergent posterior.

Description.—Adult valves elongate, subquadrate in lateral view. Dorsal margin straight, inclined down posteriorly; anterior margin smoothly curved; ventral margin broadly sinuous, with small concavity; posterior margin blunt, squared-off. Well-developed posterodorsal cardinal angle. Anterior with four blunt marginal denticles; posterior with two primary medially located marginal denticles and two smaller, blunt denticles located between the primary denticles. Left valve similar to right, but with high anterodorsal corner. Greatest length through midline of valve; greatest height through anterior hinge element.

Valve surface covered with low, broad ridges. Anterior with smooth, broad marginal ridge and adjacent C-shaped sulcus. Posterior with vertical, sinuous, massive ridge that parallels margin and forms overhang at posterodorsal corner. Short, oblique ventral ridge. V-shaped ridge originates medially, directed toward anterior. Four short, massive, vertical ridges originate in median valve, radiate out to dorsum. Secondary ornament consists of fine papillae scattered over valve surface. Twenty-seven to thirty-one normal pores evenly distributed over valve; normal pores simple, with marginal rim.

Right valve hinge consists of knoblike anterior tooth; elongate, ellipsoidal anteromedian socket; finely crenulate median groove; small, ovoid, posteromedian socket; and elongate, triangular, posterior socket.

Four adductor muscle scars form an oblique row, inclined posterodorsally. Prominent fulcral point, with calcified dorsal rim. Frontal scar large, J-shaped.

Measurements.—X–Y plot based on 31 specimens (fig. 18).

Comparisons.—*Munseyella melzeri* is distinguished from *Munseyella* sp. A of Valentine (1976) (Holocene; Baja California and southern California) by its weak, less massive ridges; convergent posterior margin; V-shaped ridge in anteromedian region; four radiating ridges in dorsal half, rather than a sinuous arrangement; and lack of a strongly calcified anterior margin. *M. melzeri* differs from *M. morrisi* Triebel, 1957 (upper Pleistocene; southern California) by its V-shaped ridge at anteromedian; weak anterior marginal ridge and sulcus; and lack of fanlike arrangement of ridges, especially toward dorsum. *M. melzeri* differs from *M. pedroensis* Triebel, 1957 (Pleistocene; southern California) by its narrow, weak anterior ridge and sulcus; three ridges radiating toward dorsum; V-shaped ridge in anteromedian region; posterior marginal ridges; and convergent posterior. *M. melzeri* differs from *M. similis* Triebel, 1957 (upper Pleistocene; southern California) by its V-shaped ridge in the anteromedian region; weak anterior sulcus; a squared-off posterior ridge, rather than arcuate-shaped ridge; and lack of two strong horizontal ridges at the anteroventral region.

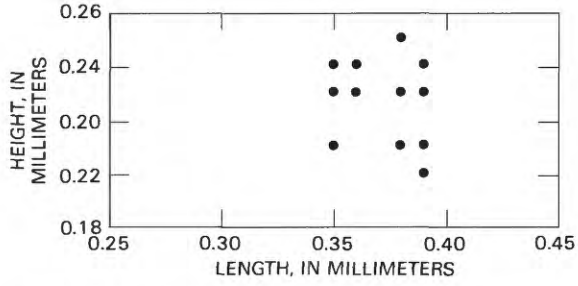

FIGURE 18.—Plot of length versus height for *Munseyella melzeri* n. sp.

Occurrence.—Assemblages II, III*.

Distribution.—Pleistocene through Holocene: Gulf of Alaska, Cook Inlet, Kodiak Shelf. Middle to outer sublittoral (fig. 19).

Material.—One hundred sixty-eight adult valves, eight juvenile valves.

Type specimens.—Holotype: USNM 408176, female right valve (pl. 7, fig. 2), locality EGAL–75–KC–210, length 0.38 mm, height 0.23 mm.

Paratypes: USNM 408177, male right valve (pl. 7, fig. 3), locality EGAL–75–KC–210, length 0.39 mm, height 0.20 mm. USNM 408178, male right valve (pl. 6, figs. 9, 14), locality EGAL–75–KC–52A, length 0.35 mm, height 0.23 mm. USNM 408179, female left valve (pl. 6, fig. 10), locality EGAL–75–KC–52A, length 0.35 mm, height 0.24 mm. USNM 408180, male right valve (pl. 6, figs. 11, 12), locality EGAL–75–KC–52A, length 0.36 mm, height 0.23 mm. USNM 408181, female right valve (pl. 6, figs. 13, 15), locality EGAL–75–KC–52A, length 0.35 mm, height 0.21 mm.

Etymology.—After Dr. Steve Melzer, a geological consultant for Science Application Information Corporation (SAIC), Midland, Tex.

Munseyella ristveti n. sp.

Plate 6, figures 16–18; plate 7, figure 4

Munseyella sp. B Brouwers, 1981, p. 11; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

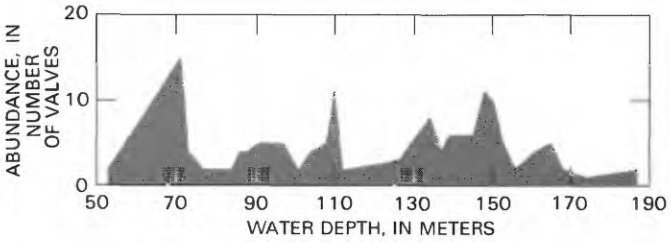

FIGURE 19.—Plot of abundance versus water depth for *Munseyella melzeri* n. sp.

Diagnosis.—Characterized by reticulate ornament; convergent posterior; broadly arched dorsum; smooth, broad, flat flange along anterior margin; two weak posterior marginal denticles; overhanging ventral ridge; and strong concavity.

Description.—Adult valves elongate, subquadrate in lateral view. Dorsal margin broadly arched, inclined downward toward the posterior; anterior margin evenly curved; ventral margin broadly sinuous, with pronounced concavity; posterior margin blunt, squared-off. Posterior margin with two blunt, strong, medially located denticles. Left valve similar to right, but with smaller, more convergent posterior end. Greatest length through midline of valve; greatest height through anterior hinge element.

Valve surface covered with low, rounded reticulation pattern. Reticulation most pronounced near anterior and posterior margins, where ridges are better developed and pattern is concentric and parallels valve margins. Rounded, crescentic ventral ridge overhangs margin and terminates posteriorly as thickened tubercle. Anterior and posterior margins with narrow, smooth, flattened rim or flange. Weak median sulcus originates near dorsum and proceeds vertically to midvalve. About 50 simple-type normal pores evenly distributed over valve.

Inner margin and line of concrescence coincide throughout. Inner lamella very narrow. Inner margin parallels valve outline. Strong, well-developed selvage. Ten radial pores, most anterior; radial pores are straight and simple.

Left valve hinge consists of an elongate, arcuate anterior socket; a coarsely crenulate median bar; and an elongate, arcuate posterior socket.

Four adductor muscle scars form an oblique row, inclined posterodorsally. Dorsal scar is elongate and subcylindrical; dorsomedian scar is subovoid, with an enlarged anterior end; ventromedian scar is narrow, ovoid; and ventral scar is very small and cylindrical. Frontal scar is massive, J-shaped. Dorsal muscle scars and mandibular scars not visible.

Measurements.—X–Y plot based on 17 specimens (fig. 20).

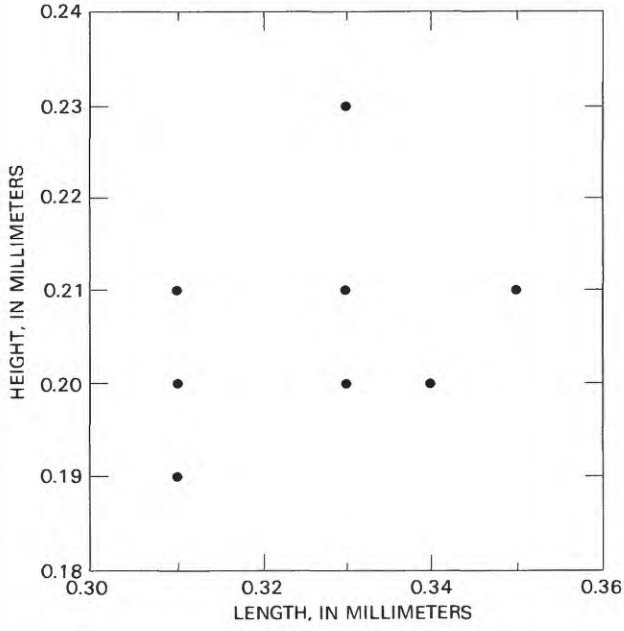

FIGURE 20.—Plot of length versus height for *Munseyella ristveti* n. sp.

Comparisons.—*Munseyella ristveti* differs from *M. melzeri* (Quaternary; Gulf of Alaska) by its reticulate ornament; convergent posterior, especially in left valve; broadly curved dorsum; broad, smooth, flat anterior marginal flange; and lack of prominent anterior marginal ridge and sulcus. *M. ristveti* differs from *Munseyella* sp. A of Valentine (1976) (Holocene; Baja California and southern California) by its reticulate ornament, convergent posterior, few posterior marginal denticles, strong concavity, and lack of prominent anterior marginal ridge and sulcus. *M. ristveti* differs from *M. morrisi* Triebel, 1957 (upper Pleistocene; southern California) by its less arched anterodorsal corner, evenly rounded anterior, reticulate ornament, and lack of prominent anterior marginal ridge and sulcus. *M. ristveti* differs from *M. pedroensis* Triebel, 1957 (upper Pleistocene; southern California) by its reticulate ornament, evenly curved dorsum, convergent posterior end, weak posterior marginal denticles, weak median vertical sulcus, and lack of heavy anterior marginal ridge and sulcus. *M. ristveti* differs from *M. similis* Triebel, 1957 (upper Pleistocene; southern California) by its reticulate ornament, convergent posterior, strong concavity, overhanging ventral ridge, broadly arched dorsum, and lack of prominent anterior marginal ridge and sulcus.

Occurrence.—Assemblages II, III.

Distribution.—Pleistocene(?), Holocene: Gulf of Alaska. Middle to outer sublittoral.

Material.—Eighteen adult valves, three juvenile valves.

Type specimens.—Holotype: USNM 408182, left valve (pl. 7, fig. 4), locality EGAL–75–KC–150, length 0.34 mm, height 0.20 mm.

Paratypes: USNM 408183, left valve (pl. 6, fig. 16), locality EGAL–75–KC–215, length 0.33 mm, height 0.21 mm. USNM 408184, right valve (pl. 6, figs. 17, 18), locality EGAL–75–KC–215, length 0.34 mm, height 0.20 mm.

Etymology.—After Dr. Byron Ristvet, a geological consultant with the Defense Nuclear Agency, Las Vegas, Nev.

Genus PECTOCYTHERE Hanai, 1957

Type species.—*Pectocythere quadrangulata* Hanai, 1957.
(Type by original designation.)

Pectocythere sp. G

Plate 7, figure 8

Pectocythere sp. G Brouwers, 1981, p. 11; Brouwers, 1983.

Diagnosis.—Characterized by an elongate, subquadrate valve outline; two strong posterior marginal denticles; ornament pitting arranged in oblique rows at anterior; and rounded, weak posterior cardinal angles.

Distribution.—Holocene: Gulf of Alaska.

Material.—One adult valve.

Illustrated specimen.—USNM 408185, left valve (pl. 7, fig. 8), locality EGAL–75–KC–32, length 0.63 mm, height 0.35 mm.

Pectocythere sp. A

Plate 7, figure 9

Diagnosis.—Characterized by an elongate, subquadrate valve outline; convergent posterior; pitted ornament arranged concentrically at anterior and radially at posterior; prominent, thin, raised posterior marginal ridge; and five ornament tubercles scattered along dorsal and ventral margins.

Distribution.—Holocene(?): eastern Gulf of Alaska.

Material.—One adult valve.

Illustrated specimen.—USNM 408186, right valve (pl. 7, fig. 9), locality DC1–79–EG–46, length 0.50 mm, height 0.26 mm.

Pectocythere janae n. sp.

Plate 7, figure 7; plate 8, figures 3–5, 7–9, 12

Pectocythere aff. *P. quadrangulata* Hanai, 1957. Brouwers, 1981, p. 11; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1982c, p. 3; Brouwers, 1983.

Diagnosis.—Characterized by a straight dorsum; low, elongate valve shape; reticulate primary ornament and labyrinthine secondary ornament; strong, V-shaped posterior marginal ridge; strong ventral ridge and posteroventral tubercle; lack of convergent posterior; and split frontal scar.

Description.—Adult valves subquadrate in lateral view. Dorsal margin broadly sinuous; anterior margin smoothly curved with greatest extent ventral of midline; ventral margin broadly concave, with shallow concavity; posterior margin truncated, with greatest width dorsal of midline. Obtuse anterodorsal cardinal angle; pronounced, protruding posterodorsal cardinal angle. Right valve similar to left, but with sinuous dorsal margin, weak posterodorsal cardinal angle, and truncated posterior margin. Greatest length through midline of valve; greatest height through anterior hinge element. Subtle dimorphism: males are slightly shorter and lower than females.

Valve surface covered with reticulation, ridges, and tubercles. Primary ornament is reticulation, with disorganized arrangement of massive low ridges and ovoid pits. Reticulation becomes concentrically arranged marginally. Posterior end with wide V-shaped ridge; pointed end oriented toward posterior. Low, sinuous dorsal ridge partly overhangs margin. Low ovoid tubercle ventral of anterodorsal corner. Pronounced tubercle at posteroventral corner. Secondary ornament is fine labyrinthine pattern over entire valve. Forty-five normal pore canals evenly distributed over valve surface, both within reticulation pits and on ridges. Normal pores simple-type, with raised marginal rim.

Inner margin and line of concrescence coincide along venter and posterior. Anterior with deep, crescentic vestibule. Weakly developed selvage. Inner lamella widest at anterior. Inner margin follows valve outline. Thirteen radial pores, one false radial pore; radial pore canals are moderately long, straight, and simple.

Right valve hinge consists of large, hemispherical anterior tooth; ovoid anteromedian socket; coarsely crenulate median groove; ovoid posteromedian socket; and large, hemispherical posterior tooth.

Four adductor muscle scars form a slightly oblique row. Dorsal scar is elongate and subtriangular, with enlarged anterior; dorsomedian and ventromedian scars are elongate; ventral scar is semicircular. Large, deep, subcircular fulcral point. Frontal scar split into larger, subtriangular posterior scar and small, ovoid anterior scar. Two small, adjacent mandibular scars occur near adductor row: the posterior scar is elongate and ellipsoidal and the anterior scar is circular. Numerous dorsal muscle scars: smaller, ellipsoidal scars above central muscle scar field and large, subquadrate scars just below hinge line.

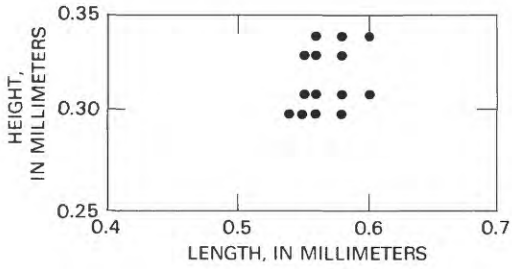

FIGURE 21.—Plot of length versus height for *Pectocythere janae* n. sp.

Measurements.—X–Y plot based on 37 specimens (fig. 21).

Comparisons.—*P. janae* differs from *P. quadrangulata* Hanai, 1957 (upper Pliocene; Hokkaido) by its anterior vestibule; straight dorsum; reticulate ornament; strong, V-shaped posterior marginal ridge; strong ventral ridge and posteroventral tubercle; less convergent posterior end; split frontal; and lack of a posteroventral vestibule. *P. janae* differs from *P. pseudoamphidonta* Hanai, 1957 (upper Pliocene; Hokkaido) by its straight dorsum; reticulate ornament; large valve with a low shape; strong, V-shaped posterior marginal ridge; weak posteroventral tubercle; and lack of a dorsal ridge and an anterior marginal ridge. *P. janae* is distinguished from *P. clavata* (Triebel, 1957) (Quaternary; southern California) by its elongate valve shape, less convergent posterior, strong V-shaped posterior marginal ridge, reticulate ornament, strong ventral ridge, and well-developed posteroventral tubercle.

Occurrence.—Assemblages I*, II*, III, V.

Distribution.—Pleistocene: Pribilof Islands. Pleistocene through Holocene: Gulf of Alaska, Cook Inlet, Puget Sound. Sublittoral (fig. 22).

Material.—One thousand forty-three adult valves, 600 juvenile valves.

Type specimens.—Holotype: USNM 408187, right valve (pl. 7, fig. 7), locality DC2–80–EG–63, length 0.56 mm, height 0.31 mm.

Paratypes: USNM 408188, left valve (pl. 8, figs. 3, 4), locality DC2–80–EG–63, length 0.58 mm, height 0.34 mm. USNM 408189, right valve (pl. 8, fig. 5), locality DC2–80–EG–63, length 0.56 mm, height 0.33 mm. USNM 408190, left valve (pl. 8, fig. 7), locality DC2–80–EG–63, length 0.58 mm, height 0.34 mm. USNM 408191, right valve (pl. 8, figs. 8, 9, 12), locality DC2–80–EG–63, length 0.56 mm, height 0.33 mm.

Etymology.—After Jan Brouwers, my sister-in-law, in recognition of her strong support of my biological studies.

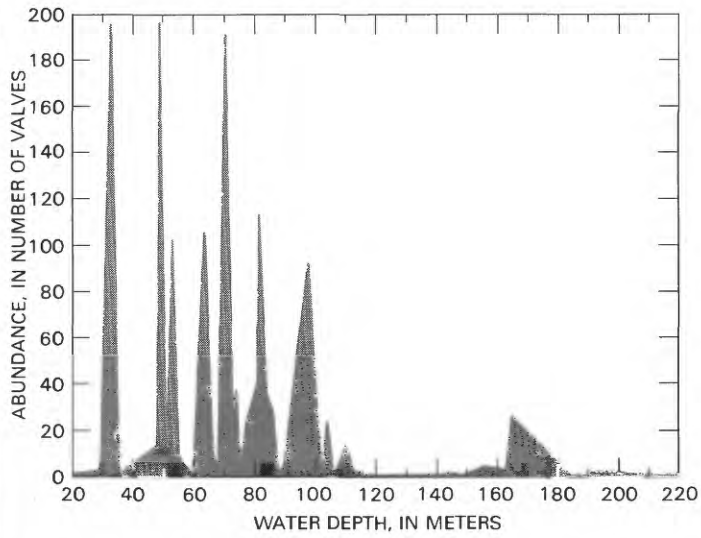

FIGURE 22.—Plot of abundance versus water depth for *Pectocythere janae* n. sp.

Pectocythere kiklukhensis n. sp.

Plate 7, figure 10; plate 9, figures 1–7, 12

Pectocythere sp. F Brouwers, 1981, p. 11; Brouwers, 1982b, p. 9; Brouwers, 1982c, p. 3; Brouwers, 1983.

Diagnosis.—Characterized by an elongate, subquadrate valve outline; subdued anterodorsal cardinal angle; pronounced dimorphism; concentric reticulate ornament; semicircular posterior ridge; and flattened posteroventral corner.

Description.—Adult valves elongate, subquadrate in lateral view. Dorsal margin straight, inclined downward posteriorly; anterior margin evenly rounded, with concave upper part; ventral margin broadly concave, with subtle concavity; posterior margin truncated. Obtuse anterodorsal cardinal angle; rounded posterodorsal cardinal angle. Posterior with two squat, strong marginal denticles. Left valve similar to right, but without concave anterodorsal margin. Greatest length through midline of valve; greatest height through anterior hinge element. Pronounced dimorphism: males are significantly lower and shorter than females.

Valve surface covered with reticulate ornament, arranged in concentric pattern. Reticulation varies markedly within species, ranging from coarsely reticulate (pl. 9, figs. 4, 5) to large pits (pl. 9, fig. 1). Reticulation ridges are broad and low, and pits are ovoid, elongate to ellipsoid, and subtriangular in shape. Low semicircular ridge parallels most of posterior margin; ridge originates at the posterodorsal corner, follows the valve outline, and curves sharply at posteroventral corner. Flattened region at posteroventral corner. Low, ovoid tubercle

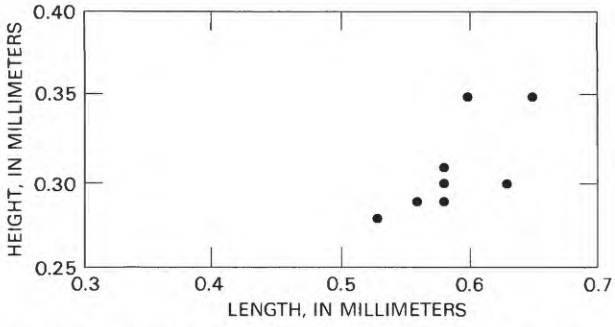

FIGURE 23.—Plot of length versus height for *Pectocythere kiklukhensis* n. sp.

present immediately anterodorsal to flattened region. Anterior margin with series of parallel ridges oriented along valve edge. Anterodorsal corner with oblique sulcus. Forty-one simple-type normal pores evenly distributed over valve, located on reticulation ridges.

Inner margin and line of concrescence coincide along posterior and venter; moderate, crescentic anterior vestibule. Fused inner lamella of even width throughout. Inner margin follows valve outline. Strong, well-developed selvage. Thirteen radial pores, most anterior; radial pore canals are short, straight, and simple.

Right valve hinge consists of massive, J-shaped anterior tooth; small, ovoid anteromedian socket; finely crenulate median groove; small, bifid posteromedian socket; and large, hemispherical posterior tooth. Hinge line slightly sinuous.

Four adductor muscle scars form an oblique row, inclined posterodorsally. Dorsal scar is semicircular; dorsomedian scar forms inflated I-shape; ventromedian scar is elongate, with enlarged anterior; ventral scar is crescentic. Pronounced, large, circular fulcral point forms deep impression. Frontal scar split into elongate, inflated, J-shaped posterior scar and small, inflated, teardrop-shaped anterior scar. Two adjacent subovoid mandibular scars immediately anteroventral of adductor row. Numerous dorsal muscle scars are present: a field of large, elongate scars just below hinge line and a second field of smaller, ovoid, less conspicuous impressions between hinge and central muscle scar field.

Measurements.—X–Y plot based on 10 specimens (fig. 23).

Comparisons.—*Pectocythere kiklukhensis* differs from *P. parkerae* Swain and Gilby, 1974 (middle Pliocene through Holocene; temperate northeast Pacific) by its low anterodorsal cardinal angle; weak, less continuous posterior marginal ridge; reticulate ornament; series of parallel anterior marginal ridges; and two strong posterior marginal denticles. *P. kiklukhensis* differs from *Pectocythere* sp. G (Holocene; Gulf of Alaska) by its more elongate valve shape, weak posterior marginal denticles, and reticulate ornament.

Occurrence.—Assemblage V.

Distribution.—Pleistocene through Holocene: Chukchi Sea, Pribilof Islands, Cook Inlet, Kodiak Shelf, Gulf of Alaska. Inner to middle sublittoral.

Material.—Eighteen adult valves.

Type specimens.—Holotype: USNM 408192, left valve (pl. 7, fig. 10), locality EGAL–75–KC–144U, length 0.58 mm, height 0.31 mm.

Paratypes: USNM 408193, left valve (pl. 9, figs. 1, 3), locality EGAL–75–KC–34, length 0.65 mm, height 0.35 mm. USNM 408194, right valve (pl. 9, fig. 2), locality EGAL–75–KC–34, length 0.60 mm, height 0.35 mm. USNM 408195, left valve (pl. 9, fig. 4, 6), locality EGAL–75–KC–52A, length 0.58 mm, height 0.30 mm. USNM 408196, right valve (pl. 9, fig. 5), locality EGAL–75–KC–52A, length 0.58 mm, height 0.29 mm. USNM 408197, right valve (pl. 9, figs. 7, 12), locality EGAL–75–KC–34, length 0.63 mm, height 0.30 mm.

Etymology.—After the Kiklukh River, a major drainage for proglacial lakes of Bering Glacier, southeast Alaska.

Pectocythere marincovichi n. sp.

Plate 7, figures 11, 12; plate 9, figures 8–11, 13–15

Pectocythere sp. E Brouwers, 1981, p. 11; Brouwers, 1982b, p. 9; Brouwers, 1983.

Diagnosis.—Characterized by an elongate, subquadrate valve outline; convergent posterior; two strong posterior marginal denticles; low, subtle reticulation; massive, crescentic posterodorsal ridge; four scattered ovoid to elongate tubercles; deep, crescentic anterior vestibule; shallow, arcuate posteroventral vestibule.

Description.—Adult valves elongate, subquadrate in lateral view. Dorsal margin straight, inclined obliquely toward posterior; anterior margin evenly curved, with greatest extent ventral of midline; ventral margin broadly concave, inclined obliquely toward posterior; posterior margin blunt, truncated, nearly vertical. Rounded, obtuse anterodorsal cardinal angle; protruding, rounded, obtuse posterodorsal cardinal angle. Posterior margin with two strong, blunt marginal denticles. Left valve similar to right, but with more pronounced concavity and more convergent posterior end. Greatest length through midline; greatest height through anterior hinge element. Subtle dimorphism: males somewhat lower, shorter than females, with less convergent posterior end, more pronounced concavity, straighter dorsum, and less protruding anterodorsal cardinal angle.

Valve surface covered with reticulation, ridges, and tubercles. Reticulation variably developed among individuals, ranging from overall valve coverage (pl. 9,

fig. 10) to very subdued localized coverage (pl. 9, fig. 13). Reticulation low and subtle, consisting of thin ridges; pattern best developed along dorsal margin. Low, smooth, massive, crescentic ridge parallels posterodorsal corner. Several ovoid to elongate raised regions or tubercles are present: a comma-shaped tubercle near anterodorsal corner; an elongate-ovoid tubercle in median part of dorsal margin; a prominent circular tubercle in posteromedian valve region; and an elongate-ellipsoidal tubercle at posteroventral region. Crescentic-shaped depressed region at posteroventral corner. Twenty-six to thirty-three simple-type normal pore canals evenly scattered over valve.

Inner margin and line of concrescence coincide along venter. Anterior with moderately deep crescentic vestibule; shallow, arcuate posteroventral vestibule. Moderately developed selvage. Fused inner lamella of nearly even width throughout; inner lamella follows valve outline.

Left valve hinge consists of large, elongate-ellipsoidal, massive anterior socket; subtriangular, smooth anteromedian tooth; finely crenulate median bar; subtriangular, smooth posteromedian tooth; and ovoid posterior socket. Median hinge element is enlarged terminally; anteromedian and posteromedian elements form terminal extensions of median element.

Four adductor muscle scars form oblique row, inclined posterodorsally. Dorsal scar is inflated, ovoid; median scars are elongate, I-shaped; ventral scar is inflated, semicircular. Prominent, ovoid fulcral point. Frontal scar is split into elongate, subcylindrical posterior scar with inflated ventral end and small, ovoid anterior scar.

Measurements.—X–Y plot based on eight specimens (fig. 24).

Comparisons.—*P. marincovichi* is distinguished from *P. parkerae* Swain and Gilby, 1974 (middle Pliocene through Holocene; temperate northeast Pacific) by its more convergent posterior; low, elongate valve shape; four large ornament tubercles; two strong posterior marginal denticles; and lack of pitted ornament. *P. marincovichi* differs from *Pectocythere* sp. A (Holocene; Gulf of Alaska) by its small anterior vestibule; two posterior marginal denticles; four large ornament tubercles; and lack of ornament pitting. *P. marincovichi* differs from *P. kiklukhensis* (Pleistocene; Gulf of Alaska, Bering Sea, Chukchi Sea) by its high, short valve outline; more convergent posterior; weak ornament reticulation; and four large ornament tubercles.

Occurrence.—Assemblage V.

Distribution.—Pleistocene through Holocene: Gulf of Alaska, Cook Inlet, Kodiak Shelf. Inner to middle sublittoral.

Material.—Eight adult valves.

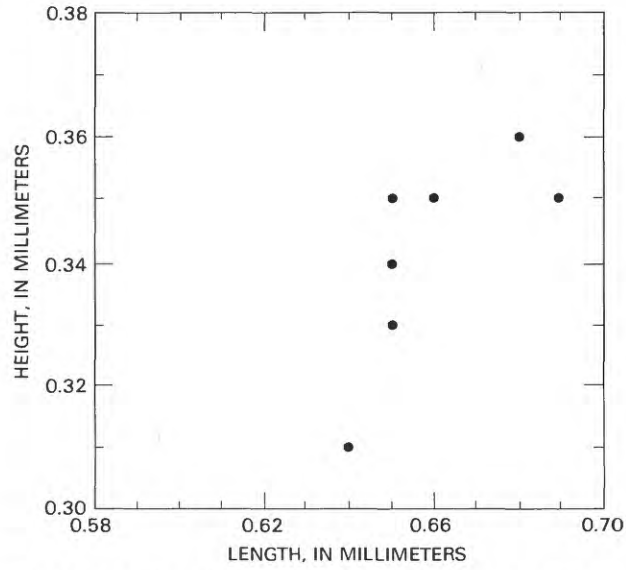

FIGURE 24.—Plot of length versus height for *Pectocythere marincovichi* n. sp.

Type specimens.—Holotype: USNM 408196, female left valve (pl. 7, fig. 11), locality EGAL–75–KC–144U, length 0.66 mm, height 0.35 mm.

Paratypes: USNM 408197, male left valve (pl. 7, fig. 12), locality EGAL–75–KC–144U, length 0.64 mm, height 0.31 mm. USNM 408198, left valve (pl. 9, figs 8, 9), locality EGAL–75–KC–25, length 0.65 mm, height 0.33 mm. USNM 408604, left valve (pl. 9, fig, 10), locality EGAL–75–KC–25, length 0.68 mm, height 0.36 mm. USNM 408199, right valve (pl. 9, figs. 11, 15), locality EGAL–75–KC–144U, length 0.69 mm, height 0.35 mm. USNM 408200, left valve (pl. 9, fig. 13), locality EGAL–75–KC–144U, length 0.66 mm, height 0.35 mm. USNM 408201, left valve (pl. 9, fig. 14), locality EGAL–75–KC–144U, length 0.65 mm, height 0.34 mm.

Etymology.—After Dr. Louie Marincovich, Jr., U.S. Geological Survey in Menlo Park, Calif., a specialist in marine mollusks of the North Pacific Basin.

Pectocythere parkerae Swain and Gilby, 1974

Plate 7, figures 5, 6; plate 8, figures 1, 2, 6; plate 9, figures 16–18

Pectocythere parkerae Swain and Gilby, 1974, p. 332, pl. 6, figs. 1a–c; pl. 7, fig. 5; text-fig. 39.

Pectocythere aff. *P. parkerae* Swain and Gilby, 1974. Brouwers, 1981, p. 11; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

Pectocythere sp. A Valentine, 1976, p. 23, pl. 10, figs. 10, 11.

? *Pectocythere* sp. A Valentine, 1976, p. 23, pl. 10, figs. 8, 9.

Diagnosis.—Characterized by an elongate, quadrate valve shape; straight dorsum; large circular ornament

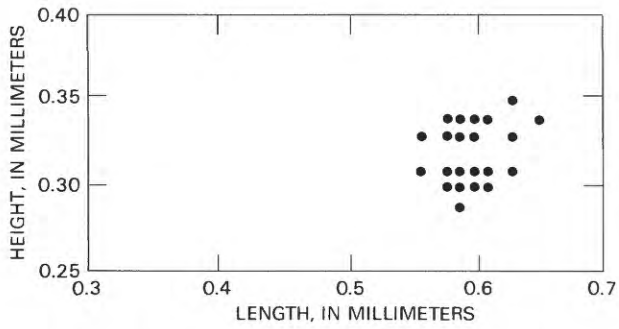

FIGURE 25.—Plot of length versus height for *Pectocythere parkerae* Swain and Gilby, 1974.

pits and concentric marginal reticulation; strong, raised, crescentic posterior marginal ridge; small, arcuate posteroventral vestibule; and large, deep, crescentic anterior vestibule.

Measurements.—X–Y plot based on 42 specimens (fig. 25).

Comparisons.—*Pectocythere parkerae* Swain and Gilby, 1974 differs from *P. pseudoamphidonta* Hanai, 1957 (upper Pliocene; Hokkaido) by its elongate shape, straight dorsum, large anterior vestibule, weak anterodorsal cardinal angle, and lack of strong ventral and dorsal ridges. *P. parkerae* differs from *P. clavata* (Triebel, 1957) (Quaternary; southern California) by its straight dorsum; numerous, small pits; low anterodorsal corner; large, crescentic anterior vestibule; and lack of a pronounced, sinuous dorsal ridge. *Pectocythere parkerae* and *P. clavata* are similar in valve shape and in that both possess strong posterior margin ridges.

Remarks.—Specimens of *Pectocythere parkerae* from the Gulf of Alaska are not identical to those specimens described from northern California and Oregon by Swain and Gilby (1974) and by Valentine (1976). The overall valve shape, gross ornament features, and inner margin features are the same for specimens from the two geographic regions. Subtle differences between the two populations include a poorly developed posteroventral flattened region and the lack of secondary pitted or heterolabyrinthine ornament in the Gulf of Alaska specimens. The overall similarities greatly outweigh the differences, and I consider the two populations to be conspecific.

Valentine (1976) illustrated a form that he called *Pectocythere* sp. A. The specimens illustrated on his plate 10, figures 10 and 11, are conspecific with *P. parkerae* (this report, pl. 8, fig. 1; pl. 9, figs. 16, 17); however, the specimens on his plate 10, figures 8 and 9, are different in valve shape and ornament. The latter form, illustrated by Valentine (1976) on his plate 10, figures 10 and 11, is modern and found between lat 34°30′ and 48°0′ N. in the mild-temperate Oregonian zoogeographic province; this geographic range is comparable to that found by Swain and Gilby (1974) for *P. parkerae*. The form illustrated by Valentine (1976) on his plate 10, figures 8 and 9, is fossil (Pliocene, southern California). The shape and ornament differences between these two forms of *P. parkerae* may simply reflect slight morphologic changes in the species that occurred from the Pliocene to the Holocene. Further analyses of Pliocene and Pleistocene samples from temperate marine climates are needed to document whether the two forms of *P. parkerae* illustrated by Valentine represent one or two species.

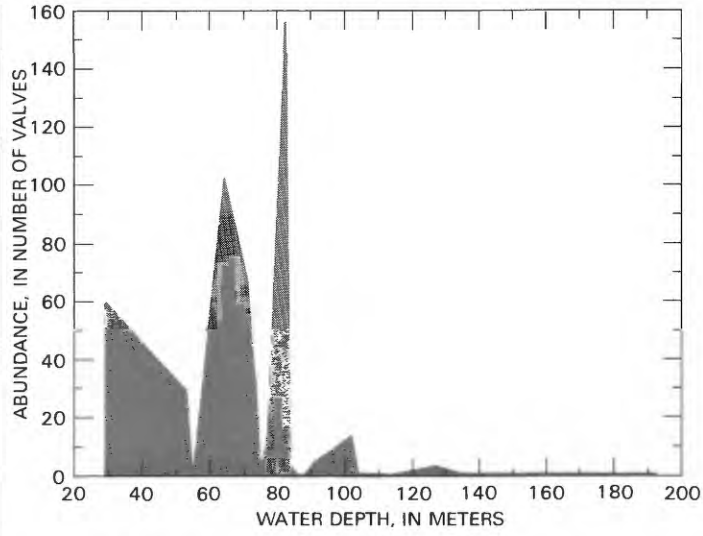

FIGURE 26.—Plot of abundance versus water depth for *Pectocythere parkerae* Swain and Gilby, 1974.

Occurrence.—Assemblages I*, II*, III, V.

Distribution.—Middle(?) to upper Pliocene: northern California. Pleistocene through Holocene: Gulf of Alaska, Cook Inlet, northern California, Oregon. Sublittoral (fig. 26).

Material.—Four hundred fifteen adult valves, 190 juvenile valves.

Illustrated specimens.—USNM 408202, right valve (pl. 7, fig. 5), locality DC2–80–EG–195, length 0.63 mm, height 0.33 mm. USNM 408203, left valve (pl. 7, fig. 6), locality DC2–80–EG–195, length 0.65 mm, height 0.34 mm. USNM 408204, female left valve (pl. 9, fig. 16), locality DC2–80–EG–195, length 0.60 mm, height 0.34 mm. USNM 408205, female right valve (pl. 9, figs. 17, 18), locality DC2–80–EG–195, length 0.63 mm, height 0.35 mm. USNM 408206, male left valve (pl. 8, fig. 1), locality DC2–80–EG–195, length 0.60 mm, height 0.33 mm. USNM 408207, female right valve (pl. 8, figs. 2, 6), locality DC2–80–EG–195, length 0.58 mm, height 0.34 mm.

Pectocythere tsiuensis n. sp.

Plate 7, figures 13, 14; plate 8, figures 10, 11, 13–18; plate 10, figures 1, 2

Pectocythere sp. D Brouwers, 1981, p. 11; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

Diagnosis.—Characterized by an elongate, subrectangular valve outline; sinuous dorsum; reticulate ornament on dorsal half of valve; large anterior vestibule; and lack of posteroventral tubercle.

Description.—Adult valves subquadrate to subrectangular in lateral view. Dorsal margin sinuous; anterior margin smoothly curved, with greatest width ventral of midline; ventral margin sinuous, with shallow, subtle concavity; posterior margin blunt, truncated along dorsal half, curving up sharply along ventral half. Large, protruding, obtuse, rounded anterodorsal cardinal angle; rounded, obtuse posterodorsal cardinal angle. Left valve similar to right, but with less convergent dorsal margin, prominent posterodorsal cardinal angle, truncated posterior margin, and better developed concavity. Greatest length through midline of valve; greatest height through anterior hinge element. Subtle dimorphism: males slightly longer than females.

Valve surface covered with reticulation pattern along dorsal half. Anterior and ventral margins with several rows of concentrically arranged reticulation. Most of ventral valve surface smooth. Reticulation concentrated along dorsomedian and posterodorsal regions of valves. Several strong reticulation ridges at posterodorsal region trend obliquely from anterodorsum to posteroventer. Reticulation pits subovoid to quadrate in shape. Fifty-three to fifty-five simple-type normal pores evenly distributed over valve, predominantly on reticulation ridges.

Inner margin and line of concrescence coincide along venter. Moderately deep, crescentic anterior vestibule; shallow, arcuate posterior and posteroventral vestibule. Strong, well-developed selvage. Fused inner lamella narrow and of even width throughout; inner margin parallels valve outline. About 16 radial pore canals, most anterior; radial pores are short, straight, and simple.

Right valve hinge consists of ovoid anterior tooth; elongate, subovoid anteromedian socket; crenulate median groove; elongate-ellipsoidal posteromedian socket; and ovoid posterior tooth.

Four adductor muscle scars form a slightly inclined row. Dorsal scar is subovoid; dorsomedian scar is quadrate; ventromedian scar is elongate, I-shaped; ventral scar is inflated, subovoid. Prominent, deep, circular fulcral point with heavily calcified dorsal rim. Frontal scar split into a large, elongate, subcylindrical posterior scar and a small, rounded anterior scar.

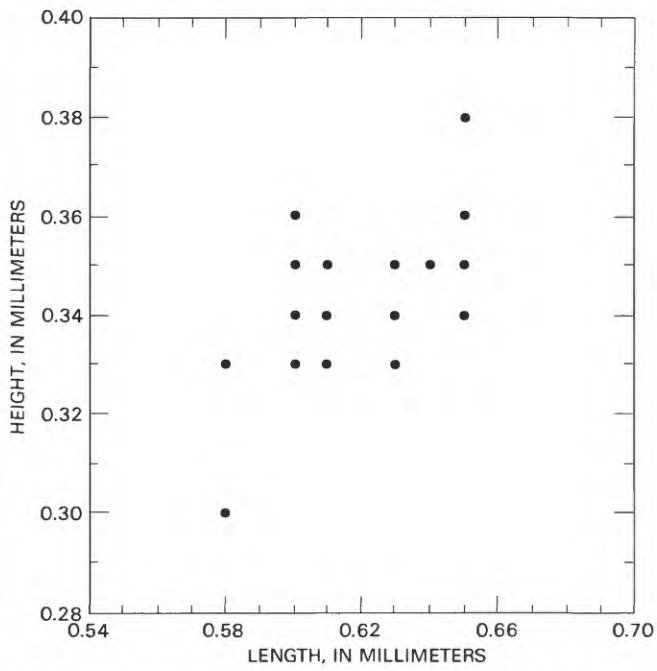

FIGURE 27.—Plot of length versus height for *Pectocythere tsiuensis* n. sp.

Measurements.—X–Y plot based on 46 specimens (fig. 27).

Comparisons.—*P. tsiuensis* differs from *P. quadrangulata* Hanai, 1957 (upper Pliocene; Hokkaido, Japan) by its less convergent dorsal margin, reticulate ornament on dorsal half of valve, weak ventral ridge without posteroventral tubercle, and large anterior vestibule. *P. tsiuensis* differs from *P. pseudoamphidonta* Hanai, 1957 (upper Pliocene; Hokkaido, Japan) by its straight dorsum, weak ventral ridge without posteroventral tubercle, reticulate ornament on dorsal half of valve, large anterior vestibule, and lack of a dorsal ridge. *P. tsiuensis* is differentiated from *P. janae* (Quaternary; northeast Pacific) by its sinuous dorsum; long, low valve outline; reticulate ornament on dorsal half of valve; and lack of posteroventral tubercle. *P. tsiuensis* differs from *P. clavata* (Triebel, 1957) (Quaternary; southern California) by its long, low valve outline; reticulate ornament on dorsal half of valve; straight dorsal margin; and lack of posteroventral tubercle.

Occurrence.—Assemblages I*, II*.

Distribution.—Pleistocene(?), Holocene: Gulf of Alaska. Inner to middle sublittoral (fig. 28).

Material.—One thousand three hundred sixty-one adult valves, 233 juvenile valves.

Type specimens.—Holotype: USNM 408208, female left valve (pl. 7, fig. 13), locality EGAL–75–KC–180, length 0.60 mm, height 0.36 mm.

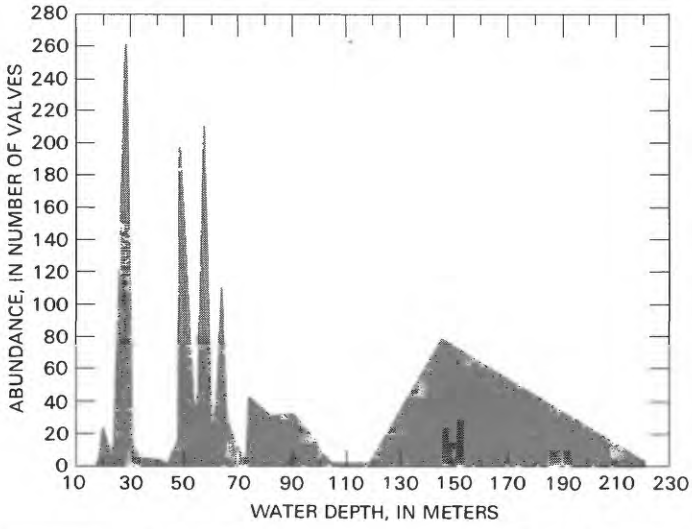

FIGURE 28.—Plot of abundance versus water depth for *Pectocythere tsiuensis* n. sp.

Paratypes: USNM 408209, female right valve (pl, 7, fig. 14), locality EGAL–75–KC–180, length 0.60 mm, height 0.33 mm. USNM 408210, left valve (pl. 8, figs. 10, 11, 15), locality EGAL–75–KC–180, length 0.65 mm, height 0.35 mm. USNM 408211, left valve (pl. 8, fig. 13), locality EGAL–75–KC–180, length 0.63 mm, height 0.34 mm. USNM 408212, right valve (pl. 8, fig. 14), locality EGAL–75–KC–180, length 0.65 mm, height 0.36 mm. USNM 408213, right valve (pl. 8, fig. 16), locality EGAL–75–KC–180, length 0.65 mm, height 0.35 mm. USNM 408214, right valve (pl. 8, fig. 17; pl. 10, fig. 1), locality EGAL–75–KC–180, length 0.61 mm, height 0.33 mm. USNM 408215, left valve (pl. 8, fig. 18; pl. 10, fig. 2), locality EGAL–75–KC–180, length 0.60 mm, height 0.34 mm.

Etymology.—After the Tsiu River, which drains Bering Glacier.

Family LEPTOCYTHERIDAE Hanai, 1957
Genus CLUTHIA Neale, 1973

Type species.—*Cythere cluthae* Brady, Crosskey, and Robertson, 1874.
(Type by subsequent designation.)

Remarks.—The oldest record of *Cluthia* presently known is middle Miocene from central Europe, in mild- to cold-temperate marine climates (Szczechura, 1986). The appearance of *Cluthia* in Central Paratethys coincides with climatic cooling during the late Badenian. During the Pliocene *Cluthia* spread into Tethys (France and Italy) and along its periphery. North Atlantic and Arctic occurrences are Quaternary in age. Communication between Paratethys and Tethys in the late middle Miocene (Carbonnel and Jiricek, 1977; Jiricek, 1983) allowed *Cluthia* to migrate from Paratethys into Tethys and then into the eastern and northern Atlantic. The occurrence of *Cluthia* in the Gulf of Alaska is fossil and probably reflects previous, colder water conditions. If the origin of *Cluthia* was in the Atlantic, then the Pacific occurrence must be post-Bering Strait (the Pacific and Arctic-Atlantic Oceans were isolated from each other until the first opening of Bering Strait about 3 Ma; Gladenkov, 1981).

Cluthia cluthae (Brady, Crosskey, and Robertson, 1874)

Plate 7, figure 15; plate 10, figures 3–10; plate 11, figure 1

Cythere cluthae Brady, Crosskey, and Robertson, 1874, p. 153, pl. 13, figs. 16, 17.

Cythere cluthae Brady, Crosskey, and Robertson. Malcolmson, 1886, p. 260; Brady and Norman, 1889, p. 145, pl. 14, figs. 25–27; Norman, 1891, p. 112; Brady and Norman, 1896, p. 732; Scott, 1899, p. 84; Norman, 1902, p. 484; Norman, 1905, p. 146; Stephensen, 1913, p. 363; Stephensen, 1936, p. 31.

Cythereis cluthae (Brady, Crosskey, and Robertson). Mueller, 1912, p. 362; Mueller, 1931, p. 29.

Leptocythere cluthae (Brady, Crosskey, and Robertson). Caralp, Moyes and Vigneaux, 1967, p. 418–420; Caralp, Klingebiel, Lamy, Latouche, Moyes, and Vigneaux, 1968, p. 13; Lev, 1969, p. 29, pl. 2, fig. 7; Caralp, Dumon, Klingebiel, Latouche, and Moyes, 1969, p. 183, 195; Yassini, 1969, p. 36–37; Moyes and Peypouquet, 1971, p. 219.

Callistocythere cluthae (Brady, Crosskey, and Robertson). Hazel, 1970, p. E8, E14, pl. 36.

Cluthia cluthae (Brady, Crosskey, and Robertson). Neale, 1973, p. 683–687, pl. 1, figs. 1–11.; Lord, 1980, p. 234, pl. 3, figs. 18, 19; Brouwers, 1981, p. 8; Brouwers, 1982b, p. 8; Brouwers, 1983; Benson, DelGrosso, and Steineck, 1983, p. 446, pl. 1, figs. 3, 4; Cronin, 1988, pl. II, fig. 4.

Not *Cluthia* aff. *C. cluthae* (Brady, Crosskey, and Robertson). McDougall, Brouwers, and Smith, 1986, pl. 10, fig. 6 (= *Semicytherura complanata*).

Diagnosis.—Characterized by subquadrate lateral outline with straight dorsum and convergent, drawn-out posterior; pronounced concavity; fine-scale, concentrically arranged reticulate ornament covering entire valve; narrow posterior marginal ridges, especially developed in females; raised median valve region; moderately developed ventral ridge; and tubercles at anterodorsal, posterodorsal, and posteroventral corners.

Measurements.—X–Y plot based on 13 specimens (fig. 29).

Comparisons.—*Cluthia cluthae* (Brady, Crosskey, and Robertson, 1874) differs from *C. foresteri* (Quaternary; Gulf of Alaska, Cook Inlet, Kodiak Shelf) by its pronounced concavity; large, high valve shape; large, less numerous reticulation pits; ornamented rather than smooth anterior; pronounced posterodorsal tubercle; presence of posteroventral and anterodorsal tubercles; and lack of overall reticulation ridges. *C. cluthae* differs

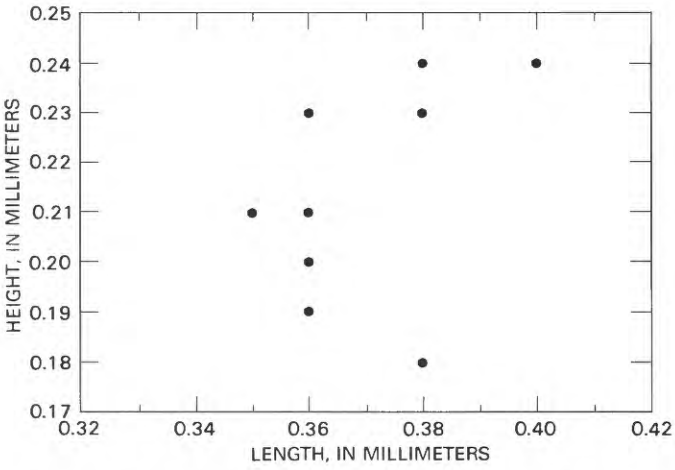

FIGURE 29.—Plot of length versus height for *Cluthia cluthae* (Brady, Crosskey, and Robertson, 1874).

from *Cluthia* sp. of Ishizaki, 1981 (Holocene; northern East China Sea) by its straight dorsum; less convergent posterior; less arched anterodorsum; rounded, less truncated posterior; less inflated median valve region; weaker ventral ridge, especially posteroventrally; small, more numerous reticulation pits; and ornamented anterior margin. *C. cluthae* differs from *C. keiji* Neale, 1975 (Quaternary; western Mediterranean and east Atlantic) by its large size; ornament tubercles; fine punctae; short, high valve shape; greater dimorphism; and strong ventral ridge.

Remarks.—Specimens of *C. cluthae* from the Gulf of Alaska represent the Pacific endpoint of a species cline that occurs from the Gulf of Alaska through the Beaufort Sea and into the North Atlantic. Comparison of my specimens with specimens from the upper Pleistocene of Norway (as illustrated by Lord, 1980, pl. 3, figs. 18, 19) reveals some morphologic differences: North Atlantic specimens have a longer, lower shape; more pronounced posterior ridge; stronger ventral ridge; less convergent posterior end; and slightly different pitting pattern. When these intraspecific differences are compared with interspecific differences for *Cluthia*, however, it is apparent that the Gulf of Alaska specimens belong to *Cluthia cluthae* s.l.

Occurrence.—Assemblages II, V.

Distribution.—Pleistocene through Holocene: North Atlantic, Bering Sea, Cook Inlet, Kodiak Shelf, Gulf of Alaska. Inner to middle sublittoral.

Material.—Seventeen adult valves, one juvenile valve.

Illustrated specimens.—USNM 408216, female left valve (pl. 7, fig. 15), locality EGAL–75–KC–73, length 0.36 mm, height 0.23 mm. USNM 408217, male right valve (pl. 11, fig. 1), locality EGAL–75–KC–73, length 0.35 mm, height 0.21 mm. USNM 408218, female left valve (pl. 10, fig. 3), locality EGAL–75–KC–157, length 0.40 mm, height 0.24 mm. USNM 408219, female right valve (pl. 10, fig. 4), locality EGAL–75–KC–157, length 0.38 mm, height 0.24 mm. USNM 408220, male left valve (pl. 10, figs. 5, 9), locality EGAL–75–KC–157, length 0.36 mm, height 0.19 mm. USNM 408221, male right valve (pl. 10, fig. 6), locality EGAL–75–KC–157, length 0.36 mm, height 0.20 mm. USNM 408222, male right valve (pl. 10, fig. 7), locality EGAL–75–KC–157, length 0.38 mm, height 0.18 mm. USNM 408223, female left valve (pl. 10, figs. 8, 10), locality EGAL–75–KC–89, length 0.38 mm, height 0.23 mm.

Cluthia foresteri n. sp.

Plate 10, figures 11–15; plate 11, figure 2

Cluthia sp. A Brouwers, 1981, p. 8; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1983.
Cluthia sp. Ishizaki and Matoba, 1985, p. 9, pl. 2, fig. 11.

Diagnosis.—Characterized by subovoid lateral outline, with narrow, slightly convergent posterior; shallow, broad concavity; numerous, small ornament pits arranged concentrically; superimposed concentric and radial reticulation; posterodorsal semicircular tubercle; and smooth anterior margin.

Description.—Adult valves elongate, subovoid in lateral outline. Dorsal margin broadly arched, converging posteriorly; anterior margin evenly curved, with greatest width ventral of midline; ventral margin sinuous, with broad, shallow concavity; posterior margin truncated. Dorsal and ventral margins converge and form narrow posterior end. Series of small, blunt denticles along posterior and anterior margins. Left valve similar to right, but with more convergent, drawn-out posterior end; more pronounced posterodorsal cardinal angle; and higher, more squared anterodorsal corner. Greatest length through midline of valve; greatest height through anterior hinge element.

Valve surface with reticulation, pitting, and tubercles. Primary ornament consists of small subcircular pits arranged concentrically, parallel to valve outline. Pits cover nearly entire valve; smooth, flattened crescentic region along anterior margin. Concentric and radial reticulation network superimposed on pitting pattern. Reticulation ridges are narrow, smooth, and slightly raised above valve surface; ridges form polygonal, angular solums. Posterodorsal region with rounded, low tubercle. Forty-seven normal pores evenly scattered over valve surface, occurring within pits; normal pores sieve-type, with recessed sieve plate.

Inner margin and line of concrescence coincide throughout. Weakly developed selvage. Inner margin

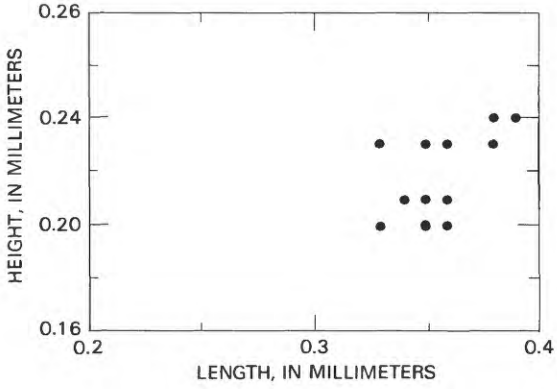

FIGURE 30.—Plot of length versus height for *Cluthia foresteri* n. sp.

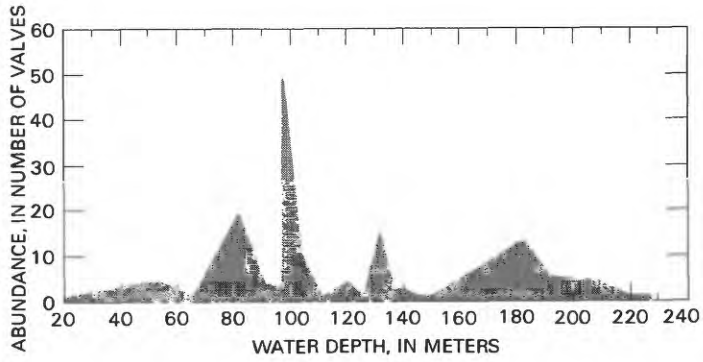

FIGURE 31.—Plot of abundance versus water depth for *Cluthia foresteri* n. sp.

parallels valve outline; narrow inner lamella. Ventral tooth and socket at concavity; right valve with pronounced, hemispherical tooth, left valve with complementary socket.

Right valve hinge consists of elongate, crenulate, anterior tooth; coarsely crenulate median groove; and elongate, crenulate, posterior tooth. Median hinge element is arched, slightly sinuous. Terminal median element enlarged into distinct quadrate teeth.

Four adductor muscle scars form vertical row. Dorsal scar is circular; dorsomedian scar is elongate, with inflated anterior and posterior ends; ventromedian scar is elongate, with inflated anterior; ventral scar is gumdrop-shaped. Frontal scar is nearly split and consists of inflated kidney-shaped scar with anteriorly attached, small ovoid scar. Two adjacent, elongate-ovoid mandibular scars ventral to and between frontal scar and adductor row. Small, shallow, subcircular fulcral point. Numerous ovoid to elongate dorsal muscle scars.

Measurements.—X–Y plot based on 32 specimens (fig. 30).

Comparisons.—*Cluthia foresteri* differs from *C. cluthae* (Brady, Crosskey, and Robertson, 1874) (Quaternary; North Atlantic, Bering Sea, Beaufort Sea, northeast Pacific) by its elongate, low valve outline; less drawn out posterior; reticulate ornament; small, numerous ornament pits; smooth anterior margin; and lack of anterodorsal and anteroventral tubercles, a ventral ridge, and an inflated median valve region. *C. foresteri* is distinguished from *Cluthia* sp. of Ishizaki, 1981 (Holocene; northeastern China Sea) by its elongate, low valve outline; evenly curved anterior margin; less oblique, less convergent dorsum; small, numerous ornament pits; hemispherical posterodorsal tubercle; reticulate ornament; and lack of a high, arched anterodorsal corner and of posterior and ventral marginal ridges. *C. foresteri* differs from *C. keiji* Neale, 1975 (Quaternary; western Mediterranean and east Atlantic) by its short, high valve shape; concentric ornament ridges; finer punctae; smooth anterior rim; and less dimorphism. *C. foresteri* differs from *C. miocenica* Szczechura, 1986 (middle Miocene; southeast Poland) by its short, high valve shape; concentric and radial ornament ridges; small posterodorsal tubercle; and lack of a posterior marginal ridge.

Remarks.—*C. foresteri* is quite distinct from *Cluthia* sp. Ishizaki, 1981, *C. keiji* Neale, 1975, *C. miocenica* Szczechura, 1986, and *C. cluthae* (Brady, Crosskey, and Robertson, 1874). It resembles *Cluthia cluthae* specimens illustrated in plate 1, figure 2c of Neale (1973, p. 682) in lateral outline and pitting pattern. The relationship between *C. foresteri* and *C. cluthae* is not known at present: whether one is derived from the other, which species has the longer fossil record, and whether subpopulations have developed due to ecologic or geographic causes.

Cluthia sp. of Ishizaki and Matoba (1985) and *C. foresteri* n. sp. are identical in morphology and valve shape. Furthermore, they occupy the same cold-temperate marine climate and the same water depth (middle to outer shelf, upper slope).

Occurrence.—Assemblages II*, III*, IV*.

Distribution.—Pleistocene: northern Honshu (Japan); Pleistocene through Holocene: Gulf of Alaska, Cook Inlet, Kodiak Shelf. Middle to outer sublittoral, upper bathyal (fig. 31).

Material.—One hundred seven adult valves, 16 juvenile valves.

Type specimens.—Holotype: USNM 408224, left valve (pl. 11, fig. 2), locality DC2–80–EG–186, length 0.36 mm, height 0.23 mm.

Paratypes: USNM 408225, female left valve (pl. 10, figs. 11, 12), locality DC2–80–EG–186, length 0.36 mm, height 0.21 mm. USNM 408226, female right valve (pl. 10, fig. 13), locality DC2–80–EG–186, length 0.35 mm, height 0.23 mm. USNM 408227, female left valve

(pl. 10, fig. 14), locality DC2–80–EG–186, length 0.35 mm, height 0.21 mm. USNM 408228, female right valve (pl. 10, fig. 15), locality DC2–80–EG–186, length 0.35 mm, height 0.23 mm.

Etymology.—After Dr. Richard M. Forester, U.S. Geological Survey, Denver, Colo., a nonmarine-ostracode specialist.

LIMNOCYTHERIDAE Klie, 1938
Subfamily LIMNOCYTHERINAE Klie, 1938
Genus LIMNOCYTHERE Brady, 1868

Type species.—*Cythere inopinata* Baird, 1843. (Type by subsequent designation.)

Limnocythere friabilis Benson and MacDonald, 1963

Plate 11, figure 3

Limnocythere friabilis Benson and Macdonald, 1963, p. 24, pl. 3, figs. 1–4.
Limnocythere friabilis Benson and Macdonald. Delorme, 1967, p. 1280; Delorme, 1968, p. 859, 871, pl. 5, figs. 66, 67.
Limnocythere (Limnocytherina) friabilis Benson and Macdonald. Delorme, 1971a, p. 45, figs. 20–30, 87, 88.
Limnocythere chippawaensis Staplin, 1963, p. 1192, pl. 160, figs. 1–3.

Remarks.—*L. friabilis* ranges through the Quaternary and is living today in cold-temperate through arctic climatic zones. Its environment is typically large freshwater lakes, although the taxon can also be found in low-energy river systems.

Material.—One adult valve.

Illustrated specimen.—USNM 408229, left valve (pl. 11, fig. 3), locality EGAL–75–KC–54, length 0.49 mm, height 0.26 mm.

Limnocythere inopinata (Baird, 1843)

Plate 11, figure 4

Cythere inopinata Baird, 1843, p. 172.
Cythere inopinata Baird, 1843, p. 195, figs. a–e.
Limnocythere inopinata (Baird). Brady, 1867.
Limnocythere inopinata (Baird). Brady, 1868a, p. 419, pl. 29, figs. 15–18; pl. 38, fig. 9; pl. 39, fig. 1; Brady, Crosskey, and Robertson, 1874, p. 173; Brady and Norman, 1889, p. 170; Mueller, 1900, p. 92; Alm, 1916, p. 148; Masi, 1905, p. 192; Sars, 1925, p. 151; Klie, 1938, p. 150; Triebel, 1941, p. 70; Kruit, 1955, p. 121; Luttig, 1955, p. 162; Wagner, 1957, p. 36–38, pl. 13; Delorme, 1967, p. 1280; Delorme, 1968, p. 859, 872–873, pl. 5, figs. 72, 73; Delorme, 1971a, p. 47–49, 95, figs. 49–55, 95; Sywula, 1974, p. 70, 262–265, 268, pl. 25, figs. a–b.
Limnocythere incisa Dahl, 1888, p. 616, pl. 17, figs. 49–58.

Remarks.—*L. inopinata* is known from the Pleistocene through the Holocene, and questionably from the Pliocene. It lives today in freshwater environments, typically in cold-temperate to arctic lakes.

Material.—One adult valve.

Illustrated specimen.—USNM 408230, female right valve (pl. 11, fig. 4), locality DC2–80–EG–42, length 0.59 mm, height 0.33 mm.

Limnocythere itasca Cole, 1949

Plate 11, figure 5

Limnocythere itasca Cole, 1949, p. 351, figs. 1–7.
Limnocythere itasca Cole. Delorme, 1971b, p. 343–344.
Limnocythere hapeziformis Staplin, 1963, p. 1199, pl. 160, figs. 15, 16.
Limnocythere (Limnocytherina) itasca Delorme, 1971a, p. 48–49, figs. 68–80, 100, 101.

Remarks.—The taxon is represented by a single, weathered, opaque adult valve. *L. itasca* ranges throughout the Quaternary and questionably in Pliocene sediments. Its habitat today is in lakes or, less commonly, in low-energy streams, both aquatic settings always being located at the forest-prairie transition. Its present geographic range is from the southern boreal forest to the central Mexico plateau (R. Forester, oral commun., 1985).

Material.—One adult valve.

Illustrated specimen.—USNM 408231, left valve (pl. 11, fig. 5), locality DC2–80–EG–73, length 0.61 mm, height 0.30 mm.

Limnocythere staplini Gutentag and Benson, 1962

Plate 11, figure 6

Limnocythere staplini Gutentag and Benson, 1962, pl. 51, fig. 15; pl. 1, figs. 1–3.
Limnocythere staplini Gutentag and Benson. Delorme, 1967, p. 1281; Delorme, 1969, p. 1473; Delorme, 1971b, p. 344.
Limnocythere (Limnocytherina) staplini Gutentag and Benson. Delorme, 1971a, p. 56–57, figs. 213–223, 267, 268.

Remarks.—*L. staplini* is documented from Pliocene through Holocene sediments and may range as far back as Miocene. The species presently lives from temperate regions to the tropics and ranges from southern Argentina to the central Canadian prairie. Its habitat is typically low-stand, generally saline lakes [from 4–5 ppt (parts per thousand) to 200 ppt salinity]. The species is rare in freshwater systems, where it always occurs in alkaline-poor systems. It is a prairie species and is not found in forest environments (R. Forester, oral commun., 1985). The occurrence of *L. staplini* is therefore quite unusual in southern Alaska, where the nonmarine coastal-plain environments are typically glacial in origin and consist of cold, very fresh water. The implication

based on environmental preferences is that this specimen represents a Pliocene or older age.

Material.—One adult valve.

Illustrated specimen.—USNM 408232, juvenile right valve (pl. 11, fig. 6), locality DC1–79–EG–1, length 0.45 mm, height 0.26 mm.

Family EUCYTHERIDAE Puri, 1954
Genus EUCYTHERE Brady, 1868

Type species.—*Cythere declivis* Norman, 1865. (Type by subsequent designation.)

Eucythere argus (Sars, 1866)

Plate 10, figures 16, 17; plate 11, figure 7; plate 12, figures 1–6

Cytheropsis argus Sars, 1866, p. 58.
Eucythere argus (Sars). Brady, 1868a, p. 431, pl. 27, figs. 49–51; Brady, Crosskey, and Robertson, 1874, p. 183, pl. 10, figs. 12–15; Sars, 1925, p. 162–163, pl. 75, fig. 1; Klie *in* Dahl, 1938, p. 178, figs. 591–594; Anderson, 1948, p. 224; Rosenfeld, 1977, p. 20, pl. 3, figs. 43–45; Cronin, 1981, p. 396, pl. 4, figs. 3, 4, 6; Horne and Rosenfeld, 1986, p. 71–76, pl. 13.72, figs. 1–3; pl. 13.74, figs. 1–4; text-figs. 1a–c; Cronin, 1988, p. 129.
Eucythere undulata Klie, 1929, p. 274–277, figs. 1–7.
Eucythere undulata Klie. Klie *in* Dahl, 1938, p. 179–180, figs. 599–602.
Eucythere declivis (Norman). Wagner, 1957 (partim), p. 43–44, pl. 15, figs. 1–4.
Eucythere sp. A Brouwers, 1982a, p. 11; Brouwers, 1983.

Diagnosis.—Characterized by an elongate, subtriangular lateral outline; broad, shallow concavity; highly arched dorsum; evenly curved anterior and weakly attenuated posterior; smooth median valve region; subtle reticulation network along dorsal, posterior, and ventral margins; concentric ridges parallel to anterior margin; very large sieve pores; and crescentic anterior vestibule.

Measurements.—X–Y plot based on 24 specimens (fig. 32).

Remarks.—Horne and Rosenfeld (1986) illustrated Holocene specimens of *Eucythere argus* (Sars, 1866) from Great Britain, the North Sea, and the Baltic Sea, including material from the Brady collection at the Hancock Museum and the Klie collection at the Hamburg Museum. *E. argus* specimens from the Gulf of Alaska differ from these by their slightly larger size, more pronounced dimorphism, particularly in valve height, and different ventromedian and ventral adductor muscle scars. Populations of *E. argus* from the northwest Atlantic (as illustrated by Cronin, 1981, from the Champlain Sea) are very similar to those from the Gulf of Alaska, whereas the northeast Atlantic populations show significant differences, particularly in valve shape and degree of dimorphism. Horne and Rosenfeld (1986) included the northwest Atlantic material in *E. argus* and noted that the taxon exhibits a considerable range of variation in carapace outline. The population from the Gulf of Alaska belongs to *E. argus* s.l.

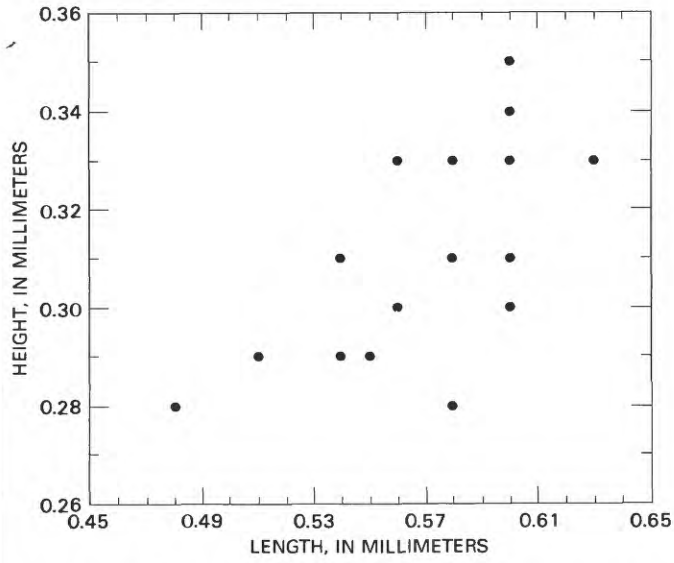

FIGURE 32.—Plot of length versus height for *Eucythere argus* (Sars, 1866).

Occurrence.—Assemblages I*, II*.

Distribution.—Pleistocene: Britain, eastern Canada. Holocene: Cook Inlet, Kodiak Shelf, Gulf of Alaska, Britain, Netherlands, Norway, Baltic Sea. Inner-middle sublittoral (fig. 33).

Material.—Sixty-seven adult valves, 22 juvenile valves.

Illustrated specimens.—USNM 408233, left valve (pl. 11, fig. 7), locality DC2–80–EG–195, length 0.56 mm, height 0.33 mm. USNM 408234, female left valve (pl. 10, fig. 16), locality DC2–80–EG–195, length 0.63 mm, height 0.33 mm. USNM 408235, female right valve (pl. 10, fig. 17; pl. 12, fig. 3), locality DC2–80–EG–195, length 0.60 mm, height 0.35 mm. USNM 408236, male left valve (pl. 12, figs. 1, 6), locality DC2–80–EG–195, length 0.60 mm, height 0.31 mm. USNM 408237, male right valve (pl. 12, figs. 2, 4), locality DC2–80–EG–195, length 0.60 mm, height 0.31 mm. USNM 408238, female left valve (pl. 12, fig. 5), locality DC2–80–EG–195, length 0.60 mm, height 0.33 mm.

Family KRITHIDAE Mandelstam, 1960
Genus KRITHE Brady, Crosskey, and Robertson, 1874

Type species.—*Cythere (Cytherideis) bartonensis* Jones, 1857.
(Type by subsequent designation.)

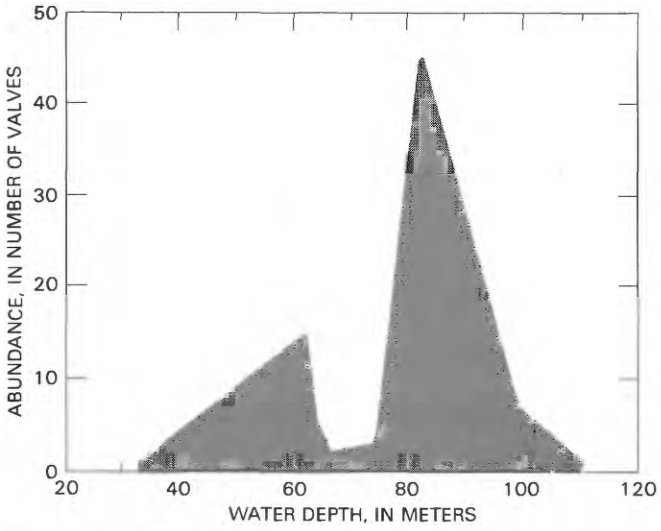

FIGURE 33.—Plot of abundance versus water depth for *Eucythere argus* (Sars, 1866).

Krithe burkholderi n. sp.

Plate 11, figure 9; plate 12, figures 7–9, 12

Krithe sp. A Brouwers (partim), 1981, p. 10; Brouwers, 1983.

Diagnosis.—Characterized by broadly arched dorsum with slightly concave posterodorsal region; subcylindrical lateral outline; subtle, shallow concavity; steeply inclined posterodorsal corner; small, deep, crescentic posterior vestibule; large, deep, semicircular anterior vestibule; short, numerous, evenly spaced radial pore canals; and large, elongate adductor muscle scars.

Description.—Adult valves subcylindrical in lateral view. Dorsal margin broadly arched, with concave posterodorsal corner; anterior margin smoothly curved; ventral margin straight, with subtle, shallow concavity; posterior margin truncated, with greatest width at posteroventral corner; posteroventral corner forms right angle, and posterodorsal margin curves up sharply as a continuous curve. Greatest length through midline of valve; greatest height just anterior of middle.

Valve surface smooth. Anterior margin with narrow marginal rim. Thirty-two normal pores evenly distributed over valve surface. Normal pores simple type, with smooth marginal rim.

Inner margin and line of concrescence coincide along venter. Large, deep, semicircular anterior vestibule and smaller, moderately deep, crescentic posterior vestibule. Inner lamella wide at anterior. Strong, well-developed selvage. Nineteen radial pore canals, one false radial pore canal, most located anterior. Radial pores are straight, simple.

Hinge in right valve is crenulate groove, enlarged terminally.

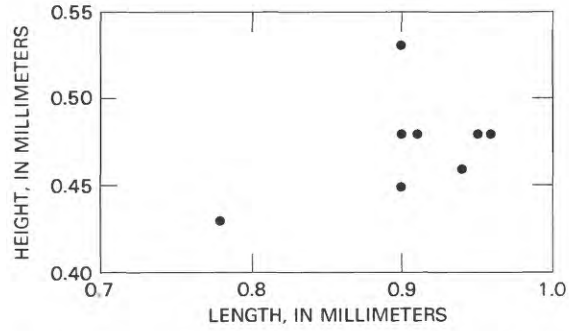

FIGURE 34.—Plot of length versus height for *Krithe burkholderi* n. sp.

Four adductor muscle scars form vertical row. Dorsal scar is dumbbell-shaped, with pronounced dorsal indentation; dorsomedian scar is elongate and quadrate, with enlarged posterior; ventromedian scar is elongate, subellipsoidal; ventral scar is subovoid. Frontal scar is kidney-shaped, with two blunt anterior projections, at bottom and middle of scar. Few, scattered, large dorsal muscle scars along oblique line from central scar field posterodorsally to hinge line.

Measurements.—X–Y plot is based on nine specimens (fig. 34).

Comparisons.—*Krithe burkholderi* differs from *K. japonica* Ishizaki, 1971 (Holocene; Honshu, Japan) by its less evenly rounded anterior margin, sharply inclined posterodorsal margin, pronounced concavity, and pointed posteroventral corner. *K. burkholderi* is distinguished from *K. hanaii* Ishizaki, 1983 (Pliocene; southern Japan) by its long, low valve shape; evenly rounded anterior; posteroventral margin with large extent of straight, truncated margin; straight dorsum; large anterior and posterior vestibules; short, evenly spaced radial pores; and small normal pores. *K. burkholderi* differs from *K. antisawanense* Ishizaki, 1966 (lower Miocene; Japan) by its weak concavity, straight dorsum, less pointed posteroventral corner, and steeply inclined posterodorsal margin. *K. burkholderi* differs from *K. sawanensis* Hanai, 1959 (Pliocene; Hokkaido, Japan) by its arched dorsum; pronounced concavity; short, high lateral outline; large, deep anterior vestibule; short, numerous, evenly spaced anterior radial pore canals; crescentic posterior vestibule; and large, elongate adductor muscle scars. *K. burkholderi* is distinguished from *K.* cf. *K. bartonensis* (Jones, 1856) of Robinson, 1978 (upper Pleistocene; northeast Atlantic) by its more arched dorsum; less evenly rounded anterior margin; strong concavity; and squared, truncated posteroventral margin. *K. burkholderi* differs from *K. praetexta* (Sars, 1866) (Holocene; northeast Atlantic) by its arched dorsum; pointed posteroventral corner; greatest anterior margin width dorsal of midline; straight poster-

odorsal corner; short, high lateral outline; posterior vestibule; few anterior radial pore canals; and large anterior vestibule. *K. burkholderi* differs from *K. glacialis* Brady, Crosskey, and Robertson, 1874 (Quaternary; shelf-upper slope, north Atlantic) by its less sinuous ventral inner margin; less inflated valve; wide, strong posterior flange; and lack of hinge teeth and a posterodorsal vestibule.

Occurrence.—Assemblage III, V.

Distribution.—Pleistocene and Holocene: Gulf of Alaska. Outer sublittoral.

Material.—Six adult valves, 17 juvenile valves.

Type specimens.—Holotype: USNM 408239, right valve (pl. 11, fig. 9), locality EGAL–75–KC–113, length 0.90 mm, height 0.45 mm.

Paratypes: USNM 408240, left valve (pl. 12, figs. 7, 8), locality EGAL–75–KC–6A, length 0.90 mm, height 0.53 mm. USNM 408241, right valve (pl. 12, figs. 9, 12), locality EGAL–75–KC–6A, length 0.95 mm, height 0.48 mm.

Etymology.—After Robert Burkholder, now retired, formerly a technician with the U.S. Geological Survey, Denver, Colo.

Krithe adelspergi n. sp.

Plate 11, figure 8; plate 12, figures 10, 11, 13–17

Krithe sp. A Brouwers (partim), 1981; Brouwers, 1982a, p. 62; Brouwers, 1982b, p. 9; Brouwers, 1983.

Diagnosis.—Characterized by long, low, subcylindrical lateral outline; straight and parallel dorsal and ventral margins; sharply inclined, oblique posterodorsal margin; pointed posteroventral corner; greatest posterior margin width at venter; evenly rounded anterior margin; small, trapezoid-shaped posterior vestibule; large, T-shaped anterior vestibule; wide anterior inner lamella; short, numerous, evenly spaced anterior radial pore canals; strong selvage; J-shaped frontal scar; and elongate, subrectangular adductor muscle scars.

Description.—Adult valves subcylindrical in lateral view. Dorsal margin straight; anterior margin smoothly curved; ventral margin straight, subparallel to dorsal margin, with subtle, shallow concavity; posterior margin pointed, with greatest extent at posteroventral corner; upper half of posterior margin curves up sharply as continuous obtuse curve. Left valve similar to right, but with less pronounced concavity. Greatest length ventral of midline, through posterodorsal corner; greatest height through middle of valve in females and through anterior hinge element in males. Marked dimorphism: males considerably longer and lower than females, with less arched dorsum and more subdued concavity.

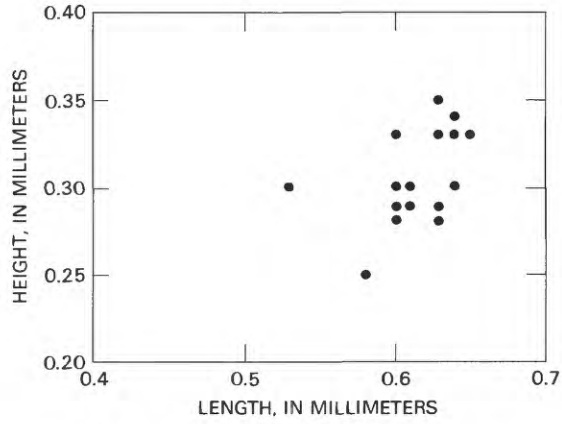

FIGURE 35.—Plot of length versus height for *Krithe adelspergi* n. sp.

Valve surface smooth. Thirty-two to thirty-four normal pores scattered over valve surface, most anterior. Normal pores simple-type, with smooth marginal rim.

Inner margin and line of concrescence coincide along anterodorsum, venter, and posterodorsum. Large, deep, irregularly shaped anterior vestibule and smaller, trapezoid-shaped posterior vestibule. Inner margin widest along anterior margin. Sinuous ventral inner margin. Strong, well-developed selvage. Eighteen radial pores, four false radial pores, most anterior. Anterior radial pores predominantly straight and simple, with pores at edge of vestibule more curved. Posterior radial pores appear anastomosing because of the relation of the vestibule shape to the origin and course of the pore canals.

Left valve hinge is a finely crenulate groove, enlarged terminally.

Four adductor muscle scars form vertical row. Dorsal scar is dumbbell-shaped, with pronounced dorsal indentation; dorsomedian scar is peanut-shaped; ventromedian scar is subquadrate; and ventral scar is ovoid. J-shaped frontal scar, long axis oriented anteriorly. Pronounced ovoid fulcral point located ventral and adjacent to frontal scar. Numerous dorsal scars of different sizes and shapes located between central muscle scar field and hinge line.

Measurements.—X–Y plot is based on 25 specimens (fig. 35).

Comparisons.—*Krithe adelspergi* differs from *K. japonica* Ishizaki, 1971 (Holocene; Honshu, Japan) by its low, elongate lateral outline; straight, subparallel dorsum and venter; sharply inclined posterodorsal margin; pointed posteroventral corner; wide anterior inner lamella; and greatest posterior margin width near venter. *K. adelspergi* is distinguished from *K. hanaii* Ishizaki, 1983 (Pliocene; continental shelf, southern Japan) by its low, long lateral outline; straight, subpar-

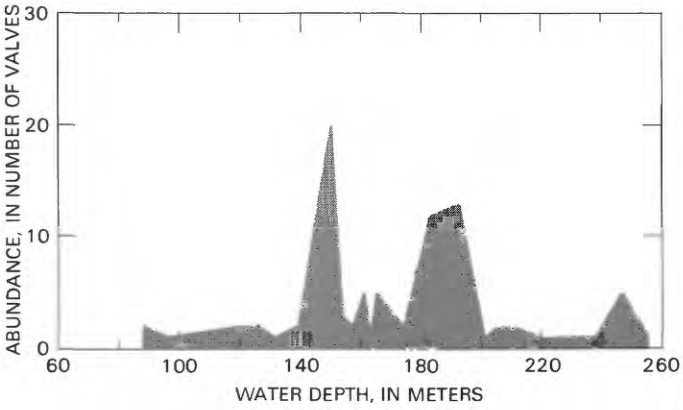

FIGURE 36.—Plot of abundance versus water depth for *Krithe adelspergi* n. sp.

allel dorsum and venter; pointed posteroventral corner; evenly rounded anterior margin; large anterior vestibule; and short, numerous, evenly spaced anterior radial pore canals. *K. adelspergi* differs from *K. antisawanense* Ishizaki, 1966 (lower Miocene; continental shelf, Japan) by its low, elongate valve shape; straight, subparallel dorsal and ventral margins; inclined posterodorsal margin; and pointed posteroventral corner. *K. adelspergi* differs from *K. sawanensis* Hanai, 1959 (Pliocene; continental shelf, Hokkaido, Japan) by its sharp anterodorsal corner; strong selvage; small posterior vestibule; short, numerous, evenly spaced anterior radial pore canals; and irregular, T-shaped, anterior vestibular space, with the narrow end toward the valve interior and the treelike expansion at the valve edge. *K. adelspergi* is distinguished from *Dentokrithe bartonensis* (Jones, 1856) (Quaternary; shelf-upper slope, northeast Atlantic) by its arched dorsum, sharply pointed posteroventral corner, irregularly rounded anterior margin, and lack of hinge teeth and a split frontal. *K. adelspergi* differs from *K. praetexta* (Sars, 1866) (Quaternary; shelf-upper slope, north Atlantic) by its high, short valve shape; sharply inclined posterodorsal margin; straight dorsum; anterior margin with greatest width dorsal of midline; pronounced dimorphism; posterior vestibule; small, T-shaped anterior vestibule; irregularly fused inner lamella; strong selvage; J-shaped frontal scar; and elongate, subrectangular adductor muscle scars.

Occurrence.—Assemblages III*, IV*, V.

Distribution.—Pleistocene to Holocene: Gulf of Alaska. Middle to outer sublittoral, upper bathyal (fig. 36).

Material.—Fifty-three adult valves, 48 juvenile valves.

Type specimens.—Holotype: USNM 408242, left valve (pl. 11, fig. 8), locality DC2–80–EG–192, length 0.65 mm, height 0.33 mm.

Paratypes: USNM 408243, female left valve (pl. 12, fig. 10), locality DC2–80–EG–192, length 0.65 mm, height 0.33 mm. USNM 408244, female right valve (pl. 12, fig. 11), locality DC2–80–EG–192, length 0.64 mm, height 0.30 mm. USNM 408245, male left valve (pl. 12, figs. 13, 15), locality DC2–80–EG–192, length 0.63 mm, height 0.28 mm. USNM 408246, male right valve (pl. 12, fig. 14), locality DC2–80–EG–192, length 0.63 mm, height 0.28 mm. USNM 408247, male left valve (pl. 12, figs. 16, 17), locality DC2–80–EG–192, length 0.58 mm, height 0.25 mm.

Etymology: After Deborah Adelsperger, a student at the University of Colorado, Denver, Colo.

Family CUSHMANIDEIDAE Puri, 1973
Genus PONTOCYTHERE Dubowsky, 1939

Type species.—*Pontocythere tchernjawskii* Dubowsky, 1939.
(Type by original designation.)

Pontocythere dahlgrenensis n. sp.

Plate 11, figures 10–11; plate 12, figure 18; plate 13, figures 1–10

Diagnosis.—Characterized by short, high, subcylindrical lateral outline; subtle concavity; moderately arched dorsum; evenly curved anterior; squared, evenly curved posterior; denticulate anterior; weak reticulation along posterior and posteroventral margins; concentric ridges along anterior and anteroventral margins; and weak scar impressions.

Description.—Adult valves elongate, subcylindrical in lateral outline. Dorsal margin highly arched; anterior margin evenly curved; ventral margin with subtle concavity; and convergent posterior. Greatest length through midline of valve; greatest height at midline, through median hinge element. Subtle dimorphism: males differ from females by their shorter and lower valve outline; less arched dorsum; and higher, more squared, less convergent posterior.

Valve surface covered with weak reticulation network, best developed along margins. Posterior and posteroventral margins with weak, low reticulation network forming elongate trapezoidal solums. Anterior and anteroventral margins with series of concentric ridges aligned parallel to valve outline. Concentric ridges are higher and more strongly developed than the reticulation network. Smooth posteromedian valve region. Secondary ornament consists of fine pitting along dorsal margin. Two crimped regions are variously developed among individuals: one region is at the adductor scar row, and the second region is at the middle of the dorsal margin. Forty-seven normal pores evenly scattered over valve surface; pores occur on reticulation ridges. Normal

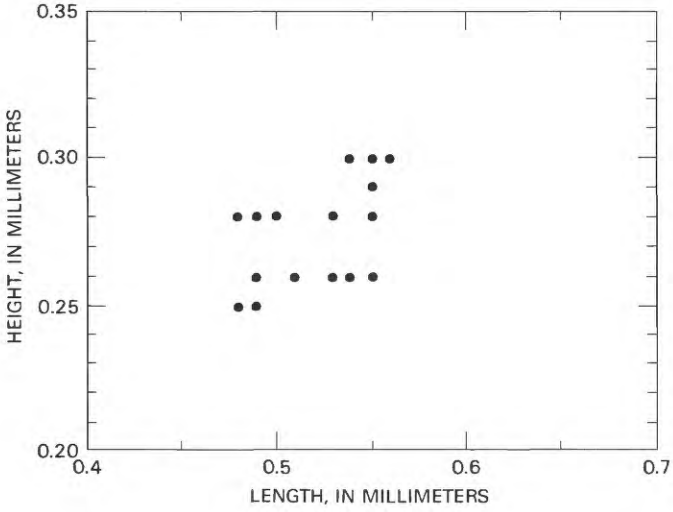

FIGURE 37.—Plot of length versus height for *Pontocythere dahlgrenensis* n. sp.

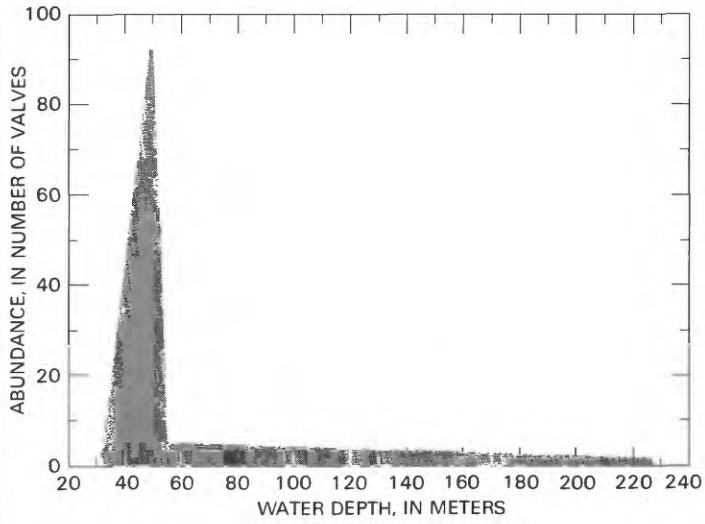

FIGURE 38.—Plot of abundance versus water depth for *Pontocythere dahlgrenensis* n. sp.

pores sieve-type; sieve is continuous with valve surface. Sieve plates vary in size and shape from small circular structures to elongate elliposidal features.

Inner margin and line of concrescence coincide throughout. Inner margin parallels valve outline; inner lamella of nearly even width throughout. Strong, well-developed selvage. Eighteen radial pore canals, most located at anterior. Radial pores moderate in length, straight and simple.

Right valve hinge consists of elongate, smooth anterior bar and posterior groove. Anterior bar continuous with dorsal margin; posterior accommodation groove is formed by enfolding of dorsal valve edge.

The three lower adductor muscle scars form a slightly oblique row, arched posterodorsally. The dorsomedian scar is gumdrop-shaped; the ventromedian scar is subtriangular; and the ventral scar is ovoid. The dorsalmost adductor scar is located above the adductor row and consists of a weak ovoid impression. Large mandibular scars: posterior scar is elongate and ellipsoidal; anterior scar is U-shaped, located anterodorsal of the posterior scar. No fulcral point observed. Frontal scar forms an inflated isosceles triangle. Numerous elongate, narrow dorsal muscle scars.

Measurements.—X–Y plot is based on 23 specimens (fig. 37).

Comparisons.—*Pontocythere dahlgrenensis* differs from *P. elongata* (Brady, 1868) (Holocene; Britain, northwest Europe) by its short, high lateral outline; weak concavity; convex venter; small posteroventral flange; reticulate and ridge ornament; narrow inner lamella; and weak hinge. *P. dahlgrenensis* is distinguished from *Pontocythere* sp. 1 of Yajima, 1982 (upper Pleistocene; Honshu, Japan) by its short, high valve outline; less convergent, squared posterior end; weak concavity; denticulate anterior margin; and reticulate posterior ornament. *P. dahlgrenensis* differs from *Pontocythere* sp. 2 of Yajima, 1982 (upper Pleistocene; Honshu, Japan) by its short, high valve outline; weak concavity; high, squared, less convergent anterior and posterior ends; reticulate posterior ornament; and strong concentric anterior ridges. *P. dahlgrenensis* differs from *Pontocythere* sp. C of Valentine, 1976 (=*Cushmanidea pauciradialis* Swain, 1969, pl. 4, fig. 5a–c; Holocene; central California, Washington, Oregon) by its long, low lateral outline; less arched dorsum; and evenly rounded anterior and posterior ends. *P. dahlgrenensis* differs from *Pontocythere* sp. A of Valentine, 1976 (upper Pliocene through Holocene; central California) by its weak concavity; long valve shape; less arched dorsum; strong ornament ridges; and posterior ornament reticulation. *P. dahlgrenensis* differs from *Pontocythere* sp. B of Valentine, 1976 (Quaternary; south and central California) by its less arched dorsum, evenly curved anterior end, evenly curved posterior that lacks a posteroventral corner, anterior marginal denticles, and strong ornament.

Occurrence.—Assemblages I*, V.

Distribution.—Pleistocene, Holocene: Gulf of Alaska. Inner sublittoral (fig. 38).

Material.—Eighty-three adult valves, 22 juvenile valves.

Type specimens.—Holotype: USNM 408248, female left valve (pl. 11, fig. 10), locality EGAL–75–KC–11, length 0.48 mm, height 0.28 mm.

Paratypes: USNM 408249, female right valve (pl. 12, fig. 18; pl. 13, figs. 2, 3), locality EGAL–75–KC–11, length 0.53 mm, height 0.28 mm. USNM 408250, female

left valve (pl. 13, figs. 1, 9), locality EGAL–75–KC–11, length 0.51 mm, height 0.26 mm. USNM 408251, male left valve (pl. 13, fig. 4), locality EGAL–75–KC–11, length 0.55 mm, height 0.28 mm. USNM 408252, male right valve (pl. 13, figs. 5, 6), locality EGAL–75–KC–11, length 0.54 mm, height 0.26 mm. USNM 408253, female right valve (pl. 13, fig. 7), locality EGAL–75–KC–11, length 0.48 mm, height 0.28 mm. USNM 408254, male left valve (pl. 13, figs. 8, 10), locality EGAL–75–KC–11, length 0.51 mm, height 0.26 mm. USNM 408255, male left valve (pl. 11, fig. 11), locality EGAL–75–KC–11, length 0.55 mm, height 0.29 mm.

Etymology.—After Dahlgren Ridge, an east-west-trending ridge that connects Duktoth Mountain and Mount Leeper in the Robinson Mountains, southeast Alaska.

Pontocythere jefferiesensis n. sp.

Plate 13, figures 11–16

Diagnosis.—Characterized by an elongate, cylindrical lateral outline; broadly arched dorsum; weak concavity; truncated posterior margin; small posteroventral flange; inflated posterior; series of weak concentric anterior and ventral marginal ridges; and large, deep, crescentic anterior vestibule.

Description.—Adult valves elongate, cylindrical in lateral view. Dorsal margin broadly arched; anterior margin smoothly curved, with greatest extent ventral of valve midline; ventral margin with broad, shallow concavity; posterior margin truncated, with smoothly curved, steep posterodorsal margin. No sharp cardinal angles. Greatest length through midline of valve; greatest height posterior of midline.

Surface predominantly smooth. Series of weak concentric ridges parallel anterior margin, continuing to median valve region. Ventral margin with concentric ridges, forming an oblique pattern. Ridges are narrow and fairly low. Posterior margin and median area are smooth. Posterior end considerably inflated. Sixty-three normal pores evenly distributed over valve surface, occurring on ornament ridges. Normal pores sieve-type, with round sieve plate and subcentral setal opening. Sieve plate continuous with valve surface.

Inner margin and line of concrescence coincide along posterior and venter; large, deep, crescentic anterior vestibule. Inner margin follows valve outline; fused inner lamella widest at anterior. Radial pore canals not observed. Strong, well-developed selvage.

Left valve hinge consists of an elongate, subtriangular anterior tooth; an elongate, smooth anteromedian groove; a narrow, elongate, smooth posteromedian bar; and three small subquadrate sockets.

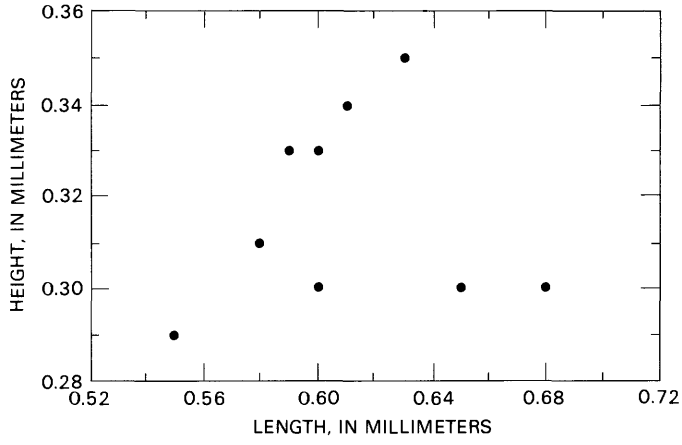

FIGURE 39.—Plot of length versus height for *Pontocythere jefferiesensis* n. sp.

The lower three adductor muscle scars form a crescentic row. The dorsomedian scar is circular; the ventromedian scar is subovoid, with inflated anterior; and the ventral scar is gumdrop-shaped. The dorsal adductor scar is elongate and narrow, with an inflated anterior, and is located separate from and above the row formed by the three lower adductor scars. No fulcral point. Frontal scar subovoid, with constricted posterodorsal end. Two very large, weak mandibular scar impressions: posterior scar is elongate and subcylindrical; anterior scar is circular. Small dorsal muscle scars located below hinge line.

Measurements.—X–Y plot is based on 10 specimens (fig. 39).

Comparisons.—*Pontocythere jefferiesensis* differs from P. elongata (Brady, 1868) (Holocene; Britain, northwest Europe) by its short, high lateral outline; small posteroventral flange; rounded, high anterior and posterior ends; weak concavity; concentric ridged ornament; and different posterior hinge element. *P. jefferiesensis* differs from *Pontocythere* sp. 1 of Yajima, 1982 (upper Pleistocene; Honshu, Japan) by its short, high valve outline; square, less convergent anterior and posterior ends; weak concavity; and less arched dorsum. *P. jefferiesensis* differs from *Pontocythere* sp. 2 of Yajima, 1982 (upper Pleistocene; Honshu, Japan) by its weak concavity; high posterior end with no convergence; and high, squared anterior end. *P. jefferiesensis* differs from *Pontocythere* sp. C of Valentine, 1976 (Holocene; central California, Washington, Oregon) by its elongate, low valve shape; less arched dorsum; weak concavity; and evenly curved posterior margin. *P. jefferiesensis* is distinguished from *Pontocythere* sp. A of Valentine, 1976 (upper Pliocene through Holocene; central California) by its weak concavity; less arched dorsum; and less convergent, less ventral slung anteroventral margin. *P. jefferiesensis* differs from *Pontocythere* sp. B of

Valentine, 1976 (Quaternary; southern and central California) by its less inclined posterodorsum, truncated posterior margin, less convergent anterior end, strong concavity, strong ridged ornament, and lack of pointed posteroventral corner.

Occurrence.—Assemblages I*, V.

Distribution.—Pleistocene, Holocene: Gulf of Alaska.

Material.—Twenty-nine adult valves, one juvenile valve.

Type specimens.—Holotype: USNM 408256, male right valve (pl. 13, figs. 11, 12, 15), locality EGAL–75–KC–134, length 0.68 mm, height 0.30 mm.

Paratype: USNM 408257, male left valve (pl. 13, figs. 13, 14, 16), locality EGAL–75–KC–134, length 0.65 mm, height 0.30 mm.

Etymology.—After Jefferies Glacier in Bagley Ice Field, Chugach Mountains.

ACKNOWLEDGMENTS

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PLATES 1–13

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PLATE 1

[All figures are camera lucida drawings]

FIGURES

1. *Cytherella* sp. A (p. 3).
   Exterior left valve (×89).USNM 408110.
2. *Neonesidea sitkagi* n. sp. (p. 3).
   Exterior right valve (×57). USNM 408111 (holotype).

3, 4. *Cythere valentinei* Tsukagoshi and Ikeya, 1987 (p. 12).
   3. Exterior left valve (×80). USNM 408114.
   4. Exterior right valve (×82). USNM 408115.

5. *Cythere alveolivalva* Smith, 1952 (p. 13).
   Exterior right valve (×67). USNM 408122.

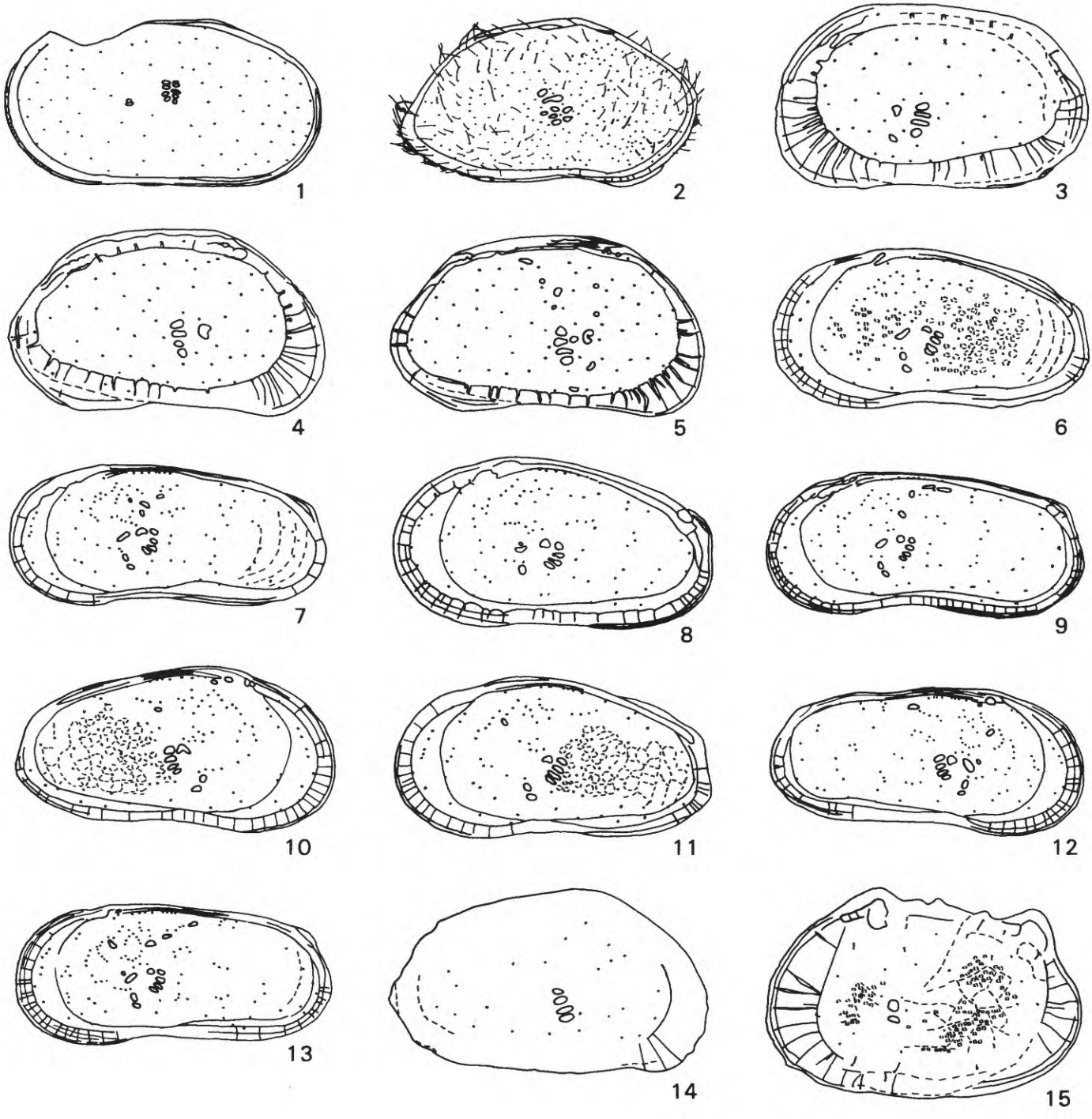
6, 7. *Cytheromorpha eskerensis* n. sp. (p. 13).
   6. Exterior female left valve (×103). USNM 408129 (holotype).
   7. Exterior male left valve (×94). USNM 408130.

8. *Cytheromorpha* sp. C (p. 15).
   Exterior female left valve (×93). USNM 408135.
9. *Cytheromorpha grandwashensis* n. sp. (p. 15).
   Exterior male left valve (×79). USNM 408136 (holotype).

10, 11. *Cytheromorpha knikensis* Forester and Brouwers, 1985 (p. 16).
   10. Exterior female right valve (×98). USNM 408146.
   11. Exterior female left valve (×98). USNM 408147.

12, 13. *Cytheromorpha molniai* n. sp. (p. 17).
   12. Exterior male right valve (×85). USNM 408154 (holotype).
   13. Exterior male left valve (×90). USNM 408155.

14. *Schizocythere* sp. A (p. 18).
   Exterior right valve (×74). USNM 408162.
15. *Palmenella limicola* (Norman, 1865) (p. 19).
   Exterior left valve (×77). USNM 408164.



CYTHERELLA, NEONESIDEA, CYTHERE, CYTHEROMORPHA, SCHIZOCYTHERE, AND *PALMENELLA*

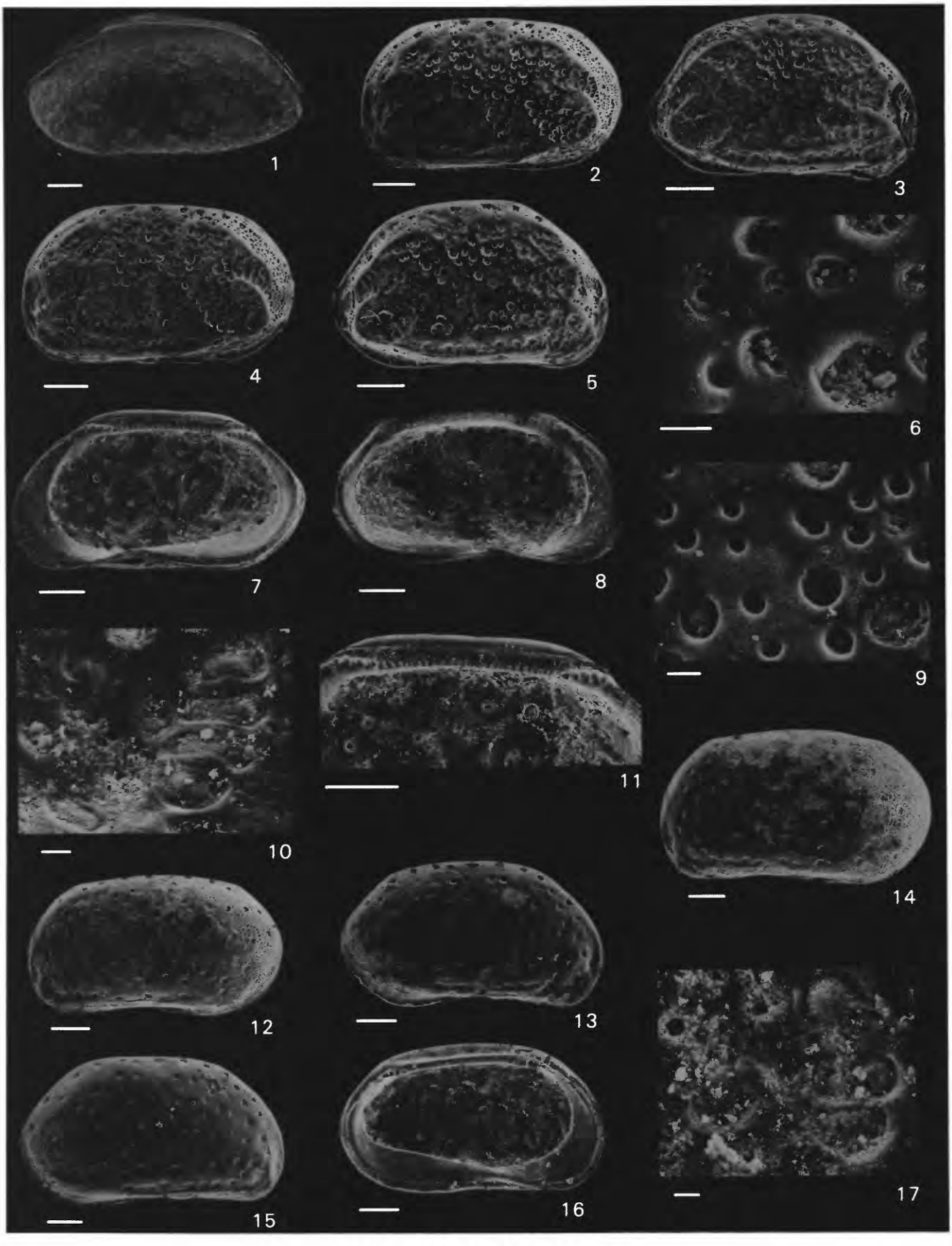
PLATE 2

[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1–5, 7, 8, 11–16; bar scale equals 10 micrometers for figs. 6, 9, 10, 17]

FIGURES 1. *Neonesidea sitkagi* n. sp. (p. 3).
Interior left valve (×68). USNM 408112 (paratype).

2–11. *Cythere valentinei* Tsukagoshi and Ikeya, 1987 (p. 12).
2. Exterior left valve (×82). USNM 408116.
3. Exterior right valve (×86). USNM 408117.
4. Exterior left valve (×85). USNM 408118.
5. Exterior right valve (×88). USNM 408119.
6. Simple-, sieve-type normal pores (×950). USNM 408119.
7. Interior right valve (×84). USNM 408120.
8. Interior left valve (×86). USNM 408121.
9. Ornament pitting and sieve pore distribution (×600). USNM 408118.
10. Central muscle scar field (×550). USNM 408120.
11. Right valve hingement (×145). USNM 408121.

12–17. *Cythere alveolivalva* Smith, 1952 (p. 13).
12. Exterior left valve (×66). USNM 408123.
13. Exterior right valve (×74). USNM 408124.
14. Exterior left valve (×65). USNM 408125.
15. Exterior right valve (×64). USNM 408126.
16. Interior left valve (×77). USNM 408127.
17. Central muscle scar field (×475). USNM 408127.



NEONESIDEA AND *CYTHERE*

PLATE 3

[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 4–6, 9–11, 13–15; bar scale equals 10 micrometers for figs. 1–3, 7, 8, 12, 16, 17]

FIGURES 1–3. *Cythere alveolivalva* Smith, 1952 (p. 13).

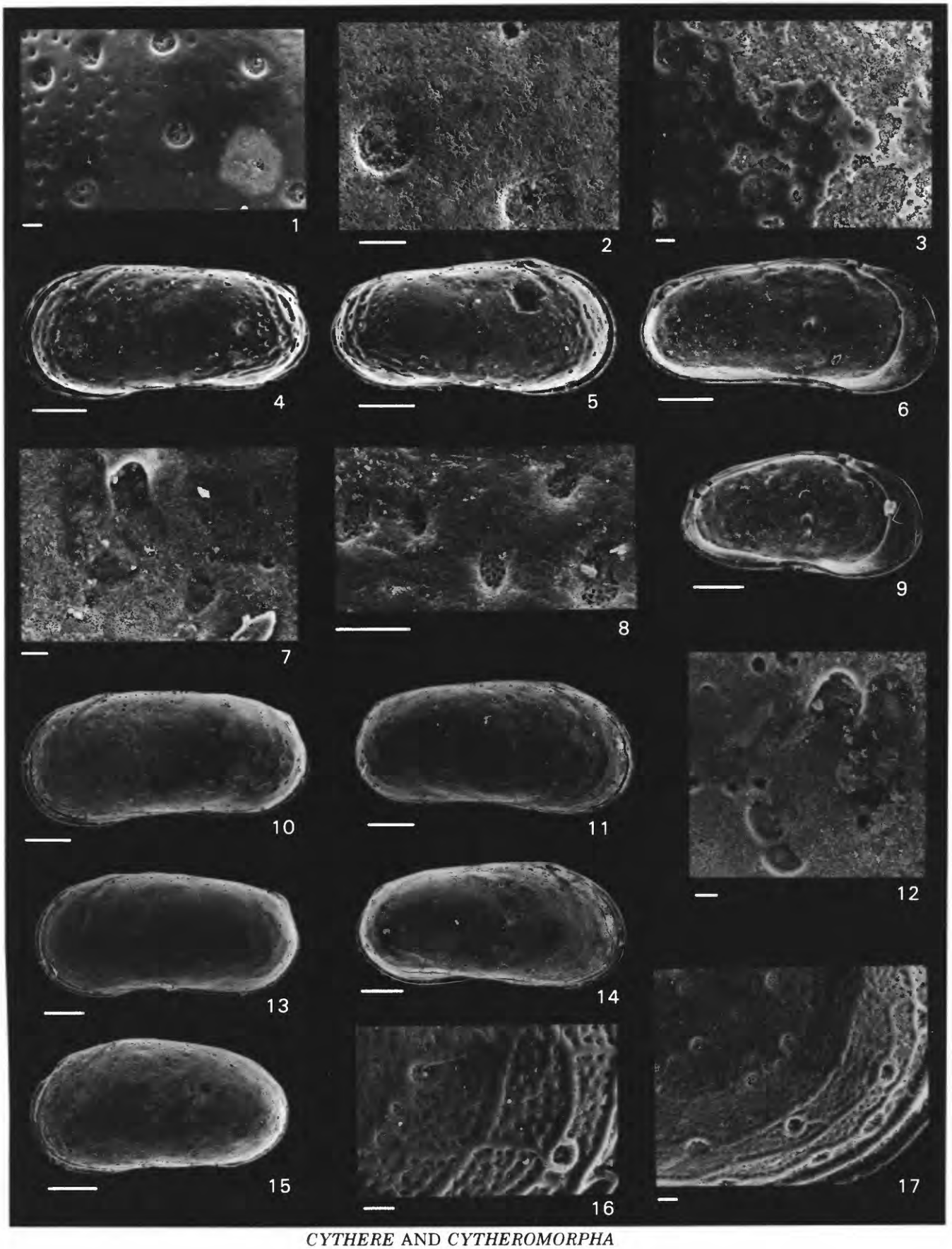
1. Sieve pore (×375). USNM 408124.
2. Sieve plate and etched valve surface (×900). USNM 408126.
3. Sharp contact between etched and unetched valve surface (×325). USNM 408128.

4–9. *Cytheromorpha eskerensis* n. sp. (p. 13).

4. Exterior male left valve (×102). USNM 408131 (paratype).
5. Exterior male right valve (×104). USNM 408132 (paratype).
6. Interior male left valve (×100). USNM 408133 (paratype).
7. Central muscle scar field (×475). USNM 408133 (paratype).
8. Sieve pores (×1,100). USNM 408131 (paratype).
9. Interior female left valve (×94). USNM 408134 (paratype).

10–17. *Cytheromorpha grandwashensis* n. sp. (p. 15).

10. Exterior male left valve (×88). USNM 408137 (paratype).
11. Exterior male right valve (×83). USNM 408138 (paratype).
12. Central muscle scar field (×450). USNM 408139 (paratype).
13. Exterior male left valve (×79). USNM 408140 (paratype).
14. Exterior male right valve (×77). USNM 408141 (paratype).
15. Exterior male left valve (×86). USNM 408142 (paratype).
16. Anteroventral ornamentation, sieve pores, and boring traces (×575). USNM 408141 (paratype).
17. Anteroventral ornamentation, sieve pores, and boring traces (×400). USNM 408138 (paratype).



CYTHERE AND *CYTHEROMORPHA*

PLATE 4

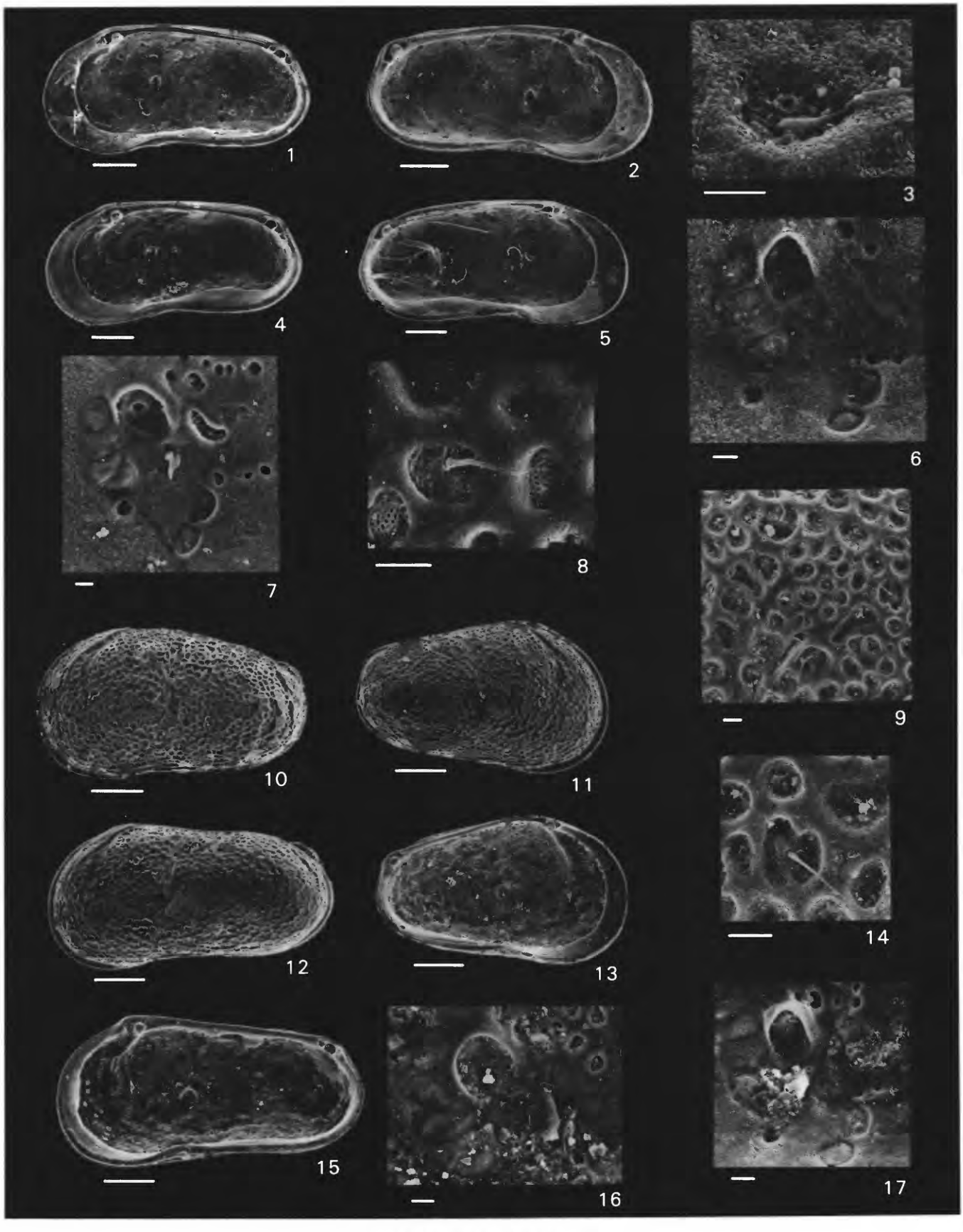
[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1, 2, 4, 5, 10–13, 15; bar scale equals 10 micrometers for figs. 3, 6–9, 14, 16, 17]

FIGURES 1–7. *Cytheromorpha grandwashensis* n. sp. (p. 15).

1. Interior male right valve (×84). USNM 408139 (paratype).
2. Interior male left valve (×86). USNM 408143 (paratype).
3. Sieve pores (×1,200). USNM 408137 (paratype)
4. Interior male right valve (×78). USNM 408144 (paratype).
5. Interior male left valve (×79). USNM 408145 (paratype).
6. Central muscle scar field (×475). USNM 408143 (paratype).
7. Central muscle scar field (×350). USNM 408145 (paratype).

8–17. *Cytheromorpha knikensis* Forester and Brouwers, 1985 (p. 16).

8. Ornamentation and sieve pores (×1,100). USNM 408148.
9. Ornamentation, sieve pores, seta, and external reflection of frontal and adductor muscle scars (×350). USNM 408149.
10. Exterior female left valve (×101). USNM 408149.
11. Exterior female right valve (×92). USNM 408148.
12. Exterior male left valve (×98). USNM 408150.
13. Interior female left valve (×100). USNM 408151.
14. Sieve pores and seta (×850). USNM 408149.
15. Interior male left valve (×97). USNM 408152.
16. Central muscle scar field (×450). USNM 408151.
17. Central muscle scar field (×450). USNM 408153.



CYTHEROMORPHA

PLATE 5

[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1–5, 7, 10, 13–17; bar scale equals 10 micrometers for figs. 6, 8, 9, 12; bar scale equals 1 micrometer for fig. 11]

FIGURES 1–8. *Cytheromorpha molniai* n. sp. (p. 17).

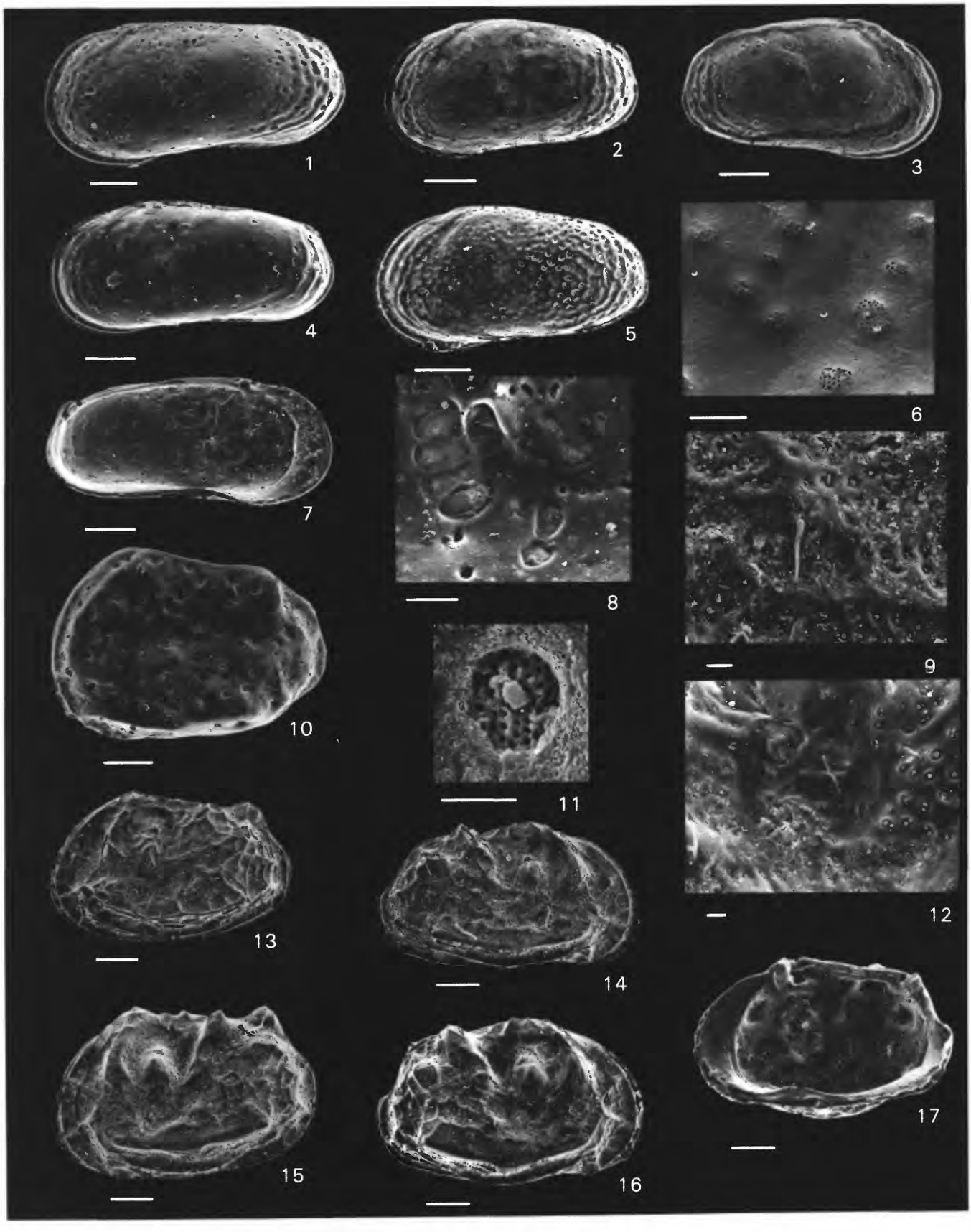
1. Exterior male left valve (×104). USNM 408156 (paratype).
2. Exterior female left valve (×92). USNM 408157 (paratype).
3. Exterior female right valve (×87). USNM 408158 (paratype).
4. Exterior male left valve (×91). USNM 408159 (paratype).
5. Exterior female left valve (×106). USNM 408160 (paratype).
6. Sieve pores (×1,100). USNM 408159 (paratype).
7. Interior male left valve (×92). USNM 408161 (paratype).
8. Central muscle scar field (×1,000). USNM 408161 (paratype).

9, 12–17. *Palmenella limicola* (Norman, 1865) (p. 19).

9. Pores and secondary ornament papillae (×500). USNM 408165.
12. Pores and secondary ornament papillae (×475). USNM 408167.
13. Exterior male left valve (×78). USNM 408166.
14. Exterior male right valve (×82). USNM 408165.
15. Exterior female left valve (×75). USNM 408168.
16. Exterior female right valve (×79). USNM 408167.
17. Interior female right valve (×76). USNM 408169.

10, 11. *Schizocythere* sp. A (p. 18).

10. Exterior juvenile left valve (×94). USNM 408163.
11. Sieve pore (×19,500). USNM 408163.



CYTHEROMORPHA, PALMENELLA, AND *SCHIZOCYTHERE*

PLATE 6

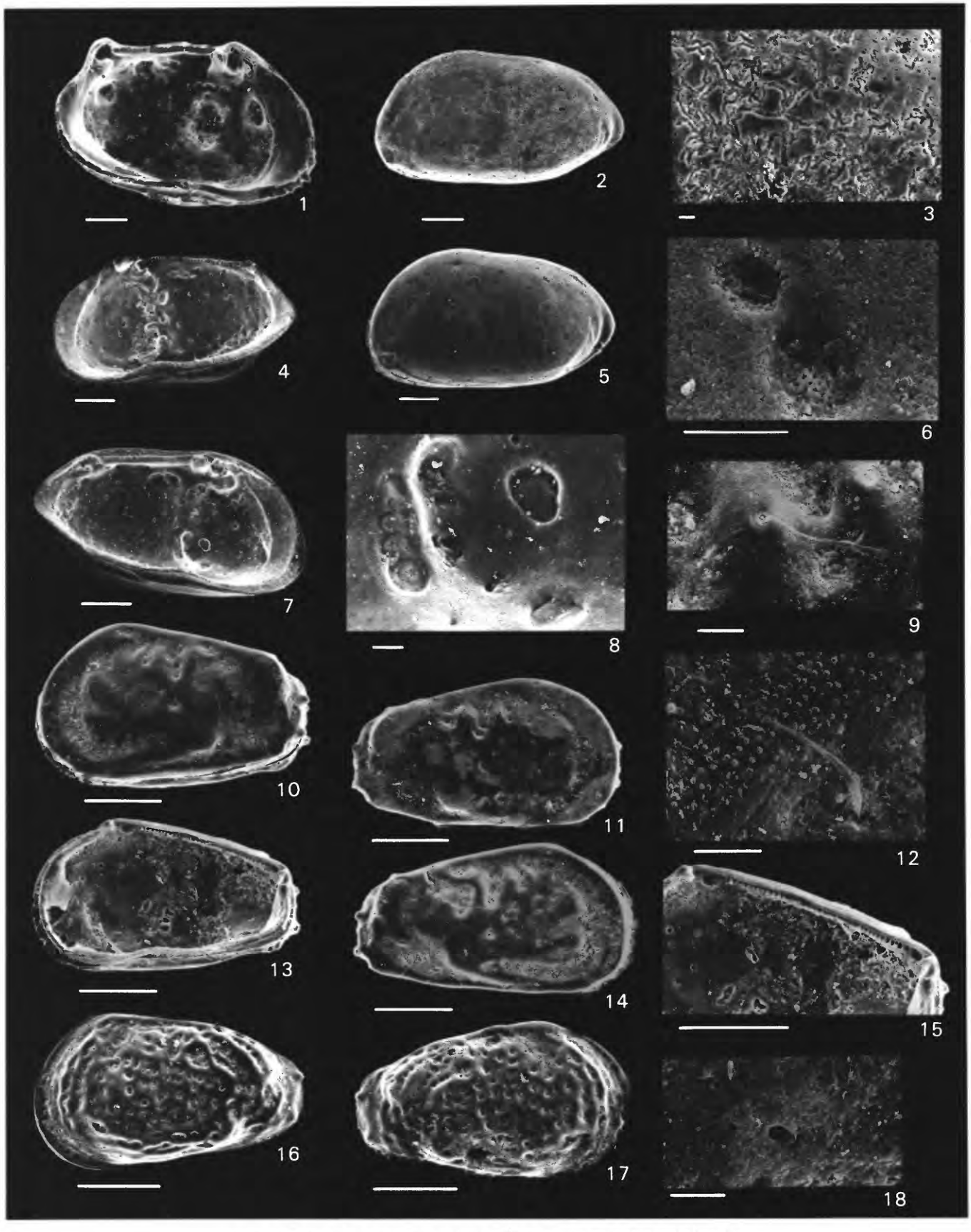
[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1, 2, 4, 5, 7, 10, 11, 13–17; bar scale equals 10 micrometers for figs. 3, 6, 8, 9, 12, 18]

FIGURES 1. *Palmenella limicola* (Norman, 1865) (p. 19).
Interior female left valve (×75). USNM 408170.

2–8. *Acuminocythere crescentensis* Swain and Gilby, 1973 (p. 20).
2. Exterior male left valve (×71). USNM 408172.
3. Borings on valve surface (×325). USNM 408172.
4. Interior female right valve (×63). USNM 408173.
5. Exterior female left valve (×65). USNM 408174.
6. Sieve pores (×2,000). USNM 408172.
7. Interior female left valve (×81). USNM 408175.
8. Central muscle scar field (×600). USNM 408175.

9–15. *Munseyella melzeri* n. sp. (p. 22).
9. Pores (×875). USNM 408178 (paratype).
10. Exterior female left valve (×149). USNM 408179 (paratype).
11. Exterior male right valve (×144). USNM 408180 (paratype).
12. Pore and secondary ornament papillae (×1,300). USNM 408180 (paratype).
13. Interior female right valve (×144). USNM 408181 (paratype).
14. Exterior male right valve (×154). USNM 408178 (paratype).
15. Hingement (×210). USNM 408181 (paratype).

16–18. *Munseyella ristveti* n. sp. (p. 22).
16. Exterior left valve (×153). USNM 408183 (paratype).
17. Exterior right valve (×153). USNM 408184 (paratype).
18. Pore (×1,100). USNM 408184 (paratype).



PALMENELLA, ACUMINOCYTHERE, AND *MUNSEYELLA*

PLATE 7

[All figures are camera lucida drawings]

FIGURES

1. *Acuminocythere crescentensis* Swain and Gilby, 1974 (p. 20).
   Exterior left valve (×69). USNM 408171.

2, 3. *Munseyella melzeri* n. sp. (p. 22).
   2. Exterior female right valve (×130). USNM 408176 (holotype).
   3. Exterior male right valve (×128). USNM 408177 (paratype).

4. *Munseyella ristveti* n. sp. (p. 22).
   Exterior left valve (×144). USNM 408182 (holotype).

5, 6. *Pectocythere parkerae* Swain and Gilby, 1974 (p. 27).
   5. Exterior right valve (×79). USNM 408202.
   6. Exterior left valve (×75). USNM 408203.

7. *Pectocythere janae* n. sp. (p. 24).
   Exterior right valve (×89). USNM 408187 (holotype).

8. *Pectocythere* sp. G (p. 24).
   Exterior left valve (×77). USNM 408185.

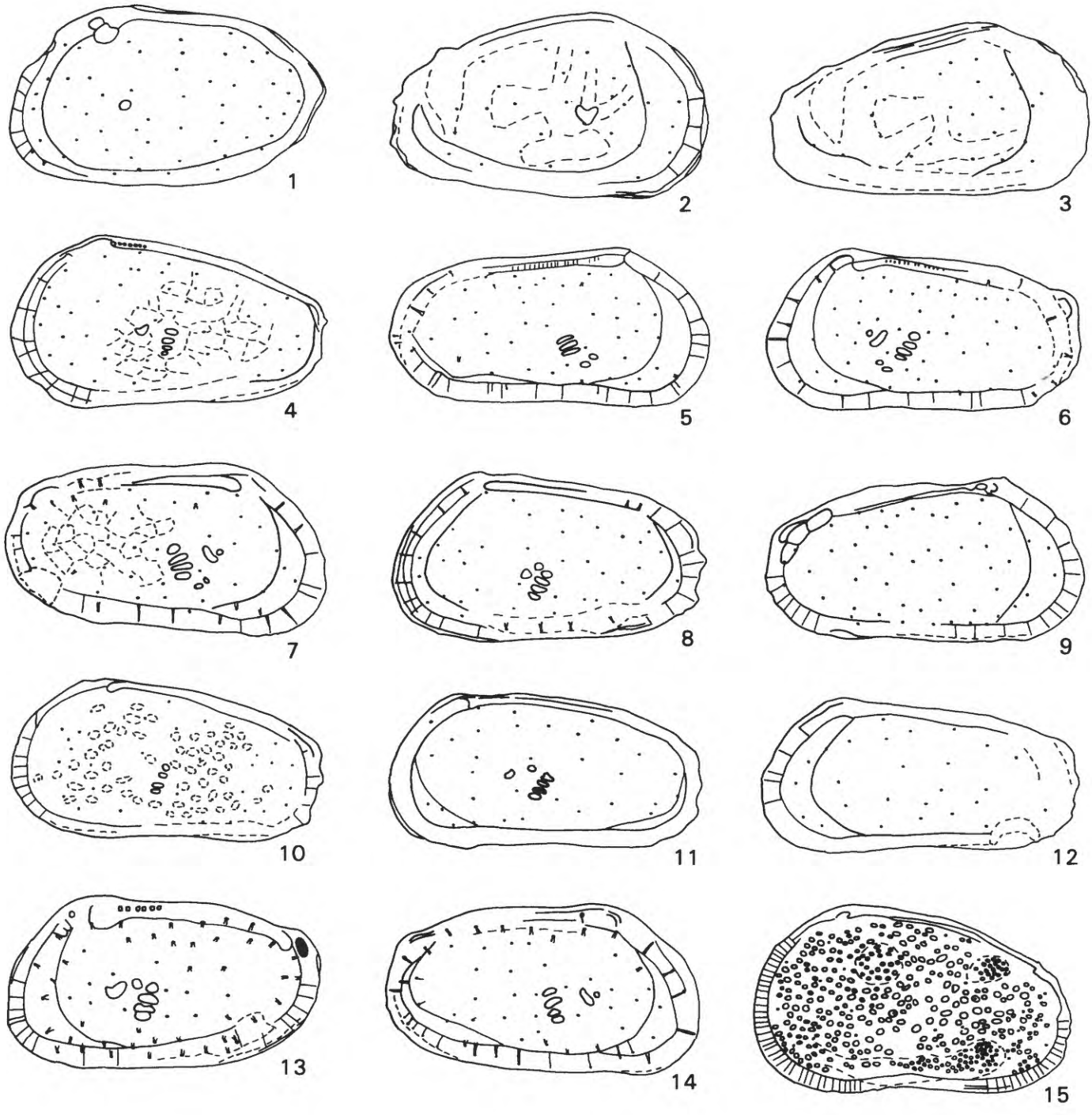
9. *Pectocythere* sp. A (p. 24).
   Exterior right valve (×100). USNM 408186.

10. *Pectocythere kiklukhensis* n. sp. (p. 25).
    Exterior left valve (×85). USNM 408192 (holotype).

11, 12. *Pectocythere marincovichi* n. sp. (p. 26).
   11. Exterior female left valve (×74). USNM 408196 (holotype).
   12. Exterior male left valve (×77). USNM 408197 (paratype).

13, 14. *Pectocythere tsiuensis* n. sp. (p.29).
   13. Exterior female left valve (×80). USNM 408208 (holotype).
   14. Exterior female right valve (×82). USNM 408209 (paratype).

15. *Cluthia cluthae* (Brady, Crosskey, and Robertson, 1874) (p. 30).
    Exterior male left valve (×139). USNM 408216.



ACUMINOCYTHERE, MUNSEYELLA, PECTOCYTHERE, AND *CLUTHIA*

PLATE 8

[All figures are scanning electron micrographs. Bar scale equals 100 micrometers for figs. 1, 2, 4, 5, 7–10, 13, 14, 16–18; bar scale equals 10 micrometers for figs. 3, 6, 11, 12, 15]

FIGURES 1, 2, 6. *Pectocythere parkerae* Swain and Gilby, 1974 (p. 27).

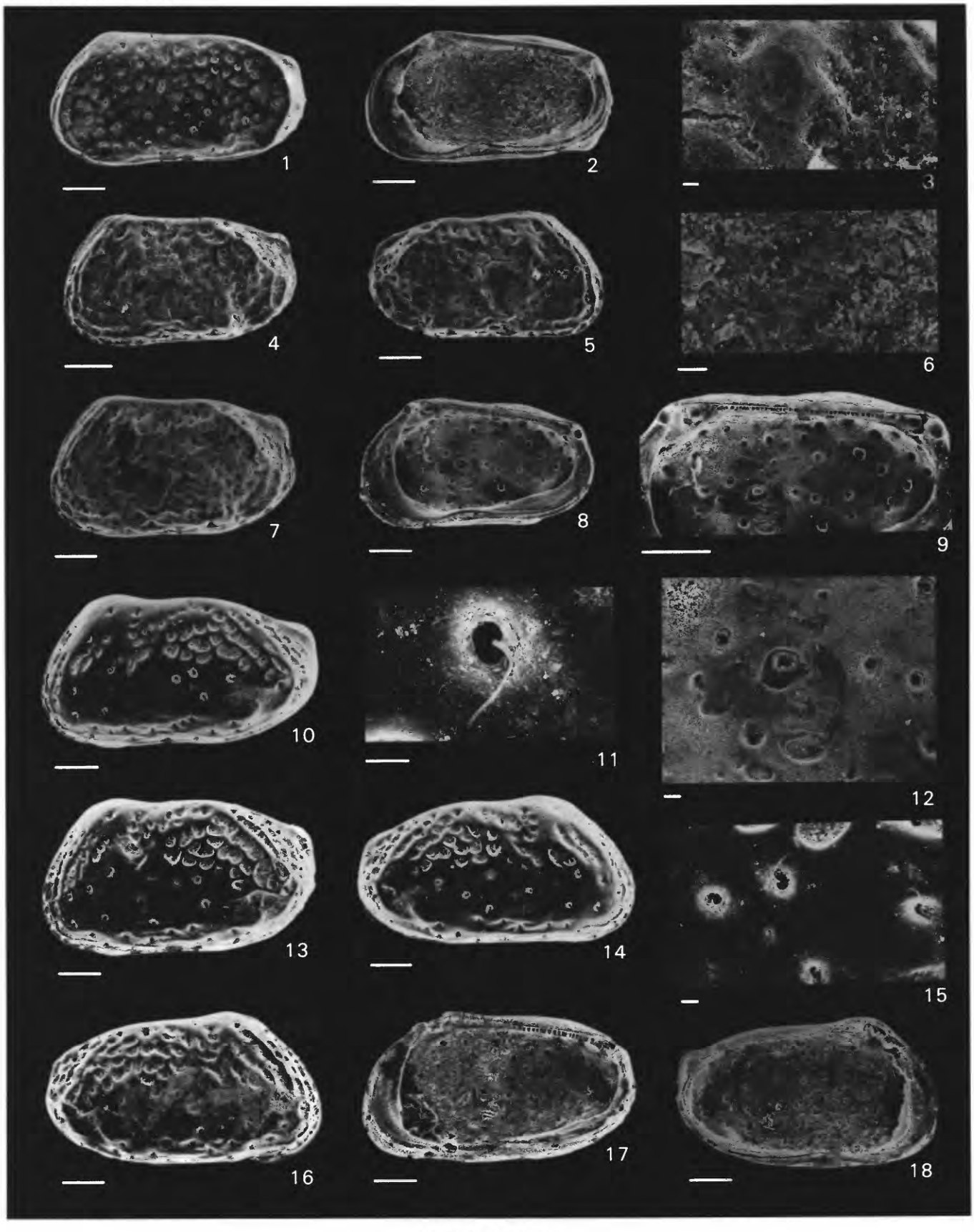
1. Exterior male left valve (×81). USNM 408206.
2. Interior female right valve (×83). USNM 408207.
6. Adductor muscle scars (×525). USNM 408207.

3–5, 7–9, 12. *Pectocythere janae* n. sp. (p. 24).

3. Pores and secondary ornament (×300). USNM 408188 (paratype).
4. Exterior left valve (×76). USNM 408188 (paratype).
5. Exterior right valve (×80). USNM 408189 (paratype).
7. Exterior left valve (×79). USNM 408190 (paratype).
8. Interior right valve (×80). USNM 408191 (paratype).
9. Hinge, dorsal muscle scars, and central muscle scar field (×130). USNM 408191 (paratype).
12. Central muscle scar field (×300). USNM 408191 (paratype).

10, 11, 13–18. *Pectocythere tsiuensis* n. sp. (p. 29).

10. Exterior left valve (×80). USNM 408210 (paratype).
11. Pore with seta (×825). USNM 408210 (paratype).
13. Exterior left valve (×83). USNM 408211 (paratype).
14. Exterior right valve (×82). USNM 408212 (paratype).
15. Pores with seta (×300). USNM 408210 (paratype).
16. Exterior right valve (×81). USNM 408213 (paratype).
17. Interior right valve (×85). USNM 408214 (paratype).
18. Interior left valve (×82). USNM 408215 (paratype).



PECTOCYTHERE

PLATE 9

[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1, 2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 17; bar scale equals 10 micrometers for figs. 3, 6, 9, 12, 15, 18]

FIGURES 1–7, 12. *Pectocythere kiklukhensis* n. sp. (p. 25).

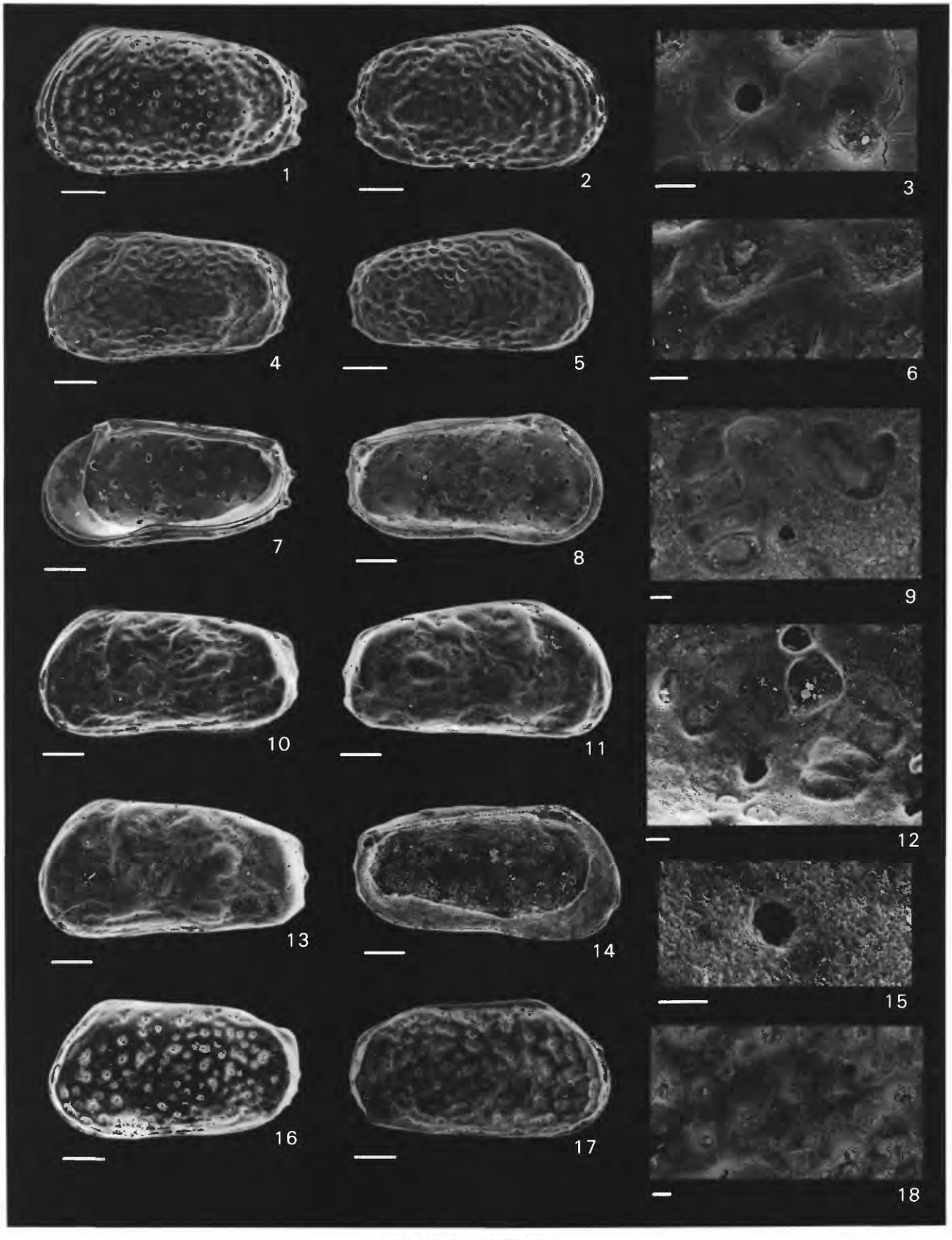
1. Exterior left valve (×79). USNM 408193 (paratype).
2. Exterior right valve (×83). USNM 408194 (paratype).
3. Pore and bored surface (×800). USNM 408193 (paratype).
4. Exterior left valve (×81). USNM 408195 (paratype).
5. Exterior right valve (×82). USNM 408196 (paratype).
6. Pore and seta (×700). USNM 408195 (paratype).
7. Interior right valve (×76). USNM 408197 (paratype).
12. Central muscle scar field (×400). USNM 408197 (paratype).

8–11, 13–15. *Pectocythere marincovichi* n. sp. (p. 26).

8. Interior left valve (×75). USNM 408198 (paratype).
9. Central muscle scar field (×400). USNM 408198 (paratype).
10. Exterior left valve (×73). USNM 408604 (paratype).
11. Exterior right valve (×75). USNM 408199 (paratype).
13. Exterior left valve (×79). USNM 408200.
14. Interior left valve (×79). USNM 408201 (paratype).
15. Normal pore (×950). USNM 408199 (paratype).

16–18. *Pectocythere parkerae* Swain and Gilby, 1974 (p. 27).

16. Exterior female left valve (×80). USNM 408204.
17. Exterior female right valve (×79). USNM 408205.
18. Simple pores and etched, bored valve surface (×350). USNM 408205.



PECTOCYTHERE

PLATE 10

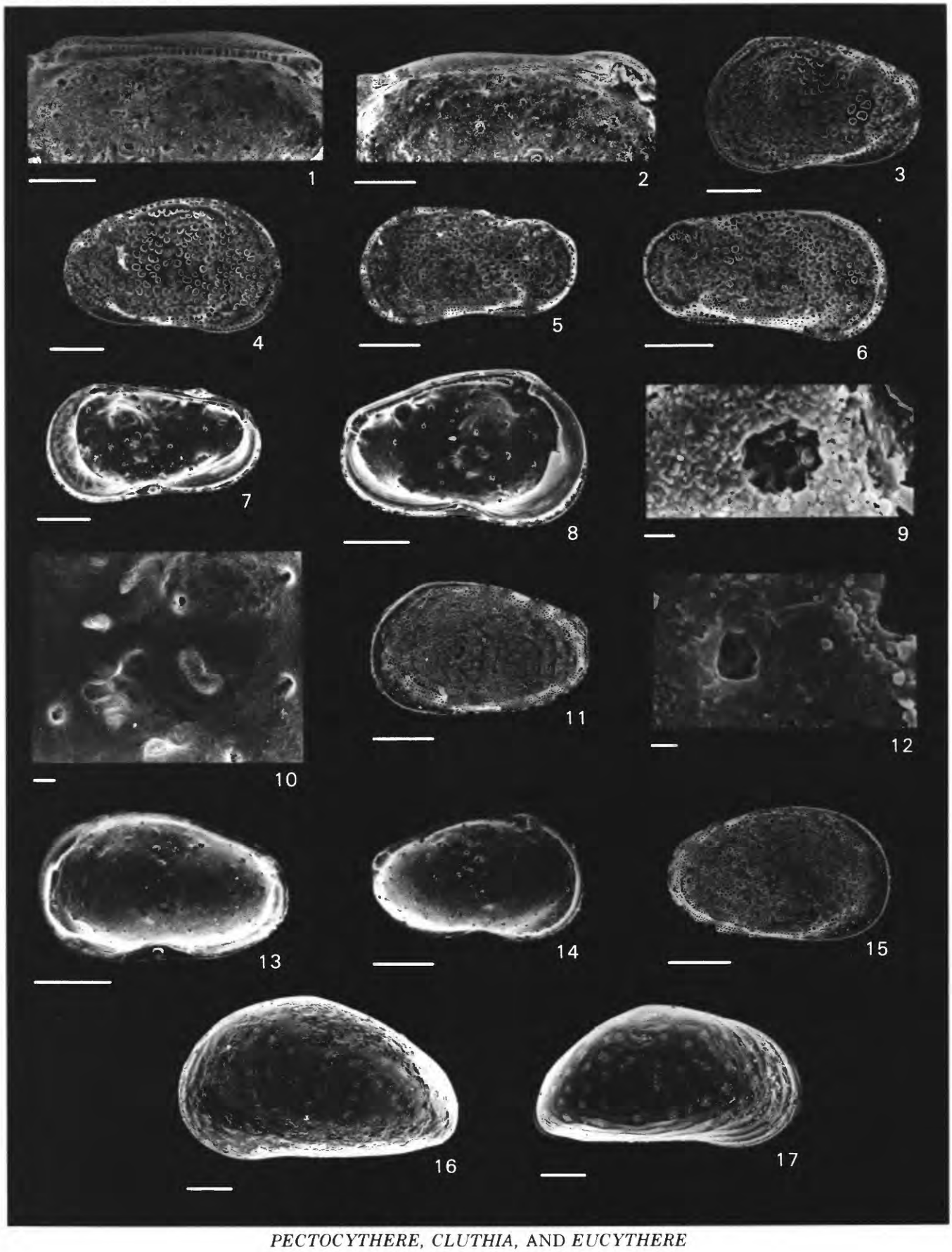
[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1–8, 11, 13–17; bar scale equals 10 micrometers for fig. 10; bar scale equals 1 micrometer for figs. 9, 12]

FIGURES 1, 2. *Pectocythere tsiuensis* n. sp. (p. 27).
- 1. Right valve hingement (×130). USNM 408214 (paratype).
- 2. Left valve hingement (×120). USNM 408215 (paratype).

3–10. *Cluthia cluthae* (Brady, Crosskey, and Robertson, 1874) (p. 30).
- 3. Exterior female left valve (×100). USNM 408218.
- 4. Exterior female right valve (×109). USNM 408219.
- 5. Exterior male left valve (×117). USNM 408220.
- 6. Exterior male right valve (×128). USNM 408221.
- 7. Interior male right valve (×108). USNM 408222.
- 8. Interior female left valve (×125). USNM 408223.
- 9. Sieve pore (×6,000). USNM 408220.
- 10. Central muscle scar field (×425). USNM 408223.

11–15. *Cluthia foresteri* n. sp. (p. 31).
- 11. Exterior female left valve (×117). USNM 408225 (paratype).
- 12. Sieve pore (×4,750). USNM 408225 (paratype).
- 13. Interior female right valve (×136). USNM 408226 (paratype).
- 14. Interior female left valve (×117). USNM 408227 (paratype).
- 15. Exterior female right valve (×120). USNM 408228 (paratype).

16, 17. *Eucythere argus* (Sars, 1866) (p. 34).
- 16. Exterior female left valve (×86). USNM 408234.
- 17. Exterior female right valve (×83). USNM 408235.



PECTOCYTHERE, CLUTHIA, AND *EUCYTHERE*

PLATE 11

[All figures are camera lucida drawings]

FIGURES 1. *Cluthia cluthae* (Brady, Crosskey, and Robertson, 1874) (p. 30).
Exterior male right valve (×143). USNM 408217.

2. *Cluthia foresteri* n. sp. (p. 31).
Exterior left valve (×136). USNM 408224 (holotype).

3. *Limnocythere friabilis* Benson and MacDonald, 1963 (p. 33).
Exterior left valve (×102). USNM 408229.

4. *Limnocythere inopinata* (Baird, 1843) (p. 33).
Exterior female right valve (×85). USNM 408230.

5. *Limnocythere itasca* Cole, 1949 (p. 33).
Exterior left valve (×82). USNM 408231.

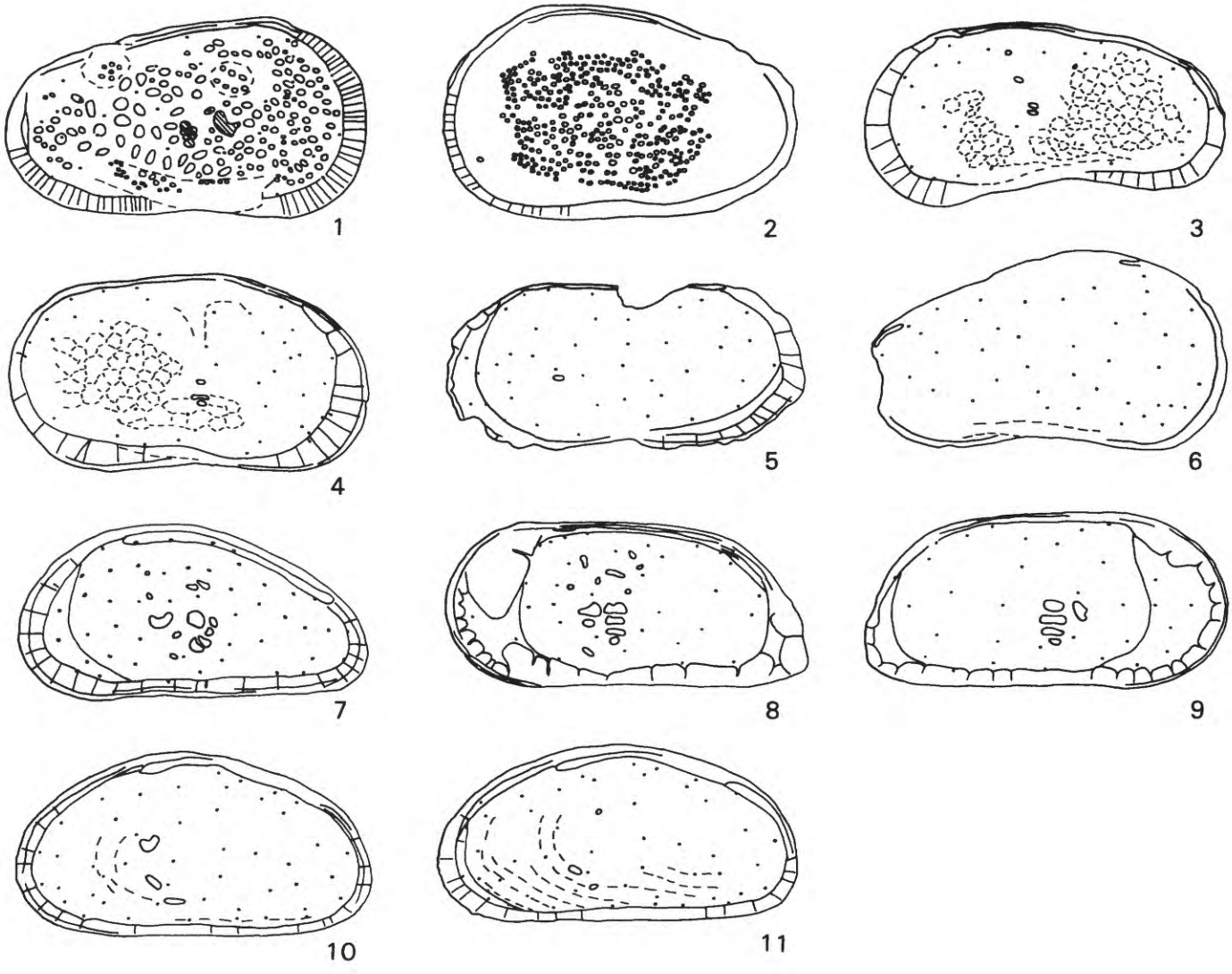
6. *Limnocythere staplini* Gutentag and Benson, 1962 (p. 33).
Exterior juvenile right valve (×111). USNM 408232.

7. *Eucythere argus* (Sars, 1866) (p. 34).
Exterior left valve (×86). USNM 408233.

8. *Krithe adelspergi* n. sp. (p. 36).
Exterior left valve (×75). USNM 408242 (holotype).

9. *Krithe burkholderi* n. sp. (p. 35).
Exterior right valve (×56). USNM 408239 (holotype).

10, 11. *Pontocythere dahlgrenensis* n. sp. (p. 37).
10. Exterior female left valve (×103). USNM 408248 (holotype).
11. Exterior male left valve (×94). USNM 408255 (paratype).



CLUTHIA, LIMNOCYTHERE, EUCYTHERE, KRITHE, AND *PONTOCYTHERE*

PLATE 12

[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1,2, 5, 7, 9–11, 13, 14, 16; bar scale equals 10 micrometers for figs. 3, 4, 6, 12, 17, 18; bar scale equals 1 micron for figs. 8, 15]

FIGURES 1–6. *Eucythere argus* (Sars, 1866) (p. 34).

1. Exterior male left valve (×83). USNM 408236.
2. Exterior male right valve (×83). USNM 408237.
3. Large sieve pores and ornament (×500). USNM 408235.
4. Sieve pore (×1,800). USNM 408237.
5. Interior female left valve (×88). USNM 408238.
6. Sieve pore with seta (×1,200). USNM 408236.

7–9, 12. *Krithe burkholderi* n. sp. (p. 35).

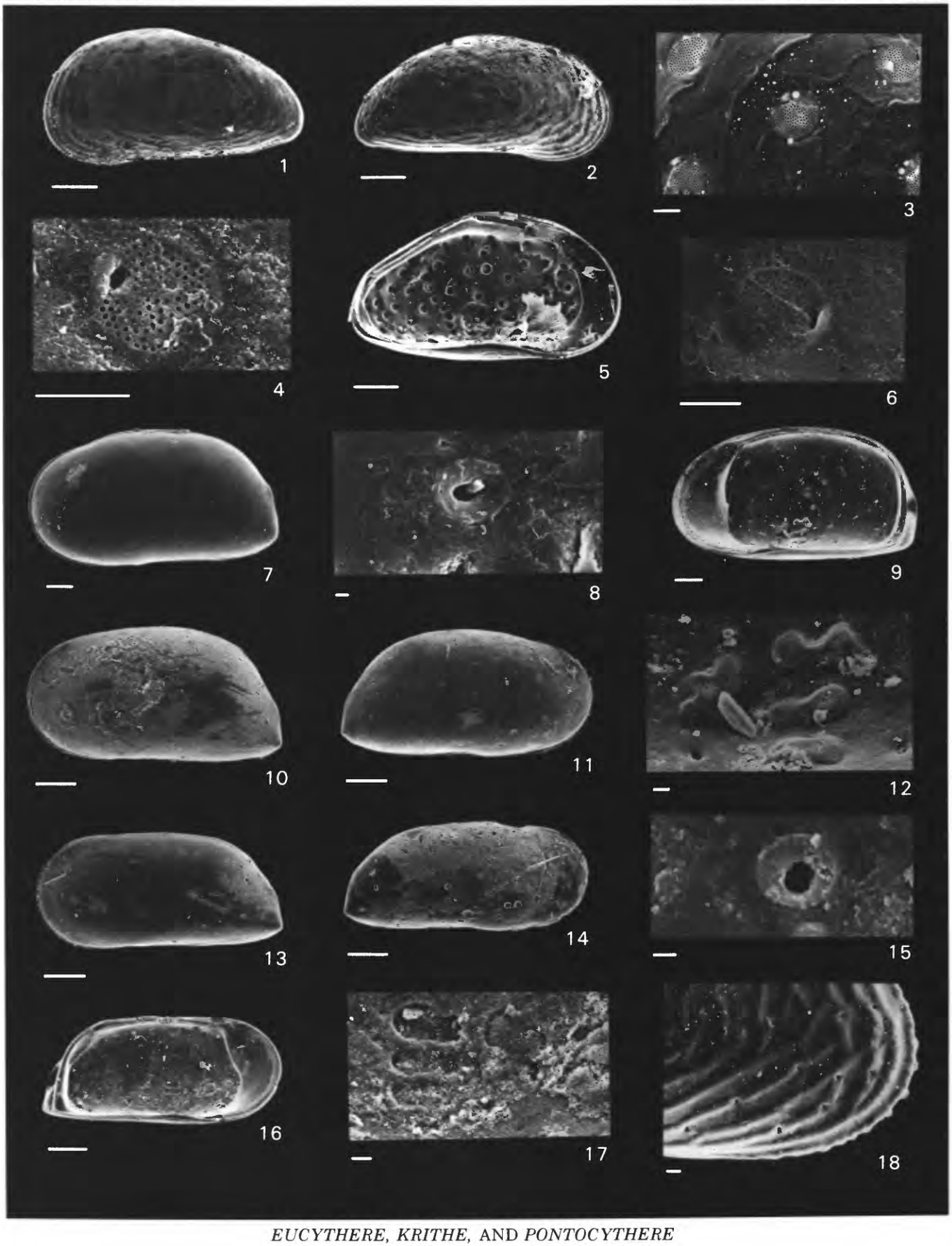
7. Exterior left valve (×53). USNM 408240 (paratype).
8. Simple pore with remnant seta (×27,500). USNM 408240 (paratype).
9. Interior right valve (×50). USNM 408241 (paratype).
12. Central muscle scar field (×300). USNM 408241 (paratype).

10, 11, 13–17. *Krithe adelspergi* n. sp. (p. 36).

10. Exterior female left valve (×74). USNM 408243 (paratype).
11. Exterior female right valve (×75). USNM 408244 (paratype).
13. Exterior male left valve (×73). USNM 408245 (paratype).
14. Exterior male right valve (×73). USNM 408246 (paratype).
15. Simple pore (×4,000). USNM 408245 (paratype).
16. Interior male left valve (×77). USNM 408247 (paratype).
17. Central muscle scar field (×400). USNM 408247 (paratype).

18. *Pontocythere dahlgrenensis* n. sp. (p. 37).

Anterior ornament and pores (×300). USNM 408249 (paratype).



EUCYTHERE, KRITHE, AND *PONTOCYTHERE*

PLATE 13

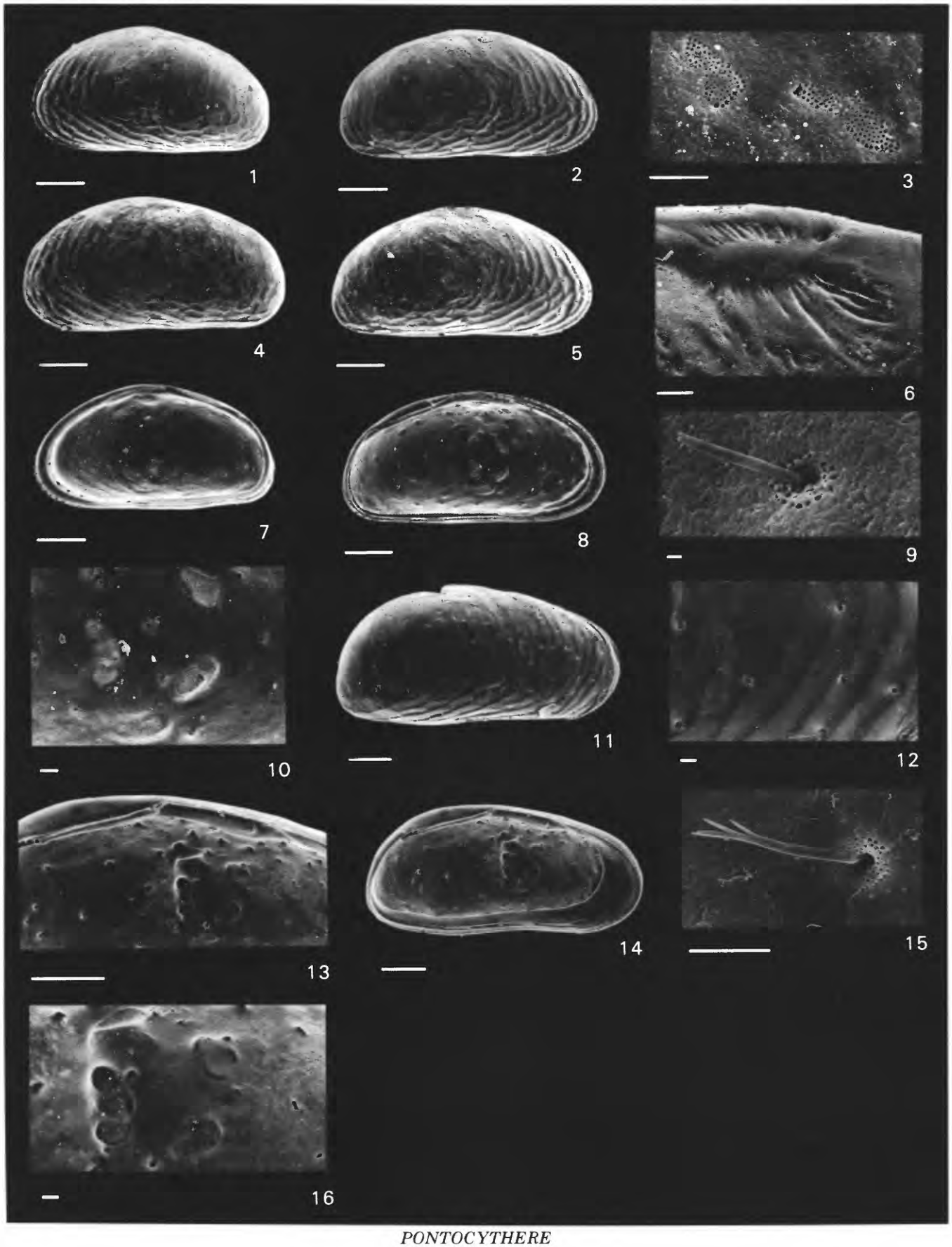
[All figures are scanning electron micrographs. Bar scale equals 100 micrometers for figs. 1, 2, 4, 5, 7, 8, 11, 13, 14; bar scale equals 10 micrometers for figs. 3, 6, 10, 12, 15, 16; bar scale equals 1 micrometer for fig. 9]

FIGURES 1–10. *Pontocythere dahlgrenensis* n. sp. (p. 37).

1. Exterior female left valve (×89). USNM 408250 (paratype).
2. Exterior female right valve (×94). USNM 408249 (paratype).
3. Sieve pores (×1,125). USNM 408249 (paratype).
4. Exterior male left valve (×91). USNM 408251 (paratype).
5. Exterior male right valve (×94). USNM 408252 (paratype).
6. Anterodorsal ornament (×700). USNM 408252 (paratype).
7. Interior female right valve (×96). USNM 408253 (paratype).
8. Interior male left valve (×99). USNM 408254 (paratype).
9. Sieve pore with remnant seta (×3,000). USNM 408250 (paratype).
10. Central muscle scar field (×325). USNM 408254 (paratype).

11–16. *Pontocythere jefferiesensis* n. sp. (p. 39).

11. Exterior male right valve (×81). USNM 408256 (holotype)
12. Anteroventral ornament and pores (×300). USNM 408256 (holotype).
13. Hingement and central muscle scars (×190). USNM 408257 (paratype).
14. Interior male left valve (×82). USNM 408257 (paratype).
15. Sieve pore and seta (×1,550). USNM 408256 (holotype).
16. Central muscle scar field (×300). USNM 408257 (paratype).



PONTOCYTHERE

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