

Systematic Paleontology of Quaternary Ostracode  
Assemblages from the Gulf of Alaska, Part 2:  
Families Trachyleberididae, Hemicytheridae,  
Loxoconchidae, Paracytherideidae

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# Systematic Paleontology of Quaternary Ostracode Assemblages from the Gulf of Alaska, Part 2: Families Trachyleberididae, Hemicytheridae, Loxoconchidae, Paracytherideidae

*By* Elisabeth M. Brouwers

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# CONTENTS

Abstract.....	1
Introduction.....	1
Study Area .....	1
Acknowledgments .....	2
Systematic Paleontology.....	2
<i>Acanthocythereis dunelmensis</i> .....	3
<i>Robertsonites tuberculatus</i> .....	7
<i>Ambtonia tongassensis</i> .....	8
<i>Celtia palmensis</i> .....	10
<i>Celtia blizhnii</i> .....	11
<i>Celtia pointmanbiensis</i> .....	12
<i>Finmarchinella (Finmarchinella) finmarchica</i> .....	14
<i>Finmarchinella (Barentsovia) angulata</i> .....	15
<i>Finmarchinella (Barentsovia) barentzovoensis</i> .....	15
<i>Finmarchinella (Barentsovia) guyotensis</i> .....	16
<i>Hemicythere emarginata</i> .....	17
<i>Hemicythere hazeli</i> .....	18
<i>Normanicythere leioderma</i> .....	19
<i>Aurila malaspinensis</i> .....	20
<i>Robustaurila jollaensis</i> .....	21
<i>Coquimba hanaii</i> .....	22
<i>Ambostracon tweedsmuiensis</i> .....	23
<i>Laperousecythere robusta</i> .....	25
<i>Laperousecythere yahtsensis</i> .....	26
<i>Elofsonia susitnensis</i> .....	27
<i>Loxoconcha luciensis</i> .....	28
<i>Loxoconcha</i> sp. G .....	28
<i>Sagmatocythere gombosi</i> .....	29
<i>Palmoconcha russellensis</i> .....	30
<i>Palmoconcha krausei</i> .....	31
<i>Loxoconchidea dolgoiensis</i> .....	32
<i>Paracytheridea khantaakensis</i> .....	34
References Cited .....	34

## PLATES

[Plates follow References Cited]

1-16. Quaternary ostracodes from the Gulf of Alaska.

## FIGURES

1. Map showing region studied in the Gulf of Alaska.....	2
2. Map showing sample localities in the Gulf of Alaska.....	3
3-35. Plots of:	
3. Length versus height for <i>Acanthocythereis dunelmensis</i> .....	6
4. Abundance versus water depth for <i>Acanthocythereis dunelmensis</i> .....	7
5. Length versus height for <i>Robertsonites tuberculatus</i> .....	8
6. Abundance versus water depth for <i>Robertsonites tuberculatus</i> .....	8

7.	Length versus height for <i>Ambtonia tongassensis</i> .	9
8.	Abundance versus water depth for <i>Ambtonia tongassensis</i> .	9
9.	Length versus height for <i>Celtia palmensis</i> .	11
10.	Abundance versus water depth for <i>Celtia palmensis</i> .	11
11.	Length versus height for <i>Celtia blizhnii</i> .	12
12.	Abundance versus water depth for <i>Celtia blizhnii</i> .	12
13.	Length versus height for <i>Celtia pointmanbiensis</i> .	13
14.	Length versus height for <i>Finmarchinella (Finmarchinella) finmarchica</i> .	14
15.	Abundance versus water depth for <i>Finmarchinella (Finmarchinella) finmarchica</i> .	14
16.	Length versus height for <i>Finmarchinella (Barentsovia) guyotensis</i> .	16
17.	Abundance versus water depth for <i>Finmarchinella (Barentsovia) guyotensis</i> .	17
18.	Length versus height for <i>Hemicythere hazeli</i> .	18
19.	Abundance versus water depth for <i>Hemicythere hazeli</i> .	19
20.	Length versus height for <i>Aurila malaspinensis</i> .	20
21.	Abundance versus water depth for <i>Aurila malaspinensis</i> .	21
22.	Length versus height for <i>Coquimba hanaii</i> .	22
23.	Length versus height for <i>Ambostracon tweedmuirensis</i> .	23
24.	Abundance versus water depth for <i>Ambostracon tweedmuirensis</i> .	24
25.	Length versus height for <i>Laperousecythere robusta</i> .	25
26.	Abundance versus water depth for <i>Laperousecythere robusta</i> .	26
27.	Length versus height for <i>Laperousecythere yahtsensis</i> .	27
28.	Length versus height for <i>Elofsonia susitnensis</i> .	27
29.	Length versus height for <i>Loxoconcha luciensis</i> .	28
30.	Length versus height for <i>Sagmatocythere gombosi</i> .	29
31.	Length versus height for <i>Palmoconcha russellensis</i> .	30
32.	Abundance versus water depth for <i>Palmoconcha russellensis</i> .	31
33.	Length versus height for <i>Palmoconcha krausei</i> .	31
34.	Length versus height for <i>Loxoconchidea dolgoiensis</i> .	33
35.	Abundance versus water depth for <i>Loxoconchidea dolgoiensis</i> .	33

## TABLES

1.	Location and water depth of ostracode samples collected from the Gulf of Alaska	4
2.	Occurrence of the 27 ostracode species in the 223 bottom-grab samples collected during three cruises in the Gulf of Alaska	40

## 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 ( $\mu\text{m}$ )	$3.937 \times 10^{-5}$	inch
Millimeter (mm)	$3.937 \times 10^{-2}$	inch
Meter (m)	$3.281 \times 10^0$	foot
Gram (g)	$3.5 \times 10^{-2}$	ounce
Kilogram (kg)	$2.205 \times 10^0$	pound

# Systematic Paleontology of Quaternary Ostracode Assemblages from the Gulf of Alaska,

## Part 2: Families Trachyleberididae, Hemicytheridae, Loxoconchidae, Paracytherideidae

By Elisabeth M. Brouwers

### ABSTRACT

Twenty-seven species of podocopid ostracodes are reported from Quaternary sediments of the Gulf of Alaska continental shelf. One new genus, *Laperousecythere*, and 16 new species are described (*Ambtonia tongassensis*, *Celtia palmensis*, *C. blizhnii*, *C. pointmanbiensis*, *Finmarchinella* (*Barentsovia*) *guyotensis*, *Hemicythere hazeli*, *Aurila malaspinensis*, *Coquimba hanaii*, *Ambostracon tweedsmuirensis*, *Laperousecythere yahtsensis*, *Sagmatocythere gom-bosi*, *Loxoconcha luciensis*, *Palmoconcha russellensis*, *P. krausei*, *Loxoconchidea dolgoiensis*, *Paracytheridea khantaakensis*). Ten previously described species are illustrated, and one species is placed in open nomenclature.

### INTRODUCTION

The Gulf of Alaska makes up most of the cold-temperate Aleutian Zoogeographic Province, the northern boundary of which is at the Aleutian Islands and the southern boundary is at about lat 53° N. The combination of a geographic position in the middle latitudes, coastal topography with a high mountain range on the coastal plain, and the presence of the warm Aleutian Current along the continental shelf result in a warm maritime climate. The gulf is a climatic transition between the mild- and warm-temperate North Pacific and the subfrigid and frigid Bering Sea and Arctic Ocean.

The modern ostracode fauna of the Gulf of Alaska was poorly known until these studies (Brouwers, 1981, 1982a, 1982b, 1982c, 1983, 1988a, 1988b, 1990). Brouwers (1988a) recognized five ostracode assemblages, each characterized by a unique combination of values for species

diversity, abundance, dominant species, equitability distribution of species, percentage of living individuals, and associated fauna and flora. This report describes species occurrence in terms of these five assemblages. 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 consists of taxa that occur only as fossils.

Brouwers (1990) reported on 32 species representing the Families Cytherellidae, Bairdiidae, Cytheridae, Leptocytheridae, Limnocytheridae, Eucytheridae, Krithidae, and Cushmaniidae. This report describes 27 species of the Families Trachyleberididae, Hemicytheridae, Loxoconchidae, and Paracytherideidae.

### STUDY AREA

The species described in this report are from 223 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 256 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 µm), and material examined was down to and including that

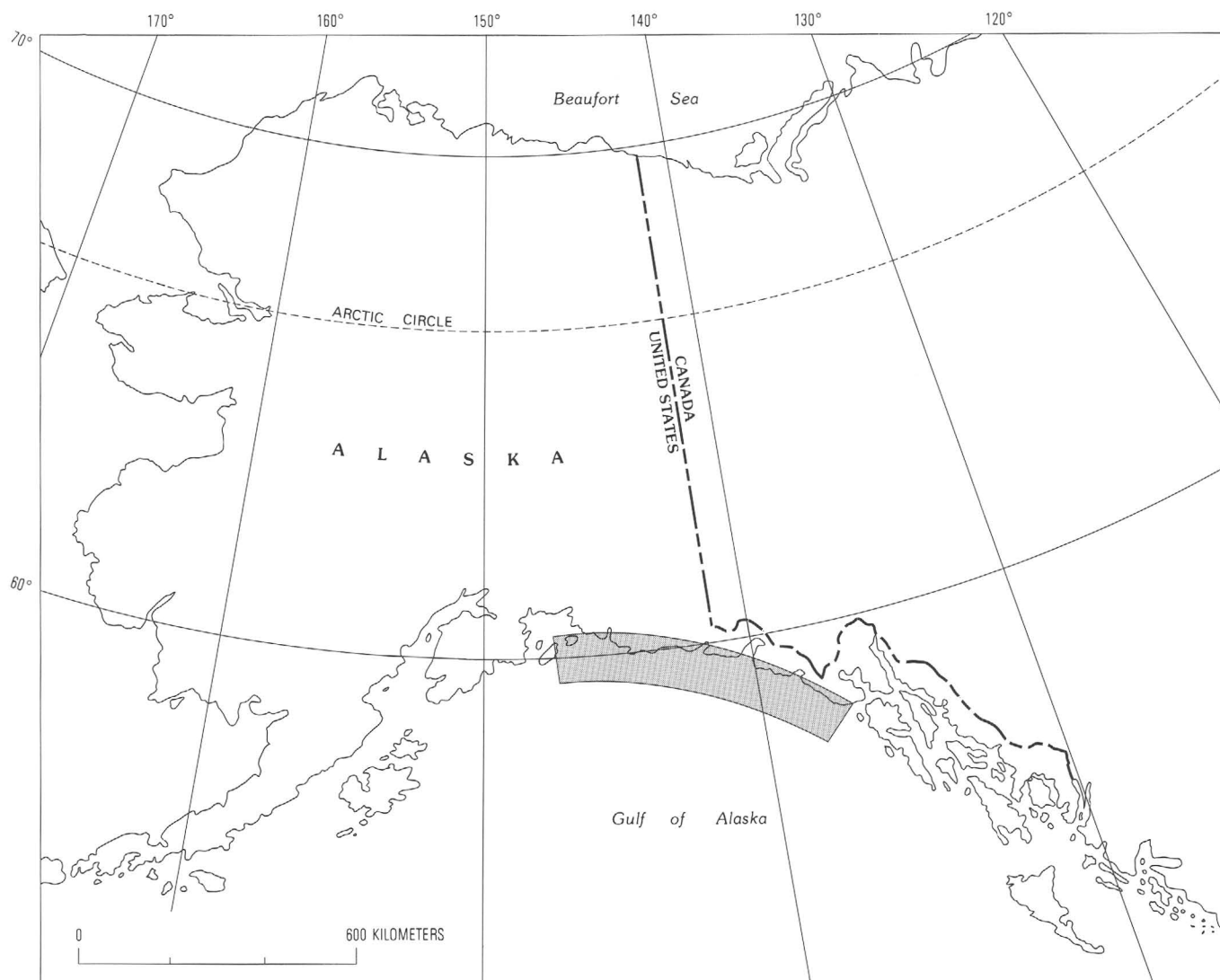


Figure 1. Map showing study area (shaded) in the Gulf of Alaska.

from the 80-mesh sieve (180  $\mu$ m). All adult and juvenile specimens were identified to species and were counted (Brouwers, 1981, 1982a, 1982b, 1983). Table 2 shows the occurrence of species in the samples.

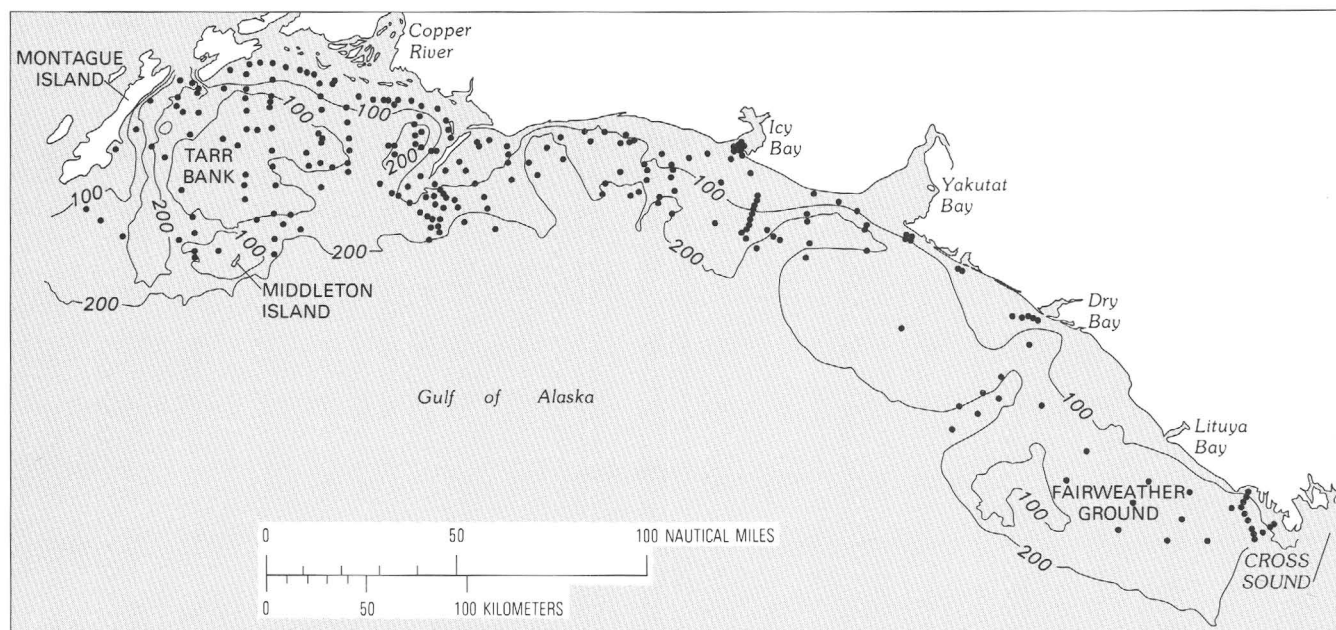
## ACKNOWLEDGMENTS

I thank Bruce F. Molnia (U.S. Geological Survey, Reston, Va.), who invited me to participate in cruises DC1-80-EG and DC2-80-EG and provided access to samples from cruises EGAL-75-KC and DC1-79-EG. I am grateful to David Horne (Thames Polytechnic, London, England), Ryoichi Tabuki (University of the Ryukyus, Japan), and John Neale (University of Hull, England), who carefully reviewed the manuscript. John Neale and Kunihiro Ishizaki reviewed the original draft. Neale and Tabuki examined specimens of *Celtia*, and Tabuki provided

examples of *Patagonacythere robusta*. John Whittaker (British Museum of Natural History, London), E.I. Schornikov (Institute of Biological Sciences, Vladivostok, Russia), and Alan Lord (University College, London, England) made critical comments on the taxa based on examination of the plates.

## SYSTEMATIC PALEONTOLOGY

All illustrated specimens are 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. Note that in the length-height plots of measurements, the number of dots does not always



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

match the number of specimens; this reflects identical measurements of some specimens.

Class OSTRACODA Latreille, 1806

Order PODOCOPIDA G.W. Mueller, 1894

Suborder PODOCOPA Sars, 1866

Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948

Subfamily TRACHYLEBERIDINAE Sylvester-Bradley, 1948

Tribe TRACHYLEBERIDINI Sylvester-Bradley, 1948

Genus *ACANTHOCYHEREIS* Howe, 1963

*Type species.*—*Acanthocythereis araneosa* Howe, 1963 (Type by original designation.)

*ACANTHOCYHEREIS DUNELMENSIS*  
(NORMAN, 1865)

Plate 1, figures 1–5; plate 2, figure 1; plate 16, figure 1; text figures 3, 4

*Cythere dunelmensis* Norman, 1865b, p. 22, pl. 7, figs. 1–4.

*Cythere dunelmensis* Norman. Brady, 1865, p. 193; Norman, 1867, p. 198; Brady, 1867, p. 208; Brady, 1868a, p. 416, pl. 30, figs. 1–12; Brady, 1868b, p. 31; Brady, 1870, p. 450; Brady and Crosskey, 1871, p. 61–63; Brady and Robertson, 1872, p. 53, 59, 62, 69; Brady, Crosskey, and Robertson, 1874, p. 168; Robertson, 1875, p. 125; Brady and Robertson, 1876, p. 186; Robertson, 1883, p. 28; Malcolmson, 1886, p. 260; Brady and Norman, 1889, p. 168; Sars, 1890, p. 72; Norman, 1891, p. 113, 120; Brady and Norman, 1896, p. 733; Scott, 1899, p. 85; Norman, 1902, p. 484; Brady, 1902, p. 99; Norman, 1905, p. 147; Scott, 1906, p. 283;

Cushman, 1906, p. 377; Ostenfeld and Wesenberg-Lund, 1909, p. 113; Norman and Brady, 1909, p. 103; Stephensen, 1913, p. 362; Kindle and Whittaker, 1918, p. 230; Sars, 1925, p. 125; Lucas, 1931, p. 401; Blake, 1933, p. 238; Klie, 1938, p. 181; Elofson, 1938, p. 7; Anderson, 1948, p. 224.

*Cythere horrida* Sars, 1866, p. 45.

*Cythereis dunelmensis* Norman. Norman, 1865a, p. 193; Stephensen, 1929, p. 3; Mueller, 1931, p. 29; Blake, 1933, p. 238; Stephensen, 1938, p. 10; Elofson, 1941, p. 296, figs. 10–11, maps 29, 30; Hagerman, 1965, p. 58, pl. 1, fig. 5.

Not *Cythereis dunelmensis* Norman. Tressler, 1941, p. 100–101, pl. 19, fig. 21.

*Cletocythereis noblissimus* Swain, 1963, p. 824–825, pl. 98, fig. 5; pl. 99, figs. 15a, 15b; text-fig. 10a.

*Acanthocythereis noblissima* (Swain). Schmidt, 1967, p. 488, pl. 62, figs. 12–16.

*Cletocythereis dunelmensis minor* (Norman). Bassiouni, 1965, p. 513, pl. 2, fig. 9.

*Cletocythereis dunelmensis dunelmensis* (Norman). Bassiouni, 1965, p. 513, pl. 2, fig. 8.

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

*Acanthocythereis dunelmensis* (Norman). Hazel, 1967a, p. 34, 35; Colhoun and McCabe, 1973, p. 187; Neale, 1974b, p. 92; Neale and Howe, 1975, pl. 1, figs. 3, 11, 13–16; Rosenfeld, 1977, p. 23, pl. 5, figs. 65–68; Peacock, Graham, Robinson, and Wilkinson, 1977, p. 98, 100; Robinson, 1978, p. 460, pl. 2, figs. 2a–2c;

**Table 1.** Location and water depth of ostracode samples collected from the Gulf of Alaska.

Sample No.	Latitude(°N)	Longitude(°W)	Water depth (meters)	Sample No.	Latitude(°N)	Longitude(°W)	Water depth (meters)
Cruise EGAL-75-KC				Cruise EGAL-75-KC-Continued			
5	59°36.5'	147°32.8'	Unknown	109	59°43.4'	144°52.7'	102
6	59°32.3'	147°21.1'	143	110	59°41.5'	144°47.2'	97
11	59°55.9	147°25.4'	49	111	59°38.9'	144°41.0'	148
16	59°45.2'	146°49.4'	91	112	59°37.6'	144°37.0'	145
17	59°38.1'	146°43.5'	97	115	59°46.0'	144°47.7'	64
18	59°33.5'	146°32.4'	113	117	59°43.0'	144°38.1'	119
20	59°28.5'	146°41.8'	88	118	59°40.7'	144°33.3'	137
22	59°27.2'	146°41.1'	106	120	59°48.8'	144°41.0'	66
24	60°01.2'	147°15.0'	143	122A	59°55.6'	144°31.4'	55
26	59°56.6'	147°06.1'	205	123	59°56.7'	144°40.2'	210
27	59°53.8'	146°59.2'	163	125	59°59.8'	144°44.0'	232
32	59°28.7'	146°29.1'	53	127	60°02.8'	144°43.5'	210
39	59°28.0'	145°59.7'	148	128	60°00.6'	144°40.0'	227
41	60°09.1'	147°07.2'	212	129	60°04.9'	144°40.4'	146
46	66°00.0'	146°45.5'	126	130	60°07.8'	144°39.5'	31
52A	59°59.0'	146°27.5'	71	132	60°07.1'	144°31.2'	20
53	60°07.7'	146°52.8'	156	133	60°03.8'	144°26.2'	17
54	60°06.1'	146°49.4'	112	134	59°59.0'	144°24.0'	20
55	60°14.5'	146°50.6'	220	138	59°38.2'	145°50.4'	168
58	60°13.8'	146°44.3'	221	141	60°06.8'	146°14.5'	71
59A	60°12.1'	146°41.2'	192	144U	59°57.3'	146°19.6'	64
59B	60°11.8'	146°41.5'	183	145	59°37.4'	146°09.0'	101
63B	60°01.8'	146°14.6'	64	146	59°35.6'	145°54.8'	143
65B	60°49.4'	146°14.9'	53	147	59°34.2'	145°45.7'	165
68A	59°42.6'	146°15.0'	81	149	60°03.2'	145°34.5'	104
69	60°16.6'	146°14.6'	49	150	60°10.4'	145°34.5'	104
70	60°12.6'	146°15.3'	108	153	60°12.5'	146°27.0'	137
71	60°10.1'	146°15.0'	84	154	59°51.4'	145°28.5'	95
72	60°15.3'	146°00.8'	90	155	59°55.2'	145°42.0'	82
73	60°10.5'	146°01.4'	95	157	60°01.4'	146°08.5'	73
74	60°09.2'	146°01.5'	90	158	60°06.0'	146°40.5'	117
75	60°07.4'	146°02.3'	84	159	60°10.2'	146°52.1'	165
76	60°02.0'	146°00.5'	77	161	60°17.4'	146°23.7'	22
77	59°56.0'	146°01.5'	86	162	60°19.2'	146°13.2'	24
78	59°51.6'	146°00.9'	101	163	60°19.5'	146°07.0'	22
80	59°46.7'	145°59.5'	91	164B	60°19.5'	146°00.0'	22
83	59°39.0'	145°59.5'	91	165	60°18.3'	145°53.5'	33
84	59°32.2'	145°59.5'	157	166	60°17.7'	145°45.6'	20
86	60°14.0'	145°34.5'	48	167	60°16.4'	145°38.4'	26
87	60°06.9'	145°34.4'	126	170A	60°16.9'	145°42.0'	20
88	59°59.2'	145°34.0'	88	170B	60°16.9'	145°42.0'	20
91	59°50.5'	145°39.6'	97	171	60°14.3'	145°28.0'	24
92	59°45.9'	145°34.5'	119	173	60°10.4'	145°13.6'	24
94	60°07.7'	145°21.0'	97	174	60°09.6'	145°06.4'	35
95	60°03.3'	145°19.8'	132	176	60°10.0'	144°48.0'	31
96	59°59.2'	145°19.3'	119	180	60°09.1'	144°44.7'	26
97	59°55.7'	145°19.5'	101	181	60°01.0'	144°24.0'	33
98	59°52.5'	145°19.8'	101	183	59°55.5'	144°34.6'	91
99	59°50.4'	145°20.6'	110	184	59°54.8'	144°54.6'	188
103	60°09.4'	144°58.2'	35	202	59°31.4'	144°36.6'	187
104	60°08.1'	144°54.9'	53	204	59°34.8'	144°35.8'	141
105	59°57.1'	144°55.4'	183	205	59°37.0'	144°35.3'	145
106	59°57.0'	144°57.4'	192	208	59°33.3'	44°31.3'	156
107	59°46.5'	145°03.2'	185	210	59°36.9'	144°30.5'	146
108	59°44.2'	144°56.2'	192	211	59°40.1'	144°28.4'	146



**Table 1.** Location and water depth of ostracode samples collected from the Gulf of Alaska.—Continued

Sample No.	Latitude(°N)	Longitude(°W)	Water depth (meters)	Sample No.	Latitude(°N)	Longitude(°W)	Water depth (meters)
Cruise EGAL-75-KC-Continued				Cruise DC1-79-EG			
212	59°46.4'	144°33.1'	91	1	59°05.0'	138°39.9'	77
213	55°44.7'	144°30.2'	113	5	58°52.1'	138°58.6'	205
214	59°43.7'	144°28.6'	55	6	58°46.8'	138°59.7'	220
215	59°42.9'	144°27.0'	134	7	58°48.2'	139°07.9'	188
216	59°42.1'	144°23.0'	152	10	58°44.9'	139°19.1'	183
217	59°39.8'	144°21.2'	154	12	58°39.0'	139°22.3'	251
221	59°50.1'	144°27.4'	29	13	58°45.2'	138°38.4'	108
223	59°52.4'	144°18.7'	51	23	58°26.0'	137°48.3'	167
224	59°50.0'	144°16.0'	64	28	58°11.2'	137°39.1'	161
225	59°46.2'	144°11.5'	101	29	58°16.4'	137°32.5'	154
229	59°34.0'	144°01.2'	189	30B	58°23.0'	137°27.9'	196
231	59°56.9'	144°09.7'	33	31B	58°18.6'	137°08.2'	154
232	59°57.3'	144°09.9'	49	35	58°22.7'	136°59.9'	70
233	59°51.6'	143°53.3'	106	36	58°21.7'	137°00.7'	111
246	59°41.9'	142°55.8'	198	37	58°21.0'	137°01.5'	137
247	59°52.2'	143°20.3'	214	38	58°20.2'	137°02.3'	159
249	59°58.4'	143°23.0'	152	39	58°19.2'	137°03.1'	173
251	59°44.5'	142°54.0'	188	41	58°15.7'	137°00.4'	187
256	59°48.2'	142°46.2'	190	45	58°14.6'	136°47.8'	119
257	59°57.3'	142°46.5'	119	46	58°13.7'	136°50.1'	93
258	59°57.5'	142°41.2'	108	47	58°12.6'	136°53.2'	133
259	59°58.1'	142°38.2'	91	Cruise DC2-80-EG			
260	60°00.0'	142°43.0'	88	14	59°19.2'	139°19.8'	20
263	59°50.8'	142°31.0'	95	16	59°18.8'	139°18.6'	35
264	59°49.5'	142°30.0'	134	24	59°07.0'	138°44.0'	42
265	59°46.2'	142°29.9'	181	27	59°07.0'	138°44.0'	43
268	59°40.7'	142°21.6'	174	41	59°06.9'	138°43.0'	40
282	59°54.5'	142°20.0'	82	48	59°06.9'	138°42.6'	37
283	59°51.0'	142°14.5'	84	60	59°28.5'	139°48.0'	58
284	59°50.0'	142°14.2'	86	62	59°28.5'	139°48.4'	64
285	59°47.4'	142°14.4'	115	63	59°28.2'	139°48.9'	62
286	59°43.0'	142°13.1'	157	67	59°28.0'	139°49.3'	82
288	59°36.0'	142°13.7'	238	70	59°28.9'	139°49.8'	98
289	59°53.1'	142°03.8'	55	73	59°27.7'	139°50.2'	104
290	59°54.6'	141°52.3'	31	82	59°28.2'	139°48.4'	74
296	59°45.5'	141°43.5'	49	86	59°27.5'	139°50.5'	110
297	59°32.9'	141°46.7'	165	89	59°28.6'	139°48.2'	55
306	59°30.4'	141°30.0'	161	91	59°00.2'	139°54.0'	128
307	59°28.9'	141°27.8'	165	94	59°26.3'	139°36.0'	20
312	59°31.7'	141°14.3'	156	97	59°41.8'	141°20.1'	60
313	59°29.5'	141°11.0'	256	99	59°41.0'	141°20.7'	60
314	59°28.5'	141°06.3'	311	155	59°43.5'	140°46.5'	20
319	59°33.8'	140°50.5'	247	167	59°40.1'	141°21.6'	68
320	59°36.4'	140°50.5'	163	168	59°40.1'	141°21.6'	68
324	59°32.3'	140°14.0'	192	169	59°39.2'	141°22.1'	73
325	59°29.0'	140°14.1'	241	170	59°38.1'	141°22.5'	84
326	59°24.6'	140°14.5'	183	174	59°37.2'	141°23.1'	91
328	59°43.2'	144°33.6'	134	177	59°36.1'	141°23.5'	102
331	59°56.1'	143°53.4'	66	180	59°35.2'	141°24.5'	111
332	59°54.3'	143°53.2'	73	183	59°34.4'	141°25.1'	121
333	59°47.1'	143°51.5'	128	186	59°33.3'	141°25.3'	132
336	59°37.6'	143°34.0'	145	189	59°32.5'	141°26.4'	139
338	60°01.0'	143°09.3'	101	192	59°31.2'	141°26.8'	150
339	60°00.8'	142°56.6'	102	195	59°36.5'	140°19.2'	82
341	59°57.7'	143°04.7'	137	Miscellaneous sample			
344	59°39.2'	142°22.2'	210	BFM-1	60°17.0'	148°21.0'	Unknown
360	59°39.7'	140°31.1'	48				
422	59°55.8'	141°35.6'	68				
428	59°54.7'	141°30.1'	49				
432	59°57.2'	141°31.6'	68				

Peacock, Graham, and Gregory, 1980, p. 9; Lord, 1980, p. 234, pl. 1, figs. 8–13; Cronin, 1981, p. 400, pl. 8, figs. 1, 2; McDougall, Brouwers, and Smith, 1986, pl. 13, figs. 2–4; Tabuki, 1986, p. 53, text-fig. 14; Athersuch, Horne, and Whittaker, 1989, p. 133–134, figs. 52a–52c.

*"Acanthocythereis" dunelmensis* (Norman). Brouwers, 1981, p. 8; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1983.

*Trachyleberis dunelmensis* (Norman). Catt and Penny, 1966, p. 409; Caralp, Klingebiel, Lamy, Latouche, Moyes, and Vigneaux, 1968, p. 13, pl. 10, fig. 1; Yassini, 1969, p. 49, 50; Bidet and Peypouquet, 1976a, p. 218; Boyd, 1981, p. 280.

**Diagnosis.**—Dorsal margin straight with overhanging tuberculate-reticulate ornament; 19 blunt flat anterior marginal denticles; double row of anteroventral denticles; heavily reticulate ornament; spinose-tuberculate ornament arranged concentrically and radially about subcentral tubercle; three large spines on tubercle; remaining spines arranged in four rows.

**Measurements.**—Length-height plot based on 36 specimens (fig. 3).

**Comparisons.**—*Acanthocythereis dunelmensis* differs from *A. mutsuensis* Ishizaki, 1971 (Holocene, central Japan) by its more quadrate shape; less convergent posterior; small, numerous ornament spines, often split at terminus; reticulate ornament; strong, numerous anterior marginal denticles; deep muscle tubercle; and inner lamella of even width throughout. *A. dunelmensis* differs from *A. munechikai* Ishizaki, 1981 (Holocene, East China Sea) by its quadrate shape; less convergent posterior; coarse reticulation network; few, large ornament spines; numerous, strong marginal denticles; strong eye tubercle; and inner lamella of even width throughout. *A. dunelmensis* differs from *"Acanthocythereis" sp.* (illustrated in Cronin and others, 1983; upper Pliocene through lower Pleistocene, southern California) by its long valve profile, especially in males; convergent posterior end; numerous, strong ornament spines, often split at terminus; different lateral arrangement of spines; and strong, numerous anterior and ventral marginal denticles.

**Remarks.**—"A." *dunelmensis* is not a typical species of *Acanthocythereis* and probably represents a new genus (J.E. Hazel, written commun., 1986). The species is more closely related to *Acanthocythereis* than to any other described trachyleberid genus. I do not have adequate material and understanding of the species group to describe a new genus-level rank for the taxon.

Elofson (1941) noted that two forms of *A. dunelmensis* exist, each with a different size and shape. The larger form has a robust carapace, with large, coarse, less numerous spines; the smaller form has a thin carapace with more numerous spines. In the northeast Atlantic, the larger form is stenohaline and stenothermal, occurring in middle-shelf

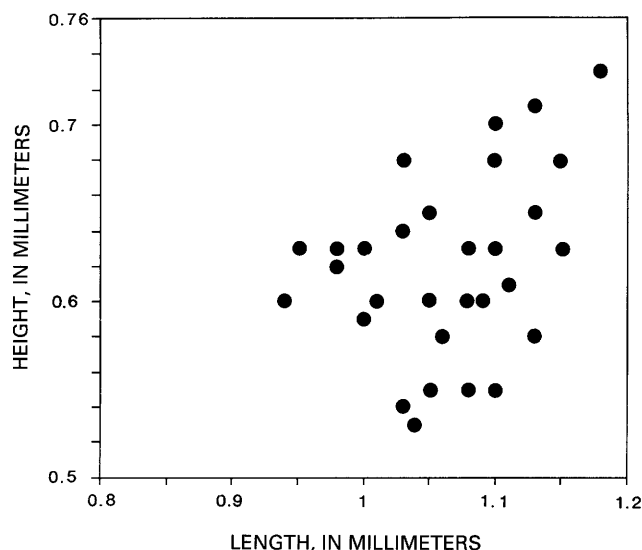


Figure 3. Plot of length versus height for *Acanthocythereis dunelmensis* (Norman, 1865).

water depths in arctic regions and outer shelf to upper slope water depths in subarctic regions. The smaller form cannot tolerate subzero temperatures and occurs in inner to middle-shelf depths in subarctic regions.

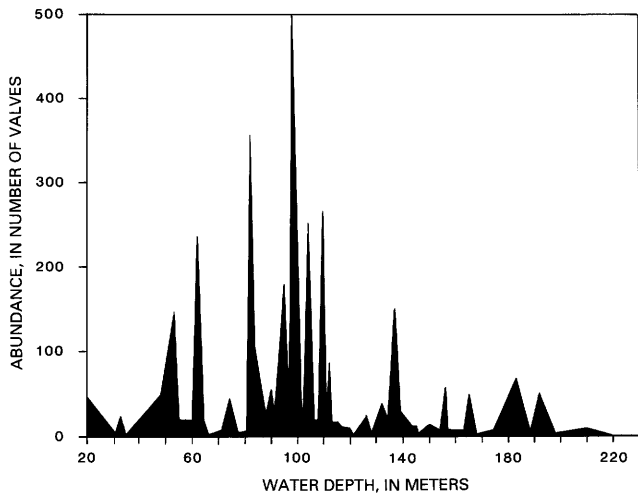
*A. dunelmensis* specimens from the Gulf of Alaska are within the large-form population, with a size range of L:1.06–1.10 mm, H:0.55–0.58 mm for males and L:1.03–1.10 mm, H:0.60–0.68 mm for females. Ornamentation includes few, massive, often bifurcating spines and denticles. The *A. dunelmensis* population in the Gulf of Alaska shows boreal submergence, that is, increasing water depths with decreasing latitude. Comparison of *A. dunelmensis* specimens from the cold-temperate Gulf of Alaska with specimens from the frigid Beaufort Sea shows that the latter population has a larger size, longer and lower valve outline, more convergent posterior, and slightly more numerous, more massive, often interconnected spines and denticles.

**Occurrence.**—Assemblages I\*, II\*, III, IV. Table 2.

**Distribution.**—Pliocene through Holocene: Gulf of Alaska. Pleistocene through Holocene: North Atlantic, Norwegian Sea, western Baltic Sea, Greenland Sea, Kara Sea, Barents Sea, North Sea, Beaufort Sea, Chukchi Sea, Bering Sea, Cook Inlet, Kodiak Shelf, Pribilof Islands, northern Honshu (Japan). Sublittoral, upper bathyal; cold-temperate to frigid-marine climatic zones (fig. 4).

**Material:** 644 adult valves, 3,592 juvenile valves.

**Illustrated specimens.**—USNM 408258, left valve (pl. 2, fig. 1), cruise EGAL-75-KC, sample 69, length 1.10 mm, height 0.68 mm. USNM 408259, male left valve (pl. 1, fig. 3; pl. 16, fig. 1), cruise DC2-8-EG, sample 73, length 1.10 mm, height 0.55 mm. USNM 408260, female right valve (pl. 1, fig. 1), cruise EGAL-75-KC, sample 284, length 1.08 mm, height 0.60 mm. USNM 408261, male left valve (pl. 1,



**Figure 4.** Plot of abundance versus water depth for *Acanthocythereis dunelmensis* (Norman, 1865).

fig. 2), cruise EGAL-75-KC, sample 284, length 1.06 mm, height 0.58 mm. USNM 408262, female left valve (pl. 1, fig. 4), cruise EGAL-75-KC, sample 284, length 1.03 mm, height 0.68 mm. USNM 408263, female left valve (pl. 1, fig. 5), cruise DC2-80-EG, sample 73, length 1.10 mm, height 0.68 mm.

Genus *ROBERTSONITES* Swain, 1963

*Type species.*—*Cythereis tuberculata* Sars, 1866 (Type by subsequent designation.)

*ROBERTSONITES TUBERCULATUS*  
(SARS, 1866)

Plate 1, figures 6–14; plate 2, figures 2, 3; text-figures 5, 6

*Cythereis tuberculata* Sars, 1866, p. 37.

*Cythereis tuberculata* Sars. Hirschmann, 1916, p. 580, figs. 5–7; Sars, 1925, p. 192–193, pl. 88; Stephensen, 1929, p. 2; Mueller, 1931, p. 29; Blake, 1933, p. 239; Stephensen, 1938, p. 9; Klie, 1938, p. 22; Tressler, 1941, p. 100, pl. 19, fig. 20; Elofson, 1941, p. 294–295; Schaefer, 1953, p. 384; Lange, 1956, p. 82; Wosizdlo, 1962, p. 81–82, pl. 4, fig. 10.

*Cythereis (Paracythereis) tuberculata* Sars. Hagerman, 1965, p. 58, fig. 4.

*Cythere tuberculata* (Sars). Brady, 1867, p. 208; Norman, 1867, p. 198; Brady, 1868a, p. 406–407, pl. 30, figs. 25–39; Brady and Robertson, 1869, p. 363; Norman, 1869, p. 290; Brady and Robertson, 1870, p. 28; Brady, 1870, p. 450; Brady and Robertson, 1872, p. 69; Robertson, 1875, p. 123; Norman, 1877, p. 206; Brady, 1878, p. 254; Robertson, 1883, p. 28; Norman, 1891, p. 123; Scott, 1899, p. 85; Brady, 1902, p. 99; Norman, 1902, p. 484; Norman, 1905, p. 146; Scott, 1906, p. 282; Anderson, 1948, p. 224; Catt and Penny, 1966, p. 409.

*Robertsonites tuberculata* (Sars). Swain, 1963, p. 821–822, pl. 98, figs. 8a–8b; pl. 99, fig. 12; text-fig. 12; Hazel, 1967a, p. 35, pl. 6, figs. 1–3; Wall and Whatley, 1971, p. 299; Neale, 1974b, p. 89, 90, 92–96; Neale and Howe, 1975, p. 388, pl. 1, fig. 1; pl. 2, figs. 1–3; Siddiqui and Grigg, 1975, pl. 2, fig. 16; Bidet and Peypouquet, 1976a, p. 218; Peacock, Graham, Robinson, and Wilkinson, 1977, p. 98; Rosenfeld, 1977, p. 24–25, pl. 5, figs. 61–64; Kidson, Gilbertson, Haynes, Heyworth, Hughs, and Whatley, 1978, p. 223; Robinson, 1978, p. 462, pl. 3, figs. 5a–5c; Peacock, Graham, and Gregory, 1980, p. 9; Paterson, Armstrong, and Browne, 1981, p. 30; Brouwers, 1981, p. 11; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983; Neale, 1983, p. 314.

*Robertsonites tuberculatus* (Sars). Cronin, 1981, p. 400–401, pl. 8, fig. 5; Horne, 1983, p. 39–52, pl. 10.40, figs. 1–3; pl. 10.42, figs. 1–3; pl. 10.44, figs. 1–3; pl. 10.46, figs. 1–4; pl. 10.48, figs. 1–3; pl. 10.50, figs. 1–3; text-figs. 1–3; Tabuki, 1986, p. 53, text-fig. 15; Athersuch, Horne, and Whittaker, 1989, p. 148–149, figs. 59a–59i; Cronin, 1991, p. 779, fig. 8–2.

*Cythere clathrata* Reuss. Brady, 1866, p. 376–377, pl. 59, figs. 12a–12c, 13a–13c.

*Cythere mutabilis* Brady. Brady, 1866 (in part), p. 377, pl. 59, figs. 14c–14h.

*Cythere logani* Brady and Crosskey. Brady, Crosskey, and Robertson, 1874, p. 165, pl. 15, figs. 17, 18.

*Robertsonites gubikensis* Swain, 1963, p. 821–822, pl. 98, figs. 8a–8b; pl. 99, fig. 12; text-fig. 9b.

*Robertsonites tuberculatina* Swain, 1963, p. 822–823, pl. 98, fig. 10; pl. 99, fig. 1; text-fig. 9c.

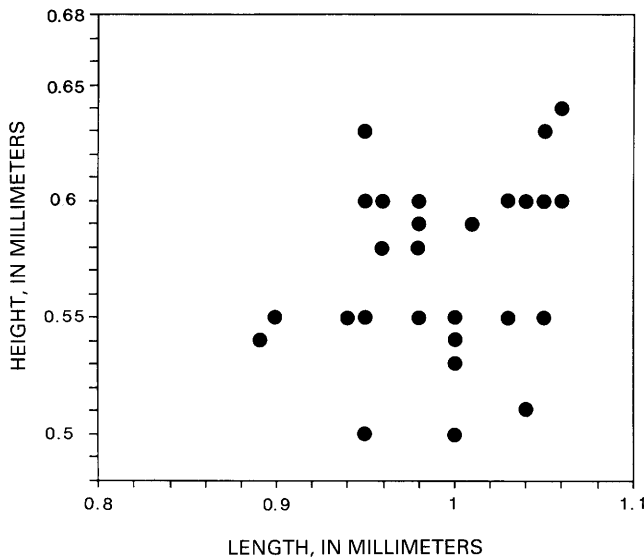
*Robertsonites logani* (Brady and Crosskey). Swain, 1963, p. 823, pl. 97, fig. 13.

*Robertsonites* sp. 2 Tabuki, 1986, p. 95, pl. 16, fig. 7.

*Diagnosis.*—Characterized by subquadrate lateral outline; concentric and radial arranged reticulum; reticulation pits arranged in clusters and becoming smaller marginally; five nodes or tubercles, two each located along dorsal and ventral margins; pronounced dimorphism; scalloped dorsal ridge; and prominent subcentral tubercle.

*Measurements.*—Length-height plot based on 36 specimens (fig. 5).

*Comparisons.*—*Robertsonites tuberculatus* differs from *R. reticuliforma* (Ishizaki, 1966) (Miocene through lower Pleistocene, central Japan) by its long, low valve shape; quadrate lateral outline; less prominent anterodorsal cardinal angle; less convergent posterior; fine-scale reticulation; prominent subcentral tubercle; ornamented posterior margin; and weak ventral ridge. Of the four species of *Robertsonites* known from Japan, *R. hanaii* is most similar to *R.*



**Figure 5.** Plot of length versus height for *Robertsonites tuberculatus* (Sars, 1866).

*tuberculatus*, but it is clearly different (Tabuki, 1986; R. Tabuki, written commun., 1991).

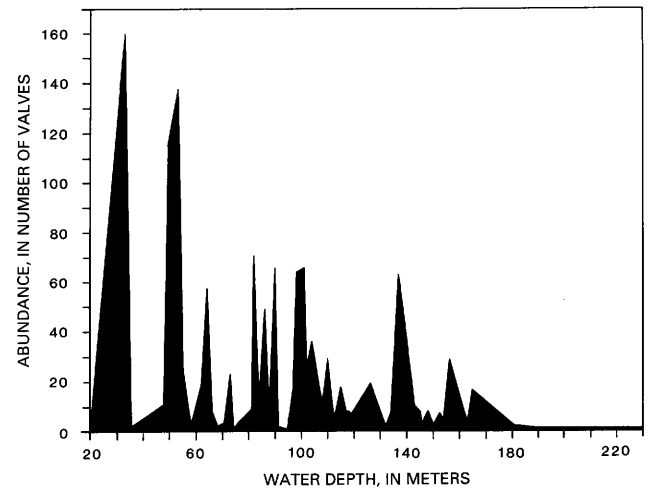
**Remarks.**—*R. tuberculatus* exhibits considerable variation in outline and ornament, with variable development of the nodes and reticulation. Noding is frequently more pronounced in juveniles. Noding in adult specimens is obscured by a strong reticulation network. The juvenile lateral outline differs from the adult in being rounded and subtriangular. Horne (1983) reported that specimens from Greenland have conspicuous secondary reticulation and are larger in size than specimens from Norway. The population from the Gulf of Alaska shows considerable variability in development of reticulation network, but in general the population is dominated by fine-scale reticulation pattern.

**Occurrence.**—Assemblages I\*, II\*, III\*, IV, V. Table 2.

**Distribution.**—Pliocene through Pleistocene: northern Honshu (Japan). Upper Pliocene through Holocene: Gulf of Alaska, Pribilof Islands, Cook Inlet and Kodiak Shelf, Bering Sea, Beaufort Sea, and the North Atlantic. Sublittoral, upper bathyal (fig. 6).

**Material.**—156 adult valves, 1,385 juvenile valves.

**Illustrated specimens.**—USNM 408264, female left valve (pl. 2, fig. 2), cruise EGAL-75-KC, sample 296, length 0.95 mm, height 0.55 mm. USNM 408265, male left valve (pl. 2, fig. 3), cruise EGAL-75-KC, sample 296, length 1.00 mm, height 0.53 mm. USNM 408266, female right valve (pl. 1, figs. 6, 9), cruise EGAL-75-KC, sample 338, length 0.98 mm, height 0.55 mm. USNM 408267, male left valve (pl. 1, figs. 7, 10), cruise EGAL-75-KC, sample 338, length 1.00 mm, height 0.53 mm. USNM 408268, male right valve (pl. 1, figs. 8, 11, 12), cruise EGAL-75-KC, sample 338, length 1.04 mm, height 0.51 mm. USNM 408269, female right valve



**Figure 6.** Plot of abundance versus water depth for *Robertsonites tuberculatus* (Sars, 1866).

(pl. 1, figs. 13, 14), cruise EGAL-75-KC, sample 338, length 0.95 mm, height 0.55 mm.

Subfamily BUNTONIINAE Apostolescu, 1961

Tribe BUNTONIINI Apostolescu, 1961

Genus *AMBTONIA* Malz, 1982

**Type species.**—*Ambtonia glabra* Malz, 1982 (Type by original designation.)

*AMBTONIA TONGASSENSIS* N. SP.

Plate 1, figure 15; plate 2, figures 4, 5; plate 3, figures 1–5; text-figures 7, 8

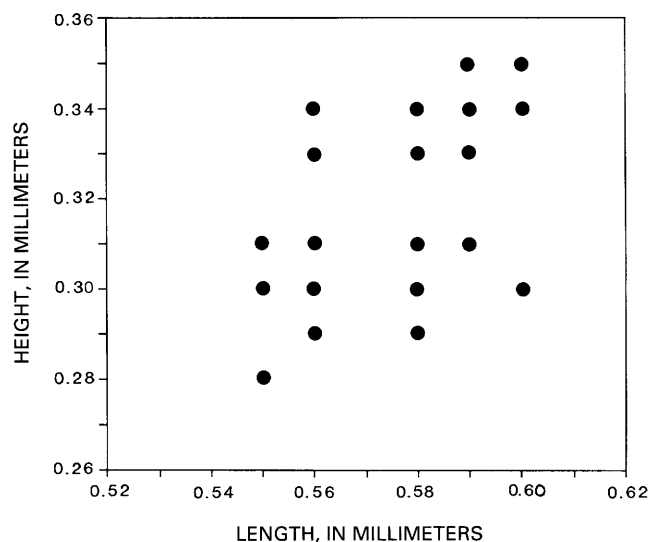
*Buntonia* sp. A Brouwers, 1981, p. 8; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1983.

“*Buntonia*” sp. A Cronin, Brouwers, Quinn, and Redline, 1983, p. 218, pl. 2, figs. 3, 4.

**Etymology.**—After Tongass National Forest, east of Yakutat Bay, southeast Alaska.

**Diagnosis.**—Characterized by subcylindrical lateral outline; subparallel dorsal and ventral margins; truncated posterior margin; denticulate posteroventral margin; pronounced dimorphism; predominantly smooth surface; subparallel posterior marginal ridges; subtle anterior marginal sulcus; slightly raised anterior marginal rim; arcuate anterior vestibule; irregular J-shaped frontal scar.

**Description.**—Adult valves subcylindrical in lateral view. Dorsal margin straight; anterior margin broadly rounded; ventral margin straight, subparallel to dorsal margin; posterior margin truncated. Dorsal and ventral margins converge posteriorly. Posteroventral margin with six small, sharp denticles. Left valve similar to right, but with more quadrate shape, convergent posterior end, and strong posterodorsal corner. Females differ from males in being considerably shorter, higher, more inflated posteriorly.



**Figure 7.** Plot of length versus height for *Ambtonia tongassensis* n. sp.

Valve surface smooth except along posterior, where series of subparallel marginal ridges are present. Anterior margin with subtle marginal sulcus, raised marginal rim. 37–42 normal pores evenly distributed over valve.

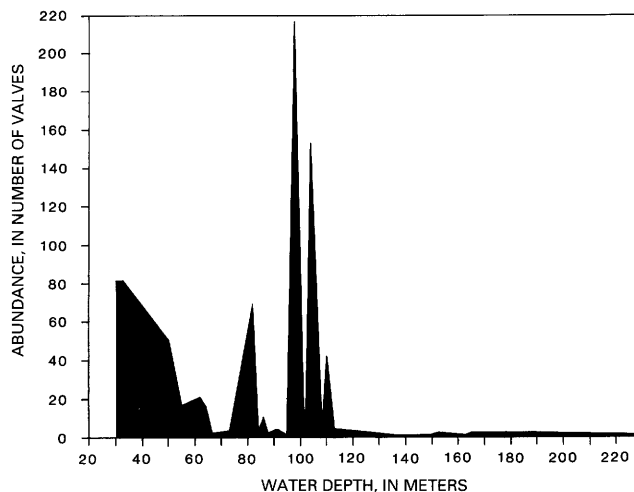
Inner margin and line of concrescence coincide at posterior and venter; moderate, arcuate anterior vestibule. Inner margin parallels valve outline. Strongly developed selvage. Broad, rounded tooth along ventral margin of right valve at middle of concavity; left valve venter with opposing socket. 46–48 radial pores, 2 false radial pores; 27–30 pores located at anterior; pores are straight, simple.

Hinge in right valve consists of anterior rounded, knob-like tooth; anteromedian rounded socket with ventral rim that connects with tooth; median, finely crenulate groove; and posterior, large, rounded arcuate tooth. Small rounded ocular sinus just below socket rim.

Four adductor muscle scars in vertical row; dorsal scar dome-shaped, dorsomedian scar elongate, ventromedian scar elongate, ventral scar gumdrop-shaped. Frontal scar a large, irregular J-shape. Round fulcral point above frontal scar; two large dorsal scars adjacent to fulcral point and above adductor row. Many thin, elongate dorsal scars just above hinge, occurring between terminal hinge elements.

**Measurements.**—Length-height plot based on 33 specimens (fig. 7).

**Comparisons.**—*Ambtonia tongassensis* is similar to the genotype, *A. glabra* Malz, 1982 (Pliocene through Pleistocene, Taiwan) in hingement, overall shape, and muscle scar pattern. *A. tongassensis* differs by its truncated posterior; anterior marginal rim; irregular frontal scar; rounded anterior hinge tooth; and lack of posterior marginal flange. *A. tongassensis* differs from *Buntonia hanaii* Yajima, 1978 (upper Pleistocene, northern Japan) by its long, low valve



**Figure 8.** Plot of abundance versus water depth for *Ambtonia tongassensis* n. sp.

outline; few, weak posterior marginal ridges; and narrow, less pronounced flat region along the anterior.

**Occurrence.**—Assemblages I\*, II\*, III\*. Table 2.

**Distribution.**—Lower Pleistocene through Holocene: eastern Gulf of Alaska, southern California. Sublittoral (fig. 8).

**Material.**—450 adult valves, 159 juvenile valves.

**Type specimens.**—Holotype: USNM 408270, female left valve (pl. 2, fig. 4), cruise DC2–80–EG, sample 70, length 0.59 mm, height 0.34 mm.

Paratypes: USNM 408271, male right valve (pl. 2, fig. 5), cruise DC2–80–EG, sample 70, length 0.59 mm, height 0.31 mm. USNM 408272, left valve (pl. 1, fig. 15), cruise DC2–80–EG, sample 195, length 0.56 mm, height 0.34 mm. USNM 408273, male right valve (pl. 3, figs. 1, 5), cruise DC2–80–EG, sample 195, length 0.55 mm, height 0.30 mm. USNM 408274, female right valve (pl. 3, figs. 2, 3), cruise DC2–80–EG, sample 195, length 0.59 mm, height 0.33 mm. USNM 408275, male left valve (pl. 3, fig. 4), locality DC2–80–EG, sample 195, length 0.55 mm, height 0.31 mm.

#### Genus *CELTIA* Neale, 1973

**Type species.**—*Cythere quadridentata* Baird, 1850 (Type by subsequent designation.)

**Diagnosis.**—Characterized by elongate, subquadrate lateral outline; subparallel dorsal and ventral margins; small caudal process; pronounced dimorphism; ornamentation ranging from predominantly smooth with fine marginal pits to large, shallow pits covering surface; weak concentric marginal ridges; sieve-type normal pores; numerous straight, simple, long radial pores; four unsplit adductor scars; J-shaped frontal scar.

**Comparisons.**—*Celtia* can be distinguished from *Bicornucythere* Schornikov and Shaitarov, 1979 (Pliocene through Holocene, northwest Pacific, southeast Asia) by its high, less convergent posterior end; small, weak marginal

denticles; weak subcentral tubercle; pitted ornament; and lack of posteroventral spine.

**Remarks.**—*Celtia* includes two species groups or subgenera that differ in morphology and in geographic distribution: the "*Leguminocythereis*" *corrugata* group and the *Celtia* s.s. group. The two groups are similar in having an elongate shape, large size, and large pitted ornament. The *Celtia* group differs in several major aspects, notably, a subquadrate rather than rounded shape, a different expression of dimorphism, and lack of strong posterior horizontal ridges. These differences are major morphologic dissimilarities that represent genus- or subgenus-level characters for this group.

The "*Leguminocythereis*" *corrugata* group includes three species—"Cytheretta" sp. B of Valentine (1976), *L. corrugata* LeRoy, 1943, and *Cytheretta rothwelli* Swain and Gilby, 1974. "*Cytheretta*" sp. B and *L. corrugata* occur in Pliocene through Holocene sediments from Baja California to southern California (subtropical to mild-temperate marine climates). *Cytheretta rothwelli* is a Holocene taxon that ranges from southern California to Nicaragua (warm-temperate to tropical-marine climates).

The *Celtia* s.s. group includes six species—*C. palmensis*, *C. blizhnii*, *C. pointmanbiensis*, *Celtia quadridentata* (Baird, 1850), *Celtia* sp. Tabuki, 1986, and *Campylocythereis*? *ukifune* Yajima, 1982. These species are similar in valve shape and size, central muscle-scar pattern, and large, shallow pitted ornament. *C. ukifune* differs in having a strong, concentric reticulation network. The *Celtia* group occurs in Pleistocene sediments from Japan (mild-temperate marine climate), in Quaternary sediments from northern California to the south Bering Sea (mild temperate to warmer subfrigid marine climates), and in the Miocene-Holocene sediments of the northeast Atlantic between lat 43° and 65°N (mild-temperate to warmer subfrigid marine climates).

**Geographic distribution.**—Gulf of Alaska, Cook Inlet and Kodiak Shelf, southern Bering Sea, northern Honshu (Japan), northern California, Washington, Oregon, and the northeast Atlantic. *Celtia* is common in the inner to middle shelf habitat of the Gulf of Alaska, thriving on the clastic sedimentary bottom (medium- to fine-grain sand and silty sand) that characterizes nearshore environments.

**Stratigraphic distribution.**—Miocene through Holocene.

#### CELTIA PALMENSIS N. SP.

Plate 2, figures 6, 7; plate 3, figures 6–15; text-figures 9, 10

"*Leguminocythereis*" sp. A Brouwers, 1981, p. 10; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

**Etymology.**—After Palma Bay, southeastern Fair-weather Range, southeast Alaska.

**Diagnosis.**—Characterized by subquadrate lateral outline; straight dorsum; denticulate anterior and posterior margins; pronounced dimorphism; large, shallow, ovoid pits

arranged concentrically; pits commonly as pairs; three ventral ridges; two weak anterior ridges; prominent eye spot; secondary surface corrugation; and arcuate anteroventral vestibule.

**Description.**—Adult valves subquadrate in lateral view. Left valve with straight dorsum; rounded, protruding anterodorsal corner; smoothly curved anterior margin; sinuous ventral margin with slight concavity; posterior margin smoothly curved, somewhat protruding. Anterior margin with 13 blunt, short denticles; posterior margin with four small median denticles. Right valve similar to left, but with less pronounced anterodorsal corner; straight ventral margin; and drawn-out posterior. Pronounced dimorphism: males are considerably longer, lower, less wide than females. Greatest length through midline of valve; greatest height through anterior hinge element.

Ornamentation consists of large, ovoid, shallow pits covering valve. Pits oriented in concentric pattern, following valve margin. Pits much smaller at valve margin and commonly occur in pairs. Three ridges proceed from concavity to middle of posterior margin. Two weak ridges parallel the anterior margin. Prominent, smooth, ovoid eye spot. Secondary ornamentation consists of corrugated surface on pit floors. 84–96 normal pores evenly distributed over valve, occurring between pits. Normal pores sieve-type, with recessed sieve plate. Sieve plate circular, with subcentral setal opening.

Inner margin and line of concrescence coincide along posterior and ventral margins; small, arcuate vestibule at anteroventer. Inner lamella widest anteriorly. Strong, well-developed selvage. Inner margin follows valve outline. 45–62 radial pore canals, 9–11 false radial pore canals; most anterior. Radial pore canals are long, straight, simple; radial pores enter marginal denticles.

Hingement in right valve consists of tabular anterior tooth; rounded, deep anteromedian socket with ventral rim; weakly crenulate median groove; small posteromedian socket; and large, curved posterior tooth. Median hinge element enlarged terminally. Hinge strongly calcified. Elongate, crescentic ocular sinus below anterior hinge element.

Four adductor muscle scars form vertical row, with scars slightly separated. Dorsal scar is subcylindrical; dorso-medial scar is dumbbell-shaped; ventromedial scar is elongate, with slightly enlarged posterior; ventral scar is semicircular. J-shaped frontal scar. No fulcral point visible. Small ovoid dorsal scars located above central muscle scars; large, elongate dorsal scars located below hinge.

**Measurements.**—Length-height plot based on 41 specimens (fig. 9).

**Comparisons.**—*Celtia palmensis* n. sp. differs from *C. blizhnii* (Quaternary, Gulf of Alaska) by its weak caudal process; weak concavity; marginal denticulation; large, ovoid pitting; secondary corrugate ornament; large sieve pores and plates; anteroventral vestibule; few radial pores; and tabular anterior hinge tooth. *C. palmensis*



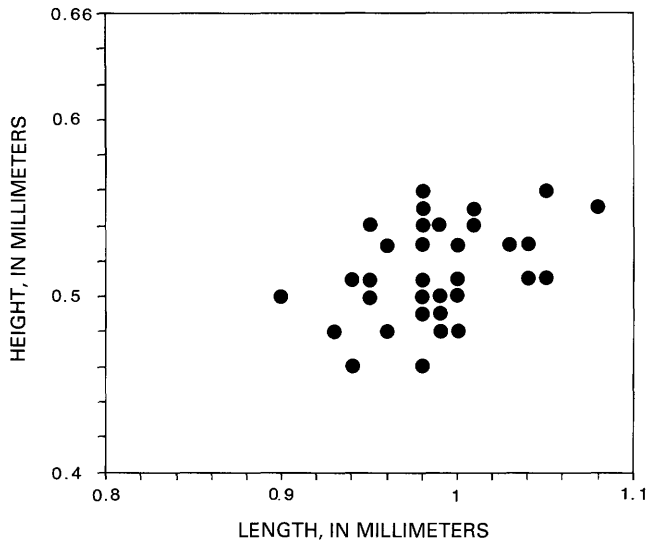


Figure 9. Plot of length versus height for *Celtia palmensis* n. sp.

differs from *C. pointmanbiensis* (Quaternary, Gulf of Alaska, south Bering Sea) by its long, high valve outline; different ornament pit pattern; secondary corrugated ornament; large anterior hinge tooth; numerous radial pores; and lack of posteroventral depressed region.

**Occurrence.**—Assemblages I\*, II\*, III. Table 2.

**Distribution.**—Pleistocene(?), Holocene: Gulf of Alaska. Sublittoral (fig. 10).

**Material.**—615 adult valves, 2,090 juvenile valves.

**Type specimens.**—Holotype: USNM 408276, female left valve (pl. 2, fig. 6), cruise DC2-80-EG, sample 60, length 1.01 mm, height 0.55 mm.

**Paratypes:** USNM 408277, male left valve (pl. 2, fig. 7), cruise DC2-80-EG, sample 60, length 0.99 mm, height 0.50 mm. USNM 408278, male left valve (pl. 3, figs. 6, 9), cruise DC2-80-EG, sample 60, length 1.03 mm, height 0.53 mm. USNM 408279, female left valve (pl. 3, fig. 7), cruise DC2-80-EG, sample 60, length 1.01 mm, height 0.54 mm. USNM 408280, female right valve (pl. 3, fig. 8), cruise DC2-80-EG, sample 60, length 1.05 mm, height 0.56 mm. USNM 408281, male right valve (pl. 3, figs. 10, 11, 14), cruise DC2-80-EG, sample 60, length 1.08 mm, height 0.55 mm. USNM 408282, male right valve (pl. 3, figs. 12, 13), cruise DC2-80-EG, sample 60, length 1.00 mm, height 0.50 mm. USNM 408283, female left valve (pl. 3, fig. 15), cruise DC2-80-EG, sample 60, length 1.00 mm, height 0.53 mm.

#### CELTIA BLIZHNII N. SP.

Plate 2, figure 8; plate 3, figures 16, 17; plate 4, figure 1; plate 5, figures 1-6; text-figures 11, 12

“*Leguminocythereis*” sp. B Brouwers, 1981, p. 10; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

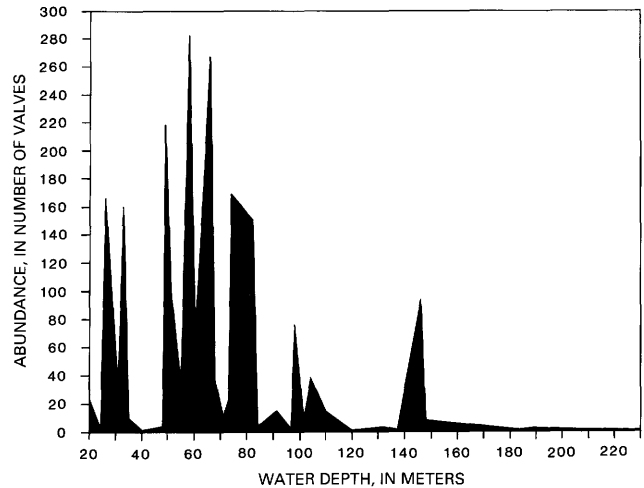


Figure 10. Plot of abundance versus water depth for *Celtia palmensis* n. sp.

“*Cytheretta*” sp. A Valentine, 1976, p. 23, pl. 4, figs. 13, 16, 17.

**Etymology.**—After Blizhnii Point, a spit of the Grand Wash River near Yakutat Bay, southeast Alaska.

**Diagnosis.**—Characterized by subquadrate lateral outline; marked dimorphism; predominantly smooth surface; two anterior marginal ridges; clusters of small marginal pits; and strong selvage.

**Description.**—Adult valves subquadrate in lateral view. Left valve with straight dorsum; rounded, obtuse anterodorsal cardinal angle; truncated anterior margin; sinuous ventral margin with slight concavity; smoothly curved posterior margin, with maximum width dorsal of mid-margin. Right valve similar, but with straight ventral margin; subtle caudal process; and posterior-converging dorsal and ventral margins. Marked dimorphism: males are longer, lower in lateral view. Greatest height through anterior hinge element; greatest length dorsal of midline of valve.

Valve surface predominantly smooth, with scattered pits and ridges. Anterior margin paralleled by two ridges that originate at anterodorsal corner and proceed along venter, terminating at middle of posterior margin. A third ridge is along the ventral margin, interior of the two marginal ridges. Pitting consists of clusters of small pits scattered over valve surface, most numerous marginally. 79-81 sieve-type normal pores evenly distributed over valve.

Inner margin and line of concrescence coincide; inner margin parallels valve outline. Inner lamella widest at anterior. Strong, well-developed selvage. 56-68 radial pore canals, 12-13 false radial pore canals; most anterior. Radial pore canals are long, straight, simple. Some anterior pore canals have an inflated median region.

Hingement in right valve consists of a small triangular socket and large, knoblike tooth at anterior; deep, ovoid, anteromedian socket with marginal rim; smooth median

groove; and large, tabular, curved posterior tooth. Median element enlarged terminally into high, deep grooves. Dorsal margin of right valve enfolded into accommodation groove to receive dorsal edge of left valve.

Adductor muscle scars form vertical row. Dorsal scar is ovoid; dorsomedian scar is elongate, subquadrate; ventromedian scar is elongate and arcuate; ventral scar is subcylindrical. Frontal scar is J-shaped. No fulcral point visible. First mandibular scar subovoid, located anteroventral of frontal scar; second mandibular scar is more elongate, located adjacent to ventral inner margin and below frontal scar. Dorsal muscle scars are few, large, irregular in shape.

**Measurements.**—Length-height plot based on 30 specimens (fig. 11).

**Comparisons.**—*Celtia blizhnii* n. sp. differs from *C. palmensis* (Quaternary, Gulf of Alaska) by its large caudal process; deep concavity; smooth valve surface with fine marginal pits; small sieve pores; numerous radial pores; and subovoid anterior hinge element. *C. blizhnii* differs from *C. pointmanbiensis* (Quaternary, Gulf of Alaska, southern Bering Sea) by its high lateral outline; smooth valve surface with fine marginal pits; small sieve pores; numerous radial pores; large caudal process; and strong concavity.

**Remarks.**—"Cytheretta" sp. A of Valentine (1976) is conspecific with *C. blizhnii*, showing similar valve size and lateral outline; predominantly smooth valve surface; fine marginal pitting; low marginal ridges, especially developed at posteroventer; and small caudal process. Subtle, nonspecific differences are that "Cytheretta" sp. A has more numerous fine pits, especially along the posterior, and a more dorsally located caudal process.

**Occurrence.**—Assemblages I\*, II\*. Table 2.

**Distribution.**—Pleistocene(?), Holocene: Gulf of Alaska, northern California, Washington, Oregon. Mild-to cold-temperate marine climates; inner to middle sublittoral (fig. 12).

**Material.**—230 adult valves, 831 juvenile valves.

**Type specimens.**—Holotype: USNM 408284, female left valve (pl. 2, fig. 8), cruise DC2-80-EG, sample 60, length 0.89 mm, height 0.45 mm.

**Paratypes:** USNM 408285, male left valve (pl. 4, fig. 1), cruise DC2-80-EG, sample 60, length 0.86 mm, height 0.44 mm. USNM 408286, female left valve (pl. 3, fig. 16; pl. 5, fig. 3), cruise DC2-80-EG, sample 60, length 0.95 mm, height 0.50 mm. USNM 408287, female right valve (pl. 3, fig. 17), cruise DC2-80-EG, sample 60, length 0.90 mm, height 0.45 mm. USNM 408288, male left valve (pl. 5, figs. 1, 6), cruise DC2-80-EG, sample 60, length 0.93 mm, height 0.44 mm. USNM 408289, male right valve (pl. 5, fig. 2), cruise DC2-80-EG, sample 60, length 0.93 mm, height 0.45 mm. USNM 408290, male right valve (pl. 5, fig. 4), cruise DC2-80-EG, sample 60, length 0.88 mm, height 0.41 mm. USNM 408291, female left valve (pl. 5, fig. 5), cruise DC2-80-EG, sample 60, length 0.88 mm, height 0.45 mm.

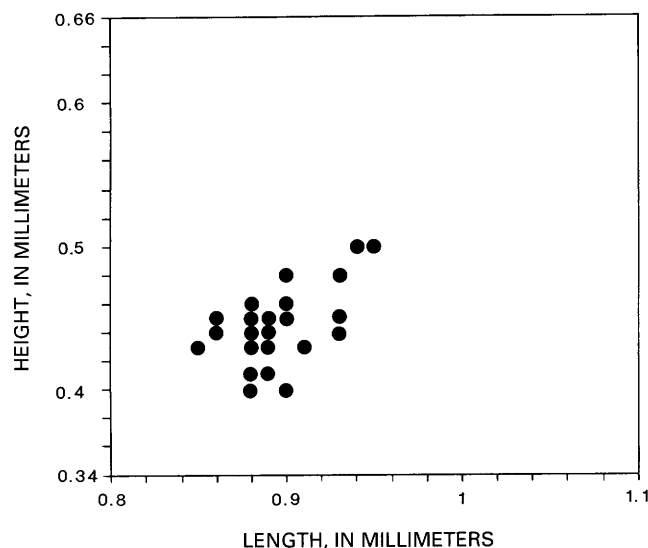


Figure 11. Plot of length versus height for *Celtia blizhnii* n. sp.

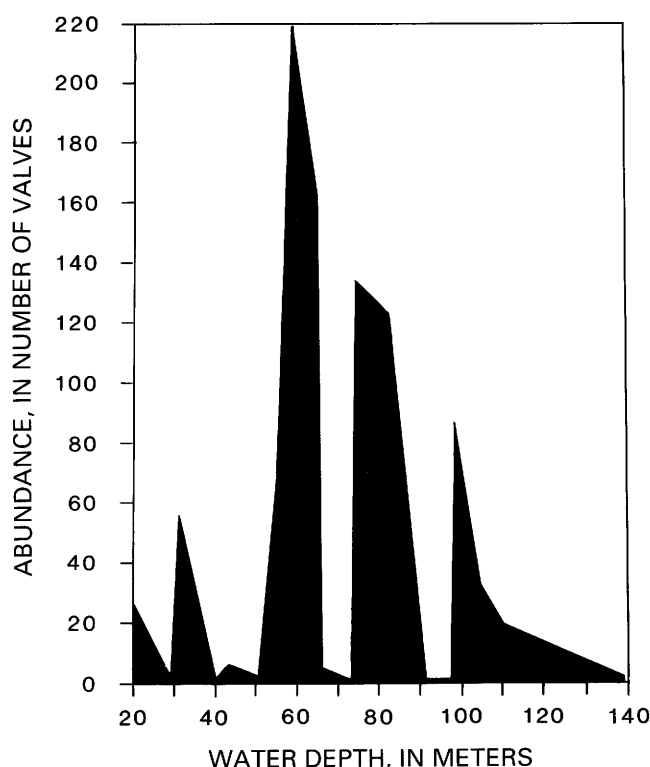


Figure 12. Plot of abundance versus water depth for *Celtia blizhnii* n. sp.

#### CELTIA POINTMANBIENSIS N. SP.

Plate 4, figure 2; plate 5, figures 7-15; text-figure 13

"*Leguminocythereis*" sp. D Brouwers, 1981, p. 10; Brouwers, 1982b, p. 9; Brouwers, 1983.

**Etymology.**—After Point Manby, a spit at the southeastern terminus of Malaspina GLACIER, southeast Alaska.

**Diagnosis.**—Characterized by short, low lateral outline; crimped posteroventral depressed region; large, shallow, ovoid ornament pits over entire surface; prominent eye spot; bifid anterior hinge element; and few radial pores.

**Description.**—Adult valves subquadrate in lateral view. Dorsal margin straight, inclined slightly toward posterior; rounded, obtuse anterodorsal cardinal angle; smoothly rounded, truncated anterior margin; sinuous, concave venter, with shallow concavity; evenly rounded posterior margin, with maximum width dorsal of midline; rounded, obtuse posterodorsal cardinal angle. Anterior and posterior margins with small, numerous denticles. Right valve similar to left, but with more convergent posterior and weak concavity. Pronounced dimorphism: males considerably longer, lower in lateral view, less wide in dorsal view, and with more convergent posterior. Greatest length through midline; greatest height through anterior hinge element.

Valve surface covered with large, shallow, ovoid pits. Pits are aligned both parallel to major ridges and concentric to valve outline. The concentric pattern predominates marginally, and the parallel pattern predominates in the median valve region. Pits become smaller at valve edge, commonly occurring as clusters or coalescing to form large pits. A ridge along the posterior and posteroventral margins forms a crimped appearance. Prominent, smooth, ovoid eye spot. 64 normal pores evenly distributed over valve, located between ornament pits. Normal pores sieve-type, with recessed sieve plate.

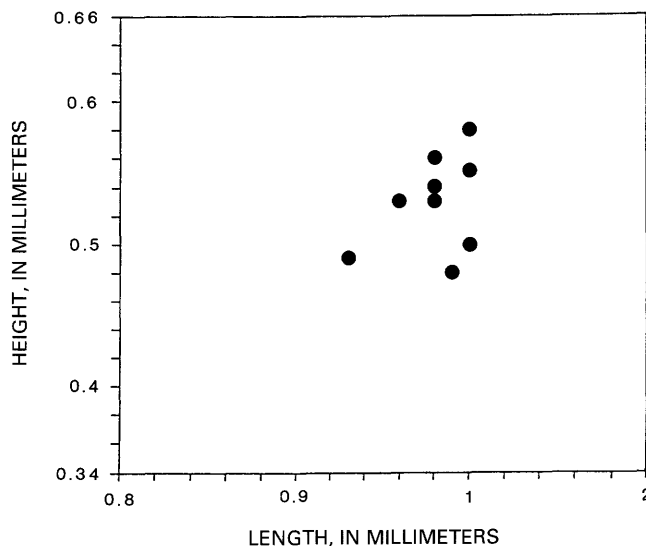
Inner margin and line of concrescence coincide throughout. Inner margin of even width throughout. Inner margin follows valve outline. Strong, well-developed selvage. 23 radial pore canals, most anterior. Radial pores are long, straight, simple. Radial pores enter marginal denticles.

Hingement in left valve consists of deep, rounded, bifid anterior socket with ventral rim; weakly crenulate median groove; and large, tabular, curved posterior socket. Median hinge element enlarged terminally to form elongate anteromedian and posteromedian teeth. Hinge is well calcified.

Four adductor muscle scars form vertical row. Dorsal scar elongate, with inflated anterior; dorsomedian scar narrow, very elongate, arcuate; ventromedian scar shaped like a high isosceles triangle; ventral scar forms an inflated ellipsoid shape. J-shaped frontal scar. Fulcral point a small weak ovoid impression. Small ovoid dorsal scars scattered between hinge and central scar field.

**Measurements.**—Length-height plot based on 11 specimens (fig. 13).

**Comparisons.**—*Celtia pointmanbiensis* n. sp. differs from *C. palmensis* (Quaternary, Gulf of Alaska) by its short, low lateral outline; posteroventral depressed region; different pit pattern; small, bifid anterior hinge element; few radial pores; and lack of secondary ornament. *C. pointmanbiensis* differs from *C. blizhnii* (Quaternary, Gulf of Alaska, south Bering Sea) by its low, short valve outline; weak concavity;



**Figure 13.** Plot of length versus height for *Celtia pointmanbiensis* n. sp.

weak, small caudal process; few radial pores; large sieve pores; and surface covered with large, ovoid ornament pits.

**Occurrence.**—Cruise EGAL-75-KC, localities 39, 53, 76, 128, 141, 144U, 159. Assemblage V. Table 2.

**Distribution.**—Pleistocene through Holocene: Gulf of Alaska, Cook Inlet and Kodiak Shelf, Pribilof Islands.

**Material.**—12 adult valves, 15 juvenile valves.

**Type specimens.**—Holotype: USNM 408292, female left valve (pl. 4, fig. 2), cruise EGAL-75-KC, sample 141, length 0.98 mm, height 0.56 mm.

Paratypes: USNM 408293, female left valve (pl. 5, fig. 7), cruise EGAL-75-KC, sample 64, length 0.96 mm, height 0.53 mm. USNM 408294, female right valve (pl. 5, fig. 8), cruise EGAL-75-KC, sample 64, length 0.98 mm, height 0.54 mm. USNM 408295, male right valve (pl. 5, figs. 9, 13), cruise EGAL-75-KC, sample 144U, length 0.99 mm, height 0.48 mm. USNM 408296, male left valve (pl. 5, fig. 10), cruise EGAL-75-KC, sample 64, length 0.93 mm, height 0.49 mm. USNM 408297, male right valve (pl. 5, fig. 11), cruise EGAL-75-KC, sample 64, length 1.00 mm, height 0.50 mm. USNM 408298, male left valve (pl. 5, fig. 12), cruise EGAL-75-KC, sample 144U, length 0.98 mm, height 0.53 mm. USNM 408299, male left valve (pl. 5, fig. 14), cruise EGAL-75-KC, sample 144U, length 0.93 mm, height 0.49 mm. USNM 408300, female right valve (pl. 5, fig. 15), cruise EGAL-75-KC, sample 144U, length 0.98 mm, height 0.53 mm.

Family HEMICYTHERIDAE Puri, 1953

Subfamily HEMICYTHERINAE Puri, 1953

Genus *FINMARCHINELLA* Swain, 1963

Subgenus *FINMARCHINELLA* Swain, 1963

**Type species.**—*Cythereis finmarchica* Sars, 1866 (Type by subsequent designation.)

*FINMARCHINELLA* (*FINMARCHINELLA*)  
*FINMARCHICA* (SARS, 1866)

Plate 4, figures 3, 4; plate 6, figures 1–10; text-figures 14, 15

*Cythereis finmarchica* Sars, 1866, p. 41.

*Cythereis finmarchica* Sars. Mueller, 1931, p. 29.

*Cythere finmarchica* (Sars). Brady, 1867, p. 208; Norman, 1867, p. 198; Brady, 1868a, p. 410, pl. 31, figs. 9–13; Brady and Robertson, 1870, p. 28; Brady and Robertson, 1872, p. 69; Brady, Crosskey, and Robertson, 1874, p. 153, pl. 10, figs. 18–21; Robertson, 1875, p. 124; Brady and Norman, 1889, p. 163; Norman, 1891, p. 113; Norman, 1902, p. 484; Norman, 1905, p. 147; Scott, 1906, p. 283.

*Eucythereis finmarchica* (Sars). DeVos, 1957, p. 32, pl. 13, figs. 2a–2g.

*Hemicythere finmarchica* (Sars). Sars, 1925, p. 185–186, pl. 85, fig. 3; Klie, 1938, p. 21.

*Nereina finmarchica* (Sars). Hazel, 1967a, p. 18–19, pl. 1, figs. 1–6; pl. 2, fig. 7.

*Finmarchinella finmarchica* (Sars). Swain, 1963, p. 813; Hazel, 1967b, p. 1284; Lev, 1969, pl. 5, fig. 6; Valentine, 1971, p. 3, figs. 27–28; Whatley and Kaye, 1971, p. 319; Moyes and Peypouquet, 1971, p. 219; Lev, 1972, p. 16; Siddiqui and Grigg, 1975, pl. 2, fig. 6; Neale and Howe, 1975, pl. 2, fig. 14; pl. 3, fig. 1; pl. 4, fig. 1; Bidet and Peypouquet, 1976a, p. 212; Bidet and Peypouquet, 1976b, p. 218; Rosenfeld, 1977, p. 26, pl. 6, fig. 80; Brouwers, 1981, p. 10; Whatley, 1982, p. 274–275, pl. K3.2, fig. 1; Neale, 1983, p. 314; West, Devoy, Funnell, and Robinson, 1984, p. 151; Guillaume, Peypouquet, and Tetart, 1985, p. 354–355, pl. 105, figs. 5, 6; Cronin, 1991, p. 787, figs. 14–9, 14–12.

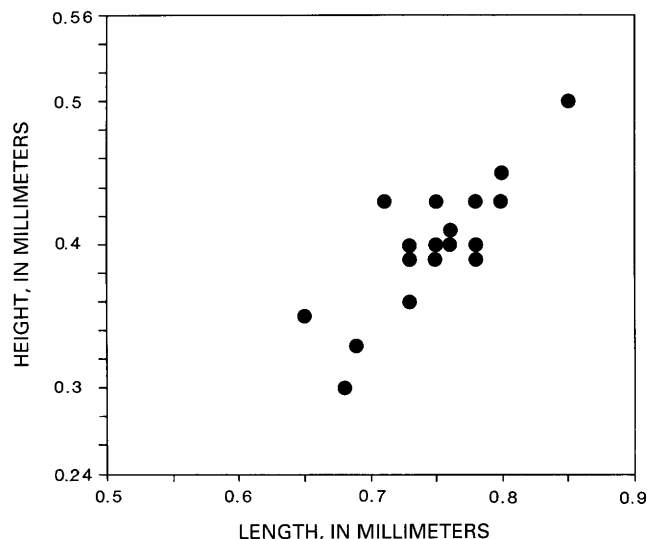
*Finmarchinella* (*Finmarchinella*) *finmarchica* (Sars). Neale, 1974a, p. 84–85, pl. 1, figs. 6–7; pl. 2, figs. 1, 5, text-fig. II; Brouwers, 1982b, p. 9; Robinson, 1984, p. 151; McDougall, Brouwers, and Smith, 1986, pl. 13, fig. 7; Tabuki, 1986, p. 51, text-fig. 10.

**Diagnosis.**—Characterized by elongate, subquadrate lateral outline; posterior-converging dorsum; shallow concavity; blunt posterior; pronounced dimorphism; subdued reticulation; oblique thin posteroventral ridge; subcentral tubercle; and large, spherical eye tubercle.

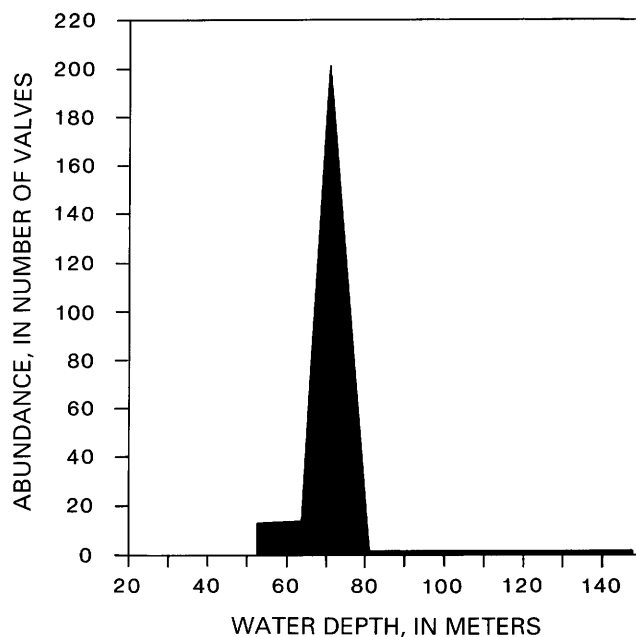
**Measurements.**—Length-height plot based on 22 specimens (fig. 14).

**Occurrence.**—Cruise EGAL-75-KC, localities 17, 32, 39, 52A, 68A, 141, 144U, 153. Assemblage V. Table 2.

**Distribution.**—Upper Pliocene(?), Pleistocene through Holocene: northeast Atlantic (Finland, Norway, Barents Sea, Spitzbergen, Davis Strait, Hunde Islands, Greenland, Franz Josef Land, Great Britain, North Sea, Celtic Sea, Bay of Biscay), Novaya Zemlya, Iceland, northwest Atlantic (Ungava Bay, Gulf of Maine, Atlantic Shelf), Pribilof Islands, Cook



**Figure 14.** Plot of length versus height for *Finmarchinella* (*Finmarchinella*) *finmarchica* (Sars, 1866).



**Figure 15.** Plot of abundance versus water depth for *Finmarchinella* (*Finmarchinella*) *finmarchica* (Sars, 1866).

Inlet and Kodiak Shelf, Gulf of Alaska, Bering Sea, Beaufort Sea, Finland, Norway. Sublittoral (fig. 15).

**Material.**—113 adult valves, 125 juvenile valves.

**Illustrated specimens.**—USNM 408301, female left valve (pl. 4, fig. 3), cruise EGAL-75-KC, sample 52A, length 0.80 mm, height 0.45 mm. USNM 408302, male left valve (pl. 4, fig. 4), cruise EGAL-75-KC, sample 52A, length 0.69 mm, height 0.33 mm. USNM 408303, female left valve (pl. 6, figs. 1, 3), cruise EGAL-75-KC, sample 52A, length 0.80 mm, height 0.43 mm. USNM 408304,

female right valve (pl. 6, fig. 2), cruise EGAL-75-KC, sample 52A, length 0.85 mm, height 0.50 mm. USNM 408305, female right valve (pl. 6, fig. 4), cruise EGAL-75-KC, sample 52A, length 0.75 mm, height 0.39 mm. USNM 408306, male left valve (pl. 6, fig. 5), cruise EGAL-75-KC, sample 52A, length 0.65 mm, height 0.35 mm. USNM 408307, male right valve (pl. 6, figs. 6, 9), cruise EGAL-75-KC, sample 52A, length 0.73 mm, height 0.36 mm. USNM 408308, female right valve (pl. 6, fig. 7), cruise EGAL-75-KC, sample 52A, length 0.75 mm, height 0.39 mm. USNM 408309, female left valve (pl. 6, figs. 8, 10), locality EGAL-75-KC, sample 52A, length 0.76 mm, height 0.40 mm.

Subgenus *BARENTSOVIA* Neale, 1974

*Type species.*—*Finmarchinella barentzovoensis* (Mandelstam, 1957) (Type by original designation.)

*FINMARCHINELLA (BARENTSOVIA)*  
*ANGULATA* (SARS, 1866)

Plate 4, figure 5

*Cythereis angulata* Sars, 1866, p. 46.

*Cythereis (Eucythereis) angulata* Sars. Elofson, 1941, p. 285–286; Hagerman, 1965, p. 56.

*Cythere angulata* (Sars). Norman, 1867, p. 198; Brady, 1868a, p. 409, pl. 26, figs. 39–42; Brady and Robertson, 1869, p. 363; Norman, 1869, p. 290; Brady and Robertson, 1870, p. 28; Brady and Robertson, 1872, p. 69; Brady, Crosskey, and Robertson, 1874, p. 162–163, pl. 4, figs. 21–24; pl. 10, fig. 22; Robertson, 1875, p. 124; Robertson, 1883, p. 28; Brady and Norman, 1889, p. 165; Norman, 1891, p. 113; Brady and Norman, 1896, p. 733; Norman, 1902, p. 484; Norman, 1905, p. 147; Scott, 1906, p. 283; Anderson, 1948, p. 224.

*Hemicythere angulata* (Sars). Sars, 1925b, p. 187–188, pl. 86, fig. 2; Mueller, 1931, p. 29; Klie, 1938, p. 187–188, pl. 86, fig. 2; Stephensen, 1938, p. 8; Klie, 1938, p. 21; Coutard, Lautridou, Lefebvre, and Clet, 1979, p. 19.

Not *Hemicythere angulata* (Sars). Akatova, 1946, p. 227, fig. 5.

“*Hemicytherinae*” (*Genre?*) *angulata* (Sars). Wagner, 1957, p. 61–62, pl. 38, fig. 2; Yassini, 1969, p. 42–43, pl. 39, fig. 17.

Not *Nereina angulata* (Sars). Hazel, 1967a, p. 19, pl. 1, figs. 7–11; pl. 2, figs. 5–8.

*Finmarchinella angulata* (Sars). Swain, 1963, p. 813, pl. 97, fig. 22, text-fig. 11c; Lev, 1970, p. 352; Whatley and Kaye, 1971, p. 319; Moyes and Peypouquet, 1971, p. 219; Neale and Howe, 1975, pl. 1, figs. 7, 10, 12; pl. 2, fig. 8; Bidet and Peypouquet, 1976a, p. 218; Kidson, Gilbertson, Haynes, Heyworth, Hughs, and Whatley, 1978, p. 223; Robinson, 1978, p. 468, pl. 6, fig. 6; Whatley, 1982, p. 275, pl. K3.2, fig. 2; Neale, 1983, p.

314; Cronin, 1991, p. 787, figs. 14–10, 14–11.

Not *Finmarchinella angulata* (Sars). Swain, 1963, p. 813–814, pl. 99, fig. 9.

*Finmarchinella (Barentsovia) angulata* (Sars). Neale, 1974a, p. 88–89, pl. 1, fig. 8; pl. 2, figs. 2, 4, 6, 10; Lord, 1980, p. 229, pl. 1, fig. 4; Brouwers, 1982c, p. 3; Tabuki, 1986, p. 51, text-fig. 11.

Not *Trachyleberis?* cf. *T. angulata* (Sars). Swain, 1951, p. 29, pl. 3, figs. 9–12.

*Diagnosis.*—Characterized by anterior marginal ridge and dorsal ridge which proceeds to posterodorsal cardinal angle, where it is quite pronounced and angles acutely to the mid-posterior margin.

*Occurrence.*—Cruise EGAL-75-KC, locality 134. Assemblage V. Table 2.

*Distribution.*—Upper Pliocene(?), Pleistocene: Gulf of Alaska. Pleistocene through Holocene: Chukchi Sea, Beaufort Sea, North Atlantic (Norway, Novaya Zemlya, Barents Sea, Celtic Sea, Greenland, Great Britain, Netherlands, Bay of Biscay).

*Material.*—1 adult valve.

*Illustrated specimen.*—USNM 408310, female right valve (pl. 4, fig. 5), cruise EGAL-75-KC, sample 134, length 0.68 mm, height 0.38 mm.

*FINMARCHINELLA (BARENTSOVIA)*  
*BARENTZOVOENSIS* (MANDELSTAM, 1957)

Plate 4, figure 6

*Nereina barentzovoensis* Mandelstam, 1957, p. 180, pl. 3, figs. 7, 8.

*Cythere clathrata* Reuss var. *C. nuda* Brady, 1866, p. 376–377, pl. 59, figs. 9, 10.

*Hemicythere angulata* (Sars). Akatova, 1946, p. 227, fig. 5.

*Nereina angulata* (Sars). Hazel, 1967a (in part), p. 19, pl. 1, figs. 7, 11.

*Finmarchinella barentzovoensis* (Mandelstam). Neale and Howe, 1975, pl. 1, figs. 4, 5, 8, 9.

*Finmarchinella (Barentsovia) barentzovoensis* (Mandelstam). Neale, 1974a, pl. 1, figs. 4, 5, 9; pl. 2, fig. 12; Tabuki, 1986, p. 51, text-fig. 11.

*Diagnosis.*—Characterized by strong ridge which follows anterior margin along dorsal half and curves to median valve region, and by two oblique ridges which proceed posterodorsally from subcentral tubercle and are linked by inflation or tubercle at posterodorsal end.

*Occurrence.*—Cruise EGAL-75-KC, samples 11, 108. Cruise DC1-79-EG, sample 45. Cruise DC2-80-EG, sample 67. Assemblage V. Table 2.

*Distribution.*—Pleistocene: Pribilof Islands, Gulf of Alaska. Pleistocene through Holocene: Beaufort Sea, North Atlantic (Hunde Islands, Norway, Novaya Zemlya, Frobisher Bay, Gulf of Maine, Spitsbergen Shelf).

*Material*.—10 juvenile valves.

*Illustrated specimen*.—USNM 408311, juvenile right valve (pl. 4, fig. 6), locality EGAL-75-KC, sample 11, length 0.55 mm, height 0.31 mm.

*FINMARCHINELLA* (BARENTSOVIA)  
*GUYOTENSIS* N. SP.

Plate 4, figures 7, 8; plate 6, figures 11–15; plate 7, figures 1, 2; text-figures 16, 17

*Finmarchinella* (Barentsovia) sp. A Brouwers, 1981, p. 10; Brouwers, 1982b, p. 9; Brouwers, 1983; Tabuki, 1986, p. 51, text-fig. 11.

*Etyymology*.—After Guyot Glacier, a large piedmont glacier extending into Icy Bay, southeast Alaska.

*Diagnosis*.—Characterized by elongate, subquadrate lateral outline; pronounced dimorphism; medium-scale reticulation; strong posterodorsal angular ridge; horizontal posteroventral ridge; subcentral tubercle; flat, smooth posterior region; raised anterior marginal rim; low arcuate ventral ridge; large eye tubercle; arcuate anterior vestibule; medially inflated radial pores.

*Description*.—Adult valves elongate, subquadrate in lateral view. Dorsal margin straight, inclined toward posterior; obtuse anterodorsal cardinal angle; anterior margin evenly rounded; ventral margin sinuous, with broad, shallow concavity; posterior margin with protruding ventral half and straight to slightly concave dorsal half; pronounced, obtuse posterodorsal cardinal angle. Right valve similar to left, but with less inclined dorsum, reduced posterodorsal cardinal angle, and overhanging valve edge at anteroventer. Pronounced dimorphism: males considerably lower than females, with more convergent posterior.

Valve surface covered with medium-scale reticulation, irregular in arrangement. Reticulation forms polygonal solums. Posterior side of valve contains two prominent tuberculate ridges. Strong right-angle ridge at posterodorsal corner, and second horizontal ridge at posteroventral corner. Large subcentral tubercle dominates median valve region. Posterior part of valve forms flat, smooth region; anterior margin has raised marginal rim. Low arcuate ridge parallels venter. Large, smooth, circular eye tubercle. 50 simple-type normal pores evenly distributed over valve on reticulation ridges.

Inner margin and line of concrescence coincide at venter and posterior; moderate, arcuate anterior vestibule. Inner margin parallels valve outline. Inner lamella of even width at anterior and posterior. Strong, well-developed selvage. 62 radial pore canals, 2 false radial pore canals, most anterior. Radial pore canals are long, straight, simple, some with inflated middle.

Hingement in right valve consists of seven large anterior teeth; crenulate median groove; and four large posterior teeth. Anterior and posterior hinge elements heavily calcified, forming single large structure with dentition at surface; anterior and posterior hinge elements become progressively smaller medially.

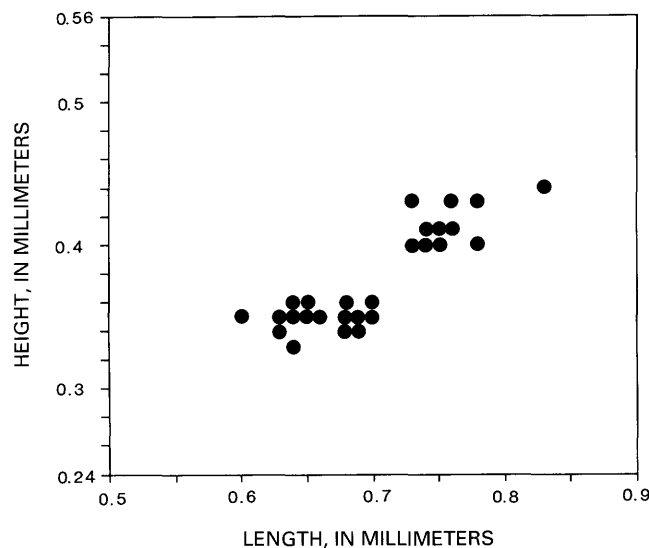


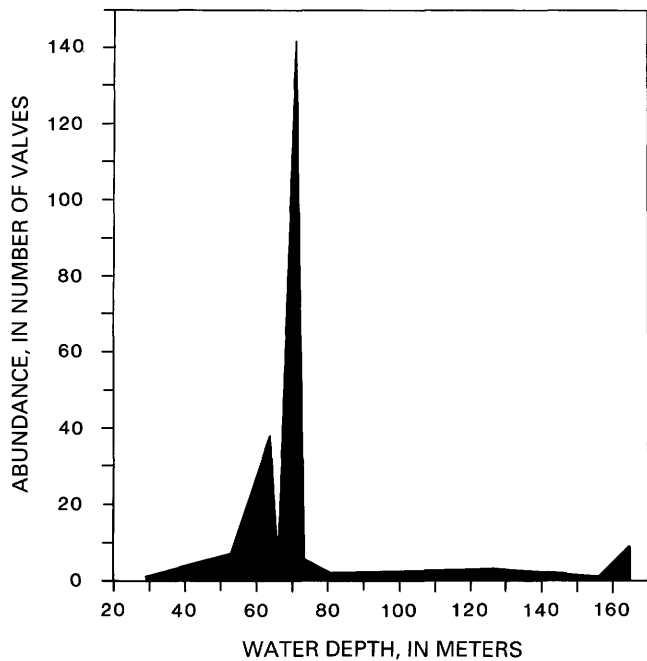
Figure 16. Plot of length versus height for *Finmarchinella* (Barentsovia) *guyotensis* n. sp.

Adductor muscle scars in subcentral tubercle. Dorsal scar is ovoid; dorsomedian scar split into two subovoid scars; ventromedian scar split into two scars; ventral scar elongate, inflated terminally. Two ovoid frontal scars. Few dorsal muscle scars, very large ovoid to tabular shapes, located between muscle tubercle and hinge.

*Measurements*.—Length-height plot based on 36 specimens (fig. 16).

*Comparisons*.—*Finmarchinella* (B.) *guyotensis* n. sp. differs from *F. (B.) curvicosta* Neale, 1974 (= *F. logani* (Brady and Crosskey, 1871) (Cronin, 1981)) (Quaternary, North Atlantic) by its quadrate shape; evenly rounded anterior margin; less convergent, less pointed posterior; pronounced posterodorsal cardinal angle; extended posteroventral corner; large flattened region along posterior; small subcentral tubercle region; small-scale reticulation network covering valve surface; and lack of radiating ridges. *F. guyotensis* differs from *F. (B.) barentzovoensis* (Mandelstam, 1957) (Pleistocene(?), Holocene, North Atlantic) by its less convergent posterior; extended posteroventral corner; weak ventral ridge; small subcentral tubercle region; large flattened region along posterior; and lack of longitudinal ridges radiating from subcentral tubercle. *F. guyotensis* differs from *F. (B.) angulata* (Sars, 1866) (Quaternary, North Atlantic) by its extended posteroventral corner; small subcentral tubercle; weak posterodorsal arcuate ridge; weak ventral ridge; and reticulation network with even-size solums. *F. guyotensis* differs from *F. (B.) japonica* (Ishizaki, 1966) (Pliocene through lower Pleistocene, central Japan) by its weak subcentral tubercle; low eye spot; fine reticulation ridges covering surface; and lack of strong posterodorsal cardinal angle, strong crescentic posteroventral ridge, and posterior marginal denticles. *F. guyotensis* differs from *F. (B.) nealei* Okada, 1979 (lower Pleistocene, central Japan) by its





**Figure 17.** Plot of abundance versus water depth for *Finmarchinella (Barentsovia) guyotensis* n. sp.

strong eye tubercle; weak ventral ridge; low, less pronounced reticulation ridges; strong posterodorsal cardinal angle; strong anterior marginal ridge; and lack of marginal denticles.

**Occurrence:** Assemblage V (fig. 17). Table 2.

**Distribution.**—Pleistocene, Holocene(?): Gulf of Alaska, Cook Inlet and Kodiak Shelf, Pribilof Islands.

**Material.**—169 adult valves, 61 juvenile valves.

**Type specimens.**—Holotype: USNM 408312, female left valve (pl. 4, fig. 7), cruise EGAL-75-KC, sample 52A, length 0.78 mm, height 0.40 mm.

**Paratypes:** USNM 408313, male left valve (pl. 4, fig. 8), cruise EGAL-75-KC, sample 52A, length 0.69 mm, height 0.34 mm. USNM 408314, female left valve (pl. 6, fig. 11), cruise EGAL-75-KC, sample 52A, length 0.78 mm, height 0.43 mm. USNM 408315, female right valve (pl. 6, figs. 12, 15), cruise EGAL-75-KC, sample 52A, length 0.78 mm, height 0.40 mm. USNM 408316, male left valve (pl. 6, fig. 13), cruise EGAL-75-KC, sample 52A, length 0.70 mm, height 0.35 mm. USNM 408317, male right valve (pl. 6, fig. 14), cruise EGAL-75-KC, sample 52A, length 0.70 mm, height 0.36 mm. USNM 408318, female right valve (pl. 7, figs. 1, 2), cruise EGAL-75-KC, sample 52A, length 0.73 mm, height 0.40 mm.

Genus *HEMICYTHERE* Sars, 1925

**Type species.**—*Cythere villosa* Sars, 1866 (Type by subsequent designation.)

# *HEMICYTHERE EMARGINATA* (SARS, 1866)

Plate 8, figure 5

*Cythereis emarginata* Sars, 1866, p. 38.

*Cythereis emarginata* Sars. Brady, 1868a, p. 475; Dahl, 1888, p. 609; Mueller, 1931, p. 29.

*Cythereis (Eucythereis) emarginata* Sars. Elofson, 1941, p. 283; Elofson, 1943, p. 8.

*Cythere emarginata* (Sars). Norman, 1869, p. 291; Brady, 1870, p. 450; Brady and Crosskey, 1871, p. 61; Brady and Robertson, 1872, p. 69; Brady, Crosskey, and Robertson, 1874, p. 166, pl. 5, figs. 1–6; Robertson, 1875, p. 124; Norman, 1877, p. 206; Malcolmson, 1886, p. 634; Brady and Norman, 1889, p. 163; Norman, 1891, p. 113; Brady and Norman, 1896, p. 733; Scott, 1899, p. 85; Norman, 1902, p. 484.

*Hemicythere emarginata* (Sars). Sars, 1925b, p. 183, pl. 85, fig. 1; Stephensen, 1938, p. 8; Klie, 1938, p. 21; Horne and Whittaker, 1983, p. 53–62.

*Aurila emarginata* (Sars). Kurc, 1961, p. 192, pl. 5, figs. 79, 80; Yassini, 1969, p. 44–45.

*Baffinicythere emarginata* (Sars). Hazel, 1967a, p. 17–18, pl. 2, figs. 1, 2, 8, 9; pl. 9, fig. 2; Lev, 1969, pl. 5, fig. 3; Lev, 1970, p. 352; Wagner, 1970, p. 45, pl. 6, fig. 10; Lev, 1972, p. 16; Neale and Howe, 1975, p. 421, pl. 2, figs. 16, 18–21; Siddiqui and Grigg, 1975, pl. 1, fig. 10; Cronin, 1977, p. 117, pl. 3, figs. 9, 10; Robinson, 1978, p. 468, pl. 6, figs. 4a, 4b; Lord, 1980, p. 229, pl. 1, fig. 15; Paterson, Armstrong, and Browne, 1981, p. 30; Cronin, 1981, p. 398, pl. 10, figs. 5, 7–10; Whatley, 1982, p. 274, pl. K3.1, figs. 15, 19–21; Brouwers, 1982c, p. 4; Neale, 1983, p. 314; Tabuki, 1986, p. 50, text-fig. 9.

Ostracod indet. Wagner, 1970, p. 46, pl. 6, fig. 18.

**Remarks.**—The modern distribution of *Hemicythere emarginata* in Alaska is restricted to the Beaufort Sea and northern Bering Sea (frigid- to subfrigid-marine climates). Its occurrence in the Gulf of Alaska is exceedingly rare and is believed to represent a fossil occurrence, probably from a Pleistocene glacial interval.

**Occurrence.**—Cruise EGAL-75-KC, samples 52A, 221. Table 2.

**Distribution.**—Pleistocene: Gulf of Alaska, Cook Inlet, Kodiak Shelf. Pleistocene-Holocene: North Atlantic (Sweden, Norway, Finmark, Shetland Islands, Iceland, Franz Josef Land, Spitsbergen, Greenland, Baffin Island, Gulf of St. Lawrence, Vineyard Sound), Norton Sound.

This species lives in inner to middle sublittoral (0–45 m) water depths. In the extreme Arctic, the taxon lives at constant subzero temperatures; at its southern limits, *H. emarginata* has a maximum survival temperature of 19° C. *H. emarginata* has not been found in salinities less than 20 parts per thousand (Elofson, 1941).

**Material.**—2 adult valves, 1 juvenile valve.

**Illustrated specimens.**—USNM 408335, female right valve (pl. 8, fig. 5), cruise EGAL-75-KC, sample 52A, length 0.80 mm, height 0.48 mm.

*HEMICYTHERE HAZELI* N. SP.

Plate 7, figures 3–12; plate 8, figures 1, 2; text-figures 18, 19

*Cythere* sp. A Swain, 1969, p. 461, pl. 1, fig. 12a, 12b.

*Heterocythereis*? sp. Swain and Gilby, 1974, p. 311–312, pl. 2, fig. 25a, 25b.

*Hemicythere* sp. A Valentine, 1976, p. 22, pl. 12, figs. 1, 4, 7, 10.

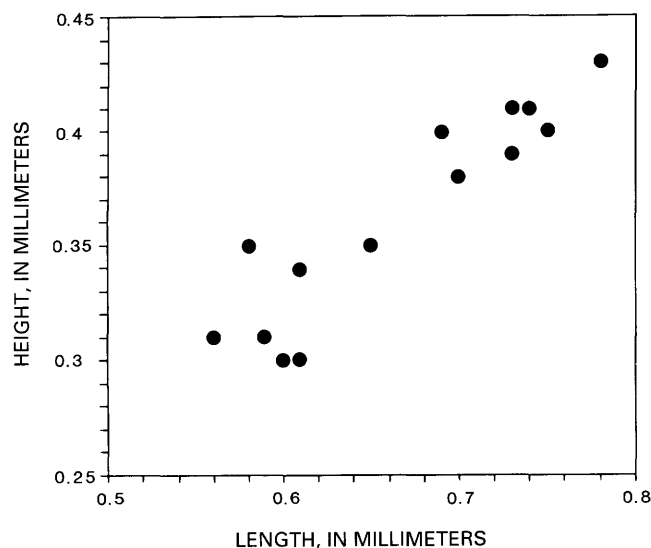
*Hemicythere* aff. *H. quadrinodosa* Schornikov. Brouwers, 1981, p. 10; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 9; Brouwers, 1983.

**Etymology.**—After Joseph E. Hazel, Louisiana State University, for his pioneering work on temperate hemicytherid and trachyleberid ostracode faunas of the North Atlantic.

**Diagnosis.**—Characterized by subquadrate lateral outline; straight dorsum; truncated posterior; shallow, broad concavity; pronounced dimorphism; five raised, smooth nodes located at anterodorsal, anteroventral, posteroventral, and posterodorsal corners and at mid-dorsum; pits oriented in rows parallel to ridges and nodes; secondary marginal pitting.

**Description.**—Adult valves subquadrate in shape in lateral view. Dorsal margin straight, inclined toward posterior; anterior margin smoothly curved; ventral margin with shallow, broad concavity; posterior margin truncated. No cardinal angles. Right valve differs from left in having a less convergent dorsum, subtle caudal process, concave anterodorsal cardinal angle, and downward-extending anteroventral corner. Pronounced dimorphism: males lower, shorter than females, with more pronounced caudal process. Greatest length through midline of valve; greatest height through anterior hinge element.

Valve surface covered with pits and raised smooth nodelike regions. Five regions of valve contain platformlike structures or nodes: (a) an anterodorsal V-shaped node with pointed end oriented toward anterior; lower arm of V is horizontal, upper arm parallels valve margin and terminates at smooth, ellipsoidal eye spot; (b) an anteroventral V-shaped node with pointed end oriented toward anterior; lower arm of V is horizontal, upper arm extends obliquely to central muscle scar node; (c) a posteroventral node forms a reverse J-shape, with long axis paralleling posteroventral valve margin; (d) a posterodorsal node forms a right angle, oriented with open end toward valve interior; (e) a dorsal node forms large subovoid shape. Regions between nodes appear depressed. Remainder of valve covered by ovoid pitting in rows parallel to ridges or nodes. Secondary fine pitting along margins and on nodes in some specimens. 72–96 normal



**Figure 18.** Plot of length versus height for *Hemicythere hazeli* n. sp.

pores evenly distributed over surface, occurring within pits. Normal pores celate with apophysis.

Inner margin and line of concrescence coincide; inner lamella of even width at anterior and posterior. Weak selvage. 56–63 radial pore canals, 2 false radial pores, most anterior. Radial pore canals are long, straight, simple, with inflated medial portion. Small ellipsoidal ocular sinus below anterior hinge.

Hingement in left valve consists of small, rounded, anterior tooth; large ovoid socket; massive, ovoid, anteromedian tooth; weakly crenulate median bar, enlarged terminally; small, ovoid, posteromedian tooth; and large, elongate, subquadrate, posterior socket. Posterior socket open to valve interior. Anterior socket has ventral rim connecting anterior and anteromedian teeth.

Adductor muscle scars in subcentral tubercle. Dorsal scar circular in shape; dorsomedian scar split into two ovoid scars; ventromedian scar split into two ellipsoidal scars; ventral scar is narrow, elongate, with inflated ends. Frontal scar split into dorsal subovoid scar and ventral, gumdrop-shaped scar. Scattered, few dorsal muscle scars, most concentrated in two regions—along anterior hinge line and just above central scar field.

**Measurements.**—Length-height plot based on 17 specimens (fig. 18).

**Comparisons.**—*Hemicythere hazeli* differs from *H. gorokuensis* Ishizaki, 1966 (Pliocene through lower Pleistocene, central Japan) by its straight dorsum; quadrate lateral outline; evenly curved posterior margin; fine pitted ornament over entire surface; five prominent nodes; and lack of radial ornament ridges. *H. hazeli* differs from *H. sp. B* of Ishizaki and Matoba (1985) (lower Pleistocene, central Japan) by its straight dorsum; five prominent ornament nodes; and

different arrangement of ornament pits. *H. hazeli* differs from *Cythere boreokurila* Schornikov, 1974 (Holocene, Kurile Islands) by its more quadrate lateral outline; straight dorsum; weak concavity; small, numerous ornament pits; and five prominent ornament nodes. *H. hazeli* differs from *H. quadrinodosa* Schornikov, 1974 (Holocene, Kurile Islands) by its quadrate valve outline; weak concavity; straight dorsum; pitted ornament; and weak nodes rather than large, pronounced ornament tubercles.

*Occurrence*.—Assemblages I\*, II\*, III, IV. Table 2.

*Distribution*.—Pleistocene, Holocene: Gulf of Alaska, Cook Inlet and Kodiak Shelf, northern California, Oregon, and Washington. Sublittoral, upper bathyal; mild- to cold-temperate marine climatic zones (fig. 19).

*Material*.—33 adult valves, 254 juvenile valves.

*Type specimens*.—Holotype: USNM 408319, female left valve (pl. 8, fig. 1), cruise EGAL-75-KC, sample 162, length 0.58 mm, height 0.35 mm.

Paratypes: USNM 408320, male right valve (pl. 8, fig. 2), cruise EGAL-75-KC, sample 162, length 0.60 mm, height 0.30 mm. USNM 408321, male right valve (pl. 7, figs. 3, 8, 9), cruise EGAL-75-KC, sample 11, length 0.65 mm, height 0.35 mm. USNM 408322, female left valve (pl. 7, fig. 4), cruise EGAL-75-KC, sample 157, length 0.78 mm, height 0.43 mm. USNM 408323, female right valve (pl. 7, figs. 5, 6), cruise EGAL-75-KC, sample 35, length 0.75 mm, height 0.40 mm. USNM 408324, male left valve (pl. 7, fig. 7), cruise EGAL-75-KC, sample 144U, length 0.70 mm, height 0.38 mm. USNM 408325, female left valve (pl. 7, fig. 10), cruise EGAL-75-KC, sample 35, length 0.74 mm, height 0.41 mm. USNM 408326, female left valve (pl. 7, figs. 11, 12), cruise EGAL-75-KC, sample 37, length 0.73 mm, height 0.39 mm.

Tribe NORMANICYTHERINI Puri, 1974

Genus NORMANICYTHERE Neale, 1959

*Type species*.—*Cythere leioderma* Norman, 1869 (Type by subsequent designation.)

NORMANICYTHERE LEIODERMA  
(NORMAN, 1869)

Plate 8, figure 3

*Cythere leioderma* Norman, 1869, p. 291.

*Cythere leioderma* Norman. Brady, 1870, p. 450–452, pl. 19, figs. 11–13; Brady and Crosskey, 1871, p. 62; Brady and Robertson, 1872, p. 68; Brady, Crosskey and Robertson, 1874, p. 149–150, pl. 9, figs. 5, 6; Brady, 1878, p. 254; Brady and Norman, 1889, p. 139, pl. 15, figs. 12, 13; Norman, 1891, p. 111; Mueller, 1912, p. 377; Stephensen, 1913, p. 363; Klie, 1929, p. 19, 42.

*Cythereis leioderma* (Norman). Blake, 1933, p. 239; Stephensen, 1938, p. 10; Elofson, 1941, p. 304.

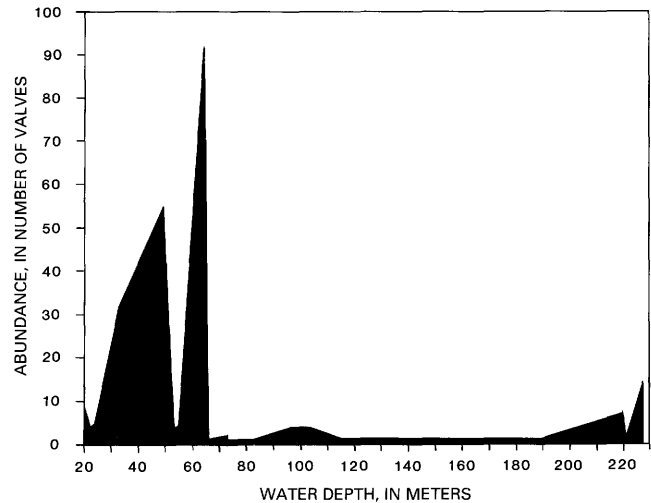


Figure 19. Plot of abundance versus water depth for *Hemicythere hazeli* n. sp.

*Normanicythere leioderma* (Sars). Neale, 1959, p. 78, pl. 13, figs. 1, 2; pl. 14, figs. 1–8; Neale, 1961, p. 424; Swain, 1963, p. 826–827, pl. 95, figs. 10, 17; text-fig. 11a; Schmidt, 1963, p. 350; Swain, 1963, p. 826, pl. 95, figs. 10, 17; text-fig. 11a; Catt and Penny, 1966, p. 409; Hazel, 1967a, p. 23–24, pl. 1, figs. 12–16; Neale and Schmidt, 1967, p. 348; Lev, 1969, pl. 1, fig. 8; pl. 2, fig. 12; pl. 5, figs. 1, 2; Lev, 1970, p. 352; Lev, 1972, p. 15; Neale and Howe, 1975, p. 423, pl. 3, figs. 9–10; Siddiqui and Grigg, 1975, pl. 2, fig. 13; Robinson, 1978, p. 460, pl. 2, figs. 7a–c; Whatley, 1982, p. 275–276, pl. K3.2, fig. 3; Brouwers, 1982c, p. 2; Neale, 1983, p. 314; McDougall, Brouwers, and Smith, 1986, pl. 6, figs. 5–8; Tabuki, 1986, p. 52, text-fig. 12.

*Normanicythere?* n. sp. Swain, 1961, p. 604, fig. 2.

*Normanicythere concinella* Swain, 1963, p. 827, pl. 95, figs. 18a–d; text-fig. 11b; Schmidt, 1967, p. 168; Neale and Schmidt, 1967, p. 348.

*Occurrence*.—Cruise EGAL-75-KC, sample 159. Table 2.

*Distribution*.—Upper Pliocene through Holocene: North Atlantic, Beaufort Sea, Bering Sea, Chukchi Sea, Cook Inlet, Gulf of Alaska, Pribilof Islands.

*Material*.—1 juvenile valve.

*Illustrated specimen*.—USNM 408327, juvenile right valve (pl. 8, fig. 3), locality EGAL-75-KC, sample 159, length 0.60 mm, height 0.38 mm.

Tribe AURILINI Puri, 1974

Genus AURILA Pokorný, 1955

*Type species*.—*Cythere convexa* Baird, 1850 (Type by subsequent designation.)

*AURILA MALASPINENSIS* N. SP.

Plate 7, figures 13–17; plate 8, figure 4; plate 9, figures 1–5; text figures 20, 21

*Aurila* sp. Swain and Gilby, 1974, p. 305–306, pl. 3, fig. 25.

*Aurila* sp. A Valentine, 1976, pl. 8, figs. 9, 10, 12, 13, 15, 16, 18, 19.

*Aurila* sp. C Valentine, 1976, p. 22, pl. 8, figs. 1–4.

*Aurila* sp. A Brouwers, 1981, p. 8; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1982c, p. 3; Brouwers, 1983.

**Etymology.**—After Malaspina Glacier, the largest piedmont glacier in Alaska.

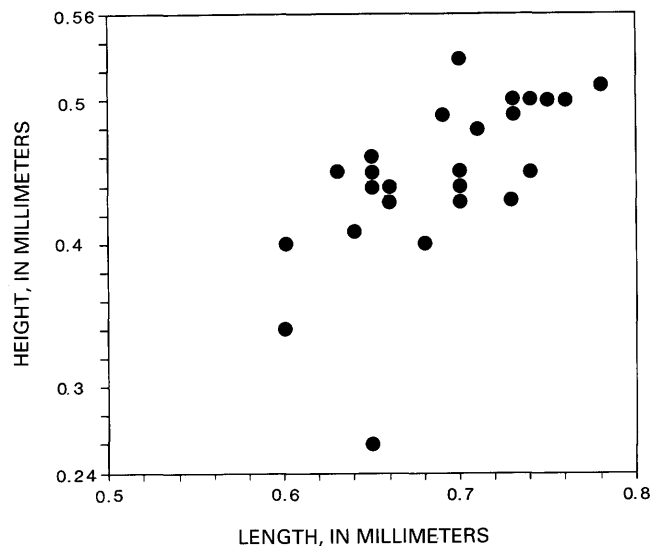
**Diagnosis.**—Characterized by ovoid lateral outline; pronounced concavity; small, overhanging ventral ridge; short, blunt caudal process ventral of midline; posteroventral marginal denticles; moderate sexual dimorphism; punctate surface with large median pits and fine marginal pits; marginal punctae close-spaced, alternating with low concentric ridges; recessed sieve plates; shallow arcuate anteroventral and posteroventral vestibules.

**Description.**—Adult valves ovoid in lateral view. Dorsal margin a high, broad arch; anterior margin smoothly curved with maximum width ventral of midline; ventral margin sinuous with pronounced concavity; small ventral ridge overhangs concavity; posterior margin with short, blunt caudal process located ventral of midline. Posteroventral corner with numerous small marginal denticles. Left valve with more pronounced caudal process, more arched dorsum. Moderate sexual dimorphism: females shorter, higher, more inflated than males. Greatest length just ventral of valve midline; greatest height between anterior hinge element and adductor scars.

Valve surface punctate. Large ovoid to circular pits in middle of valve, finer punctation along valve margins. Peripheral punctation close-spaced, arranged subparallel to valve margins and alternating with low concentric ridges. Smooth, flat, irregular eye spot. 123 sieve-type normal pores evenly distributed over surface, primarily within large pits. Sieve pores with recessed sieve plates, central setal opening.

Inner margin and line of concrescence coincide ventrally. Shallow, arcuate vestibules along anterior-anteroventral and posterior-posteroventral regions. Inner lamella of even width throughout, follows valve outline; strong selvage. 134 straight, simple radial pores, 8 false radial pores; most anterior. Deep ovoid ocular sinus below anterior socket.

Hingement in right valve consists of large, heavily calcified, bifid anterior tooth; anteromedian ovoid socket with thick ventral rim; crenulate median groove; and posterior tooth-socket-tooth, each moderate in size and ovoid to quadrate shape. Left valve larger than right, with accommodation groove to accept right valve dorsal margin.



**Figure 20.** Plot of length versus height for *Aurila malaspinensis* n. sp.

Three ovoid frontal scars form slightly inclined row adjacent to adductor muscle scars. Adductor muscle scars form vertical row, with scars inclined anteroventrally. Dorsal adductor scar is elongate-ellipsoidal; dorsomedian scar dumbbell-shaped in left valve, split into two ovoid scars in right valve; ventromedian scar is crescentic; ventral scar is subcylindrical. Two adjacent mandibular scars: dorsal scar is large, subquadrate; ventral scar is small, ovoid. Dorsal scars are large, with strong, deep impressions.

**Measurements.**—Length-height plot based on 29 specimens (fig. 20).

**Comparisons.**—*Aurila malaspinensis* differs from *A. grada* Hu and Yang, 1975 (upper Pliocene-lower Pleistocene, Taiwan) by its more rounded shape; much weaker caudal process; convex venter; punctate ornament; and lack of nodes or tubercles. *Aurila malaspinensis* differs from *A. pseudoamigdala* Ishizaki, 1966 (Pliocene, central Japan) by its less arched dorsum; less inflated carapace; more evenly spaced punctae; and smaller marginal punctae. *Aurila malaspinensis* differs from *A. lincolnensis* (LeRoy, 1943) (upper Pliocene-Holocene, central and northern California, Washington, and Oregon) by its slightly less arched dorsum; smaller punctae, especially marginally; and lack of a strong V-shaped ridge at the caudal process. *Aurila malaspinensis* differs from *Aurila* sp. D Valentine, 1976 (lower Pleistocene-Holocene, southern and central California) by its less arched dorsum; weak concavity; more rounded lateral outline; weaker caudal process; punctate ornament; and lack of reticulation ridges. *Aurila malaspinensis* differs from *A. montereyensis* (Skogsberg, 1928) (upper Pleistocene to Holocene, central and northern California, Washington, Oregon) by its less arched dorsum; more ovate shape; less inflation of the carapace; weaker concavity; and fewer, larger punctae. *Aurila malaspinensis* differs from *Aurila* sp.

(Ishizaki and Matoba, 1985) (lower Pleistocene, central Japan) by its shorter valve length; more inflated carapace; weaker ventral ridge; larger, fewer punctae; and lack of posteroventral and anterior marginal flange. *Aurila malaspinensis* differs from *A. inabai* Okubo, 1976 (Holocene, Inland Sea of Japan) by its weaker caudal process; weaker concavity; more arched dorsum; and lack of reticulation ridges.

**Remarks.**—Valentine (1976) illustrated five species of *Aurila* which he identified from offshore sediments of California, Washington, and Oregon. The taxon identified as *Aurila* sp. A is clearly conspecific with the taxon I call *Aurila malaspinensis* n. sp. from the Gulf of Alaska. The form Valentine identified as *Aurila* sp. C is very similar to *Aurila* sp. A; the only differences are that *Aurila* sp. C includes a slightly more arched dorsum, a weak ridge on the caudal process, and a slightly larger size. I do not believe that these differences represent species-level characters. The Holocene geographic range of *Aurila* sp. C falls predominantly within the range of *Aurila* sp. A. Previous studies have documented two distinct size species within a single species (Forester, 1980; Sandberg, 1964), which commonly correspond to age differences. Forester (1980) speculated that two size ranges within a geographic region may correspond to seasonal populations, that is, summer-fall and winter-spring.

**Occurrence.**—Assemblages I\*, II, III, V (fig. 21). Table 2.

**Geographic distribution.**—Gulf of Alaska, Cook Inlet and Kodiak Shelf, central and northern California, Washington, and Oregon. Sublittoral; mild- to cold-temperate climatic zones.

**Stratigraphic distribution.**—Upper Pliocene through Holocene.

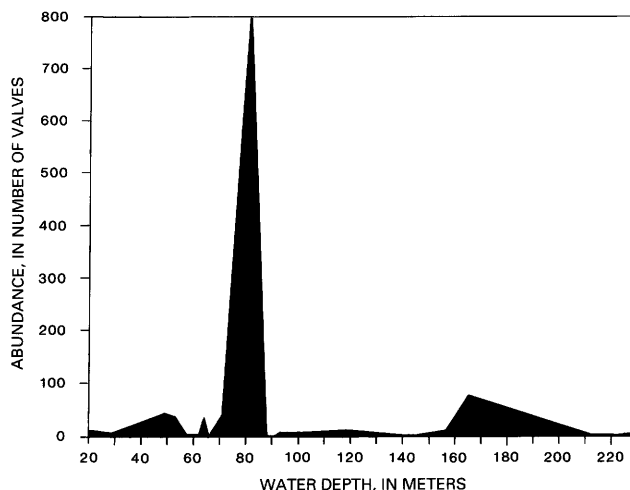
**Material.**—144 adult valves, 1,238 juvenile valves.

**Type specimens.**—Holotype: USNM 408328, female left valve (pl. 8, fig. 4), cruise EGAL-75-KC, sample 157, length 0.75 mm, height 0.50 mm.

Paratypes: USNM 408329, male left valve (pl. 7, figs. 13, 17), cruise EGAL-75-KC, sample 157, length 0.66 mm, height 0.44 mm. USNM 408330, male right valve (pl. 7, fig. 14), cruise EGAL-75-KC, sample 157, length 0.64 mm, height 0.41 mm. USNM 408331, female left valve (pl. 7, fig. 15), cruise EGAL-75-KC, sample 157, length 0.74 mm, height 0.45 mm. USNM 408332, female left valve (pl. 7, fig. 16; pl. 9, fig. 3), cruise EGAL-75-KC, sample 157, length 0.73 mm, height 0.43 mm. USNM 408333, male right valve (pl. 9, figs. 1, 5), cruise EGAL-75-KC, sample 157, length 0.60 mm, height 0.40 mm. USNM 408334, male left valve (pl. 9, figs. 2, 4), cruise EGAL-75-KC, sample 157, length 0.60 mm, height 0.34 mm.

Genus *ROBUSTAURILA* Yajima, 1982

**Type species.**—*Cythereis assimilis* Kajiya, 1913 (Type by subsequent designation.)



**Figure 21.** Plot of abundance versus water depth for *Aurila malaspinensis* n. sp.

#### *ROBUSTAURILA JOLLAENSIS* (LEROY, 1943)

Plate 8, figure 6; plate 9, figures 6–9

*Hemicythere jollaensis* LeRoy, 1943, p. 365, pl. 59, figs. 28–33; pl. 62, figs. 15, 16; text-fig. 2q.

*Hemicythere jollaensis* LeRoy. Benson, 1959, p. 65, pl. 11, figs. 7, 8.

*Aurila jollaensis* (LeRoy). Swain, 1969, p. 466, pl. 2, figs. 3a, 3b, 9; pl. 5, figs. 3a–3c; Swain and Gilby, 1974, p. 308, pl. 3, figs. 27, 28; text-figs. 34a–34c.

*“Radimella” jollaensis* (LeRoy). Valentine, 1976, p. 23, pl. 9, figs. 13, 16.

*Radimella jollaensis* (LeRoy). Brouwers, 1982c, p. 3; Cronin, Brouwers, Quinn, and Redline, 1983, p. 219, pl. 3, fig. 8.

**Remarks.**—*R. jollaensis* has a large geographic range, living today from Baja California to Puget Sound, which represents a range in marine climate from subtropical to mild temperate. Its presence in the Gulf of Alaska is rare, represented by scarce juveniles for the most part. I believe that the presence in Alaska is as fossil occurrences.

**Occurrence.**—Cruise EGAL-75-KC, samples 11, 32, 115, 134, 157. Table 2.

**Distribution.**—Upper Pliocene-Pleistocene: Gulf of Alaska. Upper Pliocene-Holocene: Washington, Oregon, California, Baja California.

**Material.**—2 adult valves, 29 juvenile valves.

**Type specimens.**—USNM 408336, female left valve (pl. 8, fig. 6), cruise EGAL-75-KC, sample 134, length 0.78 mm, height 0.40 mm. USNM 408337, juvenile left valve (pl. 9, fig. 6), cruise EGAL-75-KC, sample 157, length 0.60 mm, height 0.41 mm. USNM 408338, juvenile right valve (pl. 9, figs. 7, 9), cruise EGAL-75-KC, sample 157, length 0.80 mm, height 0.45 mm. USNM 408339, juvenile right

valve (pl. 9, fig. 8), cruise EGAL-75-KC, sample 157, length 0.63 mm, height 0.39 mm.

Subfamily COQUIMBINAE Ohmert, 1968

Genus COQUIMBA Ohmert, 1968

*Type species.*—*Coquimba hermi* Ohmert, 1968 (Type by original designation.)

COQUIMBA HANAII N. SP.

Plate 8, figure 7; plate 9, figures 10–15; text-figure 22

*Coquimba* sp. A Brouwers, 1981, p. 8; Brouwers, 1982b, p. 8; Brouwers, 1983.

*New Genus F* sp. A Valentine 1976, p. 23, pl. 3, figs. 6, 9.

*Etymology.*—After Emeritus Professor Tetsuro Hanai, an ostracode specialist at the University of Tokyo, Japan.

*Diagnosis.*—Characterized by an elongate, quadrate lateral outline; straight dorsal and ventral margins; anterior and posterior marginal denticles; sharp posterodorsal corner angle; reticulate ornament, arranged concentrically and radially about subcentral tubercle; reticulation pits floored by groups of small pits; two posterior tubercles; secondary fine marginal pitting; prominent eye spot; anterior and posterior margins with broad flat region.

*Description.*—Adult valves elongate, quadrate in shape in lateral view. Dorsal margin nearly straight, converging toward posterior; anterior margin rounded with 12 small, sharply pointed denticles along anteroventral margin; ventral margin nearly straight, tapering posteriorly; posterior margin with evenly curved ventral half and sharp cardinal angle at posterodorsal half of margin. Sharp posterodorsal cardinal angle. Posteroventral margin with five small, sharp denticles. Left valve with strong posterodorsal cardinal angle. Greatest length through midline; greatest height through anterior hinge element.

Valve surface is reticulate, tuberculate, and pitted. Primary ornament is reticulation, arranged concentrically and radially about large subcentral tubercle. Reticulation pits are large, ovoid to ellipsoidal in shape, floored by smaller sub-ovoid groups of pits. Two large, arcuate, tuberculate ridges at posterodorsum and posteroventer, slightly overhanging cardinal angles. Prominent, elongate, smooth eye spot. Fine secondary pitting along tuberculate ridges, particularly along anterior. Anterior and posterior margins with broad, arcuate region along margins; ventral margin with narrow marginal shelf. 70 normal pores evenly distributed over surface, in reticulation pits. Normal pores sieve-type, with recessed sieve plate and central setal opening.

Inner margin and line of concrescence coincide along venter; shallow, arcuate anterior and posterior vestibules. Well-developed selvage. Inner lamella widest at anterior; inner margin follows valve outline. 52 radial pores, 2 false radial pores, most anterior. Radial pores long, straight, sim-

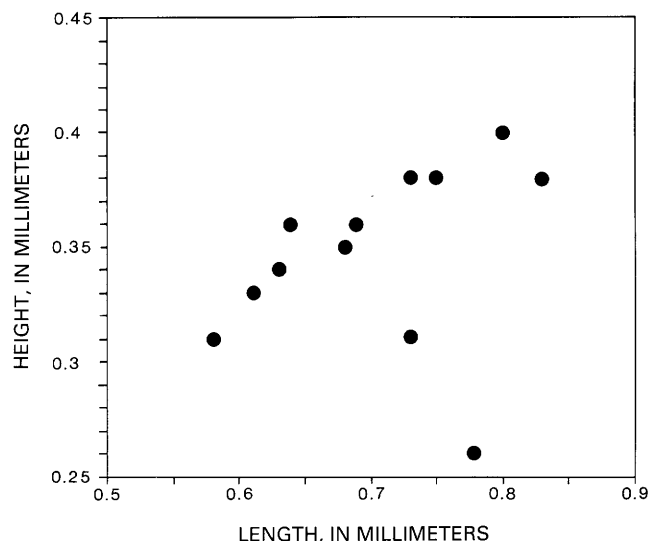


Figure 22. Plot of length versus height for *Coquimba hanaii* n. sp.

ple; marginal denticles contain radial pore canals. Many radial pores inflated medially. Elongate, ellipsoidal ocular sinus below anterior socket.

Hingement in left valve consists of triangular anterior socket; large, ovoid socket with thick ventral rim; anteromedian knoblike tooth; smooth median bar; elongate postero-medial tooth; and quadrate posterior socket.

Central muscle scars in subcentral tubercle; individual scars not visible.

*Measurements.*—Length-height plot based on 12 specimens (fig. 22).

*Comparisons.*—*Coquimba hanaii* n. sp. differs from *C. ishizakii* Yajima, 1978 (Pleistocene, central Japan) by its elongate, quadrate shape; reticulate and pitted ornament; shallow anterior marginal sulcus; less pronounced subcentral tubercle; weak ventral ridge; and pointed, drawn-out posterior. *C. hanaii* differs from *C. sp. A* of Valentine, 1976 (upper Pliocene through Holocene, central-southern California) by its elongate, quadrate lateral outline; drawn-out posterior; posterodorsal L-shaped tubercle; wide, flat anterior marginal area; secondary ornament punctae; and large eye tubercle. *C. hanaii* differs from *C. schenki* (LeRoy, 1943) (upper Pliocene through Holocene, central-southern California) by its elongate, quadrate lateral outline; drawn-out posterior; wide, flat anterior marginal area; secondary ornament punctae; prominent eye tubercle; and lack of deep anterior sulcus.

*Occurrence.*—Cruise EGAL-75-KC, localities 11, 115, 128, 141, 157, 159. Assemblage V. Table 2.

*Distribution.*—Upper Pliocene(?); Pleistocene through Holocene: Gulf of Alaska, Cook Inlet and Kodiak Shelf, northern California, Washington, Oregon.

*Material.*—12 adult valves, 10 juvenile valves.



*Type specimens*.—Holotype: USNM 408340, male left valve (pl. 8, fig. 7), cruise EGAL-75-KC, sample 159, length 0.78 mm, height 0.26 mm.

Paratypes: USNM 408341, female right valve (pl. 9, fig. 10), cruise EGAL-75-KC, sample 11, length 0.83 mm, height 0.38 mm. USNM 408342, male right valve (pl. 9, figs. 11–14), cruise EGAL-75-KC, sample 157, length 0.73 mm, height 0.31 mm. USNM 408343, female left valve (pl. 9, fig. 15), cruise EGAL-75-KC, sample 157, length 0.75 mm, height 0.38 mm.

Subfamily UROCYTHEREIDINAE Hartmann and Puri, 1974

Genus *AMBOSTRACON* Hazel, 1962

*Type species*.—*Ambostracon costatum* Hazel, 1962 (Type by original designation.)

*AMBOSTRACON TWEEDSMUIRENSIS* N. SP.

Plate 8, figure 8; plate 9, figures 16–18; plate 10, figures 1–5; plate 11, figure 1; text-figures 23, 24

*Ambostracon glaucum* (Skogsberg). Swain and Gilby, 1974, p. 317, pl. 7, fig. 7.

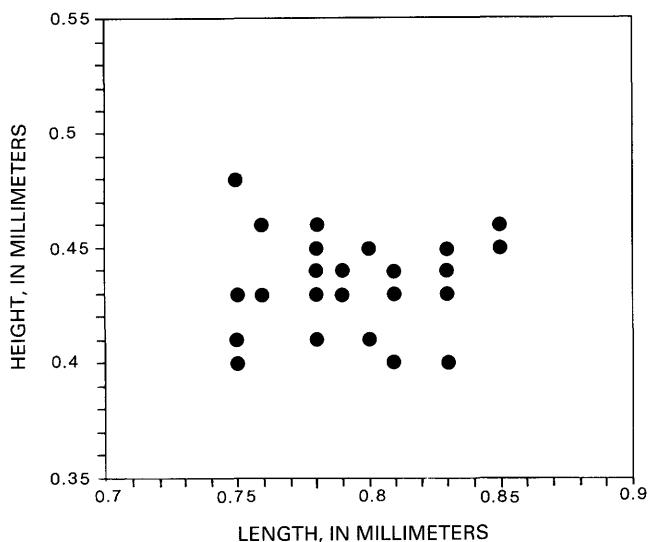
*Ambostracon* sp. A Brouwers, 1981, p. 8; Brouwers, 1982b, p. 8; Brouwers, 1983.

*Etymology*.—After Tweedsmuir Glacier, north of Dry Bay in the Saint Elias Mountains, southeast Alaska.

*Diagnosis*.—Characterized by elongate, low, subquadrate lateral outline; inclined dorsum hidden by overhanging ridges; anteroventral denticles; drawn-out posteroventral corner; blunt caudal process with small denticles; pronounced dimorphism; heavily reticulate with subcentral tubercle; prominent hemispherical eye tubercle; prominent ventral ridge; anterior and posterior flattened marginal rims; secondary papillae; recessed sieve plates with thickened conulae, and anteroventral arcuate vestibule.

*Description*.—Adult valves subquadrate in lateral view. Dorsal margin slightly inclined, hidden in exterior view by overhanging ridges; anterior margin rounded, with small marginal denticles, especially anteroventral; ventral margin broadly curved; posterior margin with blunt caudal process in ventral half, becoming concave in dorsal half. Caudal process with numerous small marginal denticles; denticles large and flat along posteroventral margin. Left valve with high anterodorsal corner and pronounced posterodorsal cardinal angle. Females differ from males in being considerably shorter, somewhat higher in lateral view, somewhat wider posteriorly. Greatest length through caudal process; greatest height through anterior hinge element.

Valve surface heavily reticulate with subcentral tubercle, ridges, and prominent hemispherical eye tubercle. Reticulation arranged radially and concentrically about subcentral tubercle. Prominent ventral ridge extends nearly the length of valve from anteroventral region. Several oblique ridges extend from dorsum anteroventrally to mid valve. Anterior



**Figure 23.** Plot of length versus height for *Ambostracon tweedsmuiensis* n. sp.

and posterior ends have broad, smooth, flattened rim. Secondary small papillae on solum floors and marginal rims. 55–77 sieve-type normal pores evenly distributed over surface, both on ridges and on solum floors. Sieve pores have recessed sieve plates with subcentral setal opening, rimmed by thickened conulae.

Inner margin and line of concrescence coincide at posterior and venter; small arcuate anteroventral vestibule. Inner lamella of even width throughout, follows valve outline. 96 straight, simple radial pore canals, 6 false radial pore canals; most radial pores at anterior. Radial pores extend into marginal denticles. Ovoid, deep ocular sinus below anterior socket.

Hingement in right valve consists of stepped anterior tooth with lower flattened anterior part and large rounded knob; rounded anteromedian socket with thick ventral rim; finely crenulate median groove; and very large, curved, smooth, bifid posterior tooth.

Three frontal scars in anterodorsal part of subcentral tubercle: circular dorsal scar, small ovoid median scar, and ovoid ventral scar with enlarged anterior. Adductor scars along posterior slope of tubercle. Dorsal scar is ovoid; dorsomedian scar split into two subtriangular scars; ventromedian scar is either an elongate narrow scar with enlarged posterior or scar is divided into two subtriangular scars; ventral scar is elongate. Two ovoid mandibular scars: one just below frontal scar, the second midway between adductor row and venter. Ovoid fulcral point between lower frontal scar and dorsomedian adductor. Dorsal muscle scars are large, form strong deep impressions.

*Measurements*.—Length-height plot based on 32 specimens (fig. 23).

*Comparisons*.—*Ambostracon tweedsmuiensis* n. sp. differs from *Ambostracon* sp. A of Valentine, 1976

(Holocene, northern-central California, Washington, Oregon) by its elongate, low lateral outline; drawn-out posteroventral corner; convergent posterior; thin, delicate marginal denticles; large prominent eye tubercle; and secondary ornament. *A. tweedsmuirensis* differs from *Ambostreacon* sp. E of Valentine, 1976 (Quaternary, central-northern California, Washington, Oregon) by its elongate, low lateral outline; drawn-out posteroventral corner; irregular, angular dorsum; weaker reticulation ridges; flattened anterior marginal rim or flange; secondary ornament; and well-defined hemispherical eye tubercle. *A. tweedsmuirensis* differs from *A. kitanipponica* Tabuki, 1986 (lower Pleistocene, northern Honshu, Japan) by its lower, longer valve shape; greater dimorphism; finer scale reticulation developed over entire valve; pronounced subcentral tubercle; and lack of anterior and posterior marginal ridges.

**Remarks.**—The specimen illustrated by Swain and Gilby (1974) as *A. glaucum* (Skogsberg) is conspecific with *A. tweedsmuirensis*. Valentine (1976) illustrated a large number of *Ambostreacon* species, each with a distinct geographic range. Swain and Gilby (1974) have incorporated at least two (and probably more) species under the name *A. glaucum*. Comparison of Skogsberg's type specimens from Monterey Bay with Valentine's (1976) material demonstrates that Valentine has illustrated true *A. glaucum*, with a Holocene geographic range from lat 28°15' N. to 35°45' N. (Punta Eugenia to Point Piedras Blancas, subtropical to mild-temperate climatic zones).

**Occurrence.**—Assemblage V. Table 2.

**Distribution.**—Pleistocene through Holocene: Gulf of Alaska, Cook Inlet and Kodiak Shelf, Oregon (fig. 24).

**Material.**—161 adult valves, 239 juvenile valves.

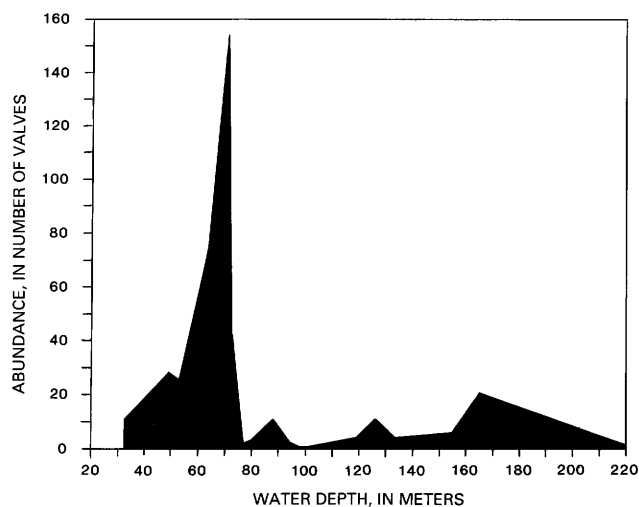
**Type specimens.**—Holotype: USNM 408343, male left valve (pl. 8, fig. 8), cruise EGAL-75-KC, sample 52A, length 0.83 mm, height 0.44 mm.

Paratype: USNM 408344, female right valve (pl. 11, fig. 1), cruise EGAL-75-KC, sample 52A, length 0.79 mm, height 0.44 mm. USNM 408345, female left valve (pl. 9, fig. 16), cruise EGAL-75-KC, sample 52A, length 0.78 mm, height 0.43 mm. USNM 408346, female right valve (pl. 9, figs. 17, 18; pl. 10, fig. 2), cruise EGAL-75-KC, sample 52A, length 0.75 mm, height 0.40 mm. USNM 408347, male left valve (pl. 10, fig. 1), cruise EGAL-75-KC, sample 52A, length 0.80 mm, height 0.41 mm. USNM 408348, male right valve (pl. 10, figs. 3, 4), cruise EGAL-75-KC, sample 28, length 0.83 mm, height 0.43 mm. USNM 408349, female left valve (pl. 10, fig. 5), cruise EGAL-75-KC, sample 28, length 0.76 mm, height 0.43 mm.

#### Genus *LAPEROUSECYTHERE* NEW GENUS

**Type species.**—*Patagonacythere robusta* Tabuki, 1986 (Type by original designation.)

**Etymology.**—After La Perouse Glacier in southeast Alaska, named for an early explorer of the Alaskan coastline.



**Figure 24.** Plot of abundance versus water depth for *Ambostracon tweedsmuirensis* n. sp.

**Diagnosis.**—Characterized by elongate, subquadrate lateral outline; subparallel dorsal and ventral margins; moderate to marked dimorphism; reticulate ornament with narrow ridges and rounded fossae; secondary and tertiary ornament; irregular, massive ventral ridge; posterodorsal and posteroventral tubercles; wide, flat anterior marginal rim; moderate number of radial pores; sieve-type normal pores with recessed sieve plate; three frontal scars; and hinge with rimmed anterior socket and trifid anteromedian tooth.

**Description.**—Adult valves elongate, subquadrate in shape in lateral view. Dorsal and ventral margins straight, subparallel. Anterior margin evenly rounded, smoothly curved; posterior margin with small, truncated caudal process. Small blunt anterior and posterior marginal denticles. Posterior slightly convergent. Pronounced anterodorsal and posterodorsal cardinal angles, weaker posteroventral cardinal angle. Moderate dimorphism, with males longer, lower than females. Greatest length through midline of valve; greatest height through anterior hinge element.

Valve surface covered with reticulation network, arranged in concentric pattern at anterior and more chaotic at posterior. Large, high, semicircular subcentral tubercle. Flattened, predominantly smooth regions along anterior and posterior margins. Irregular, overhanging dorsal and ventral ridges. Secondary and tertiary ornament may be present. Irregularly shaped smooth eye spot. Sieve-type normal pores occur on reticulation ridges and solum floors. Recessed sieve plate, rimmed with thickened conulae.

Inner margin and line of concrescence generally coincide; small posterior vestibule may be present. Inner lamella moderately wide, of even width throughout, follows valve outline. Moderate number of simple, straight, long radial pores. Well-developed selvage.

Hingement in right valve consists of stepped anterior tooth; trifid, stepped anteromedian socket with thick ventral

rim; finely crenulate median groove; elongate posteromedian socket; and large, smooth, multilobate posterior tooth.

Central muscle scars occur in subcentral depression or muscle node. Dorsal adductor scar is single; dorsomedian and ventromedian scars split into two scars each; ventral scar is single. Frontal scar split into three scars. Numerous large dorsal muscle scars.

**Comparisons.**—*Laperousecythere* n. gen. differs from *Patagonacythere* Hartmann, 1962 of Benson (1964) (Holocene, Patagonia and Antarctica) by its shorter, higher profile in lateral view; irregular, massive ventral ridge; less organized reticulation pattern; two posterior tubercles located at end of ventral and dorsal ridges; wide anterior marginal flange; wide inner lamella; recessed sieve pores; and hinge with rimmed anterior socket and tripartite antero-medial tooth. *Laperousecythere* differs from *Australicythere* Benson, 1964 (Holocene, Antarctica and Argentina) by its strong, irregular ventral ridge; wide anterior marginal flange; two posterior tubercles located at end of ventral and dorsal ridges; few marginal denticles; fine reticulation ridges; rounded rather than polygonal fossae; recessed sieve plates; secondary pustulate ornament; fewer radial pores; three frontal scars; anterior socket hinge element with rim; and lack of a posterior ridge.

**Remarks.**—*Patagonacythere* was originally described by G. Hartmann (in Hartmann-Schroeder and Hartmann, 1962) from Patagonia, Argentina. Hartmann's illustrations of the carapace consisted of line drawings, which leave considerable uncertainty as to the nature of the surface ornament. Whatley recollected sediment from Hartmann's type locality in 1971 to examine topotype material of *Patagonacythere*. Species from the topotype locality demonstrate that *Patagonacythere tricostrata* Hartmann, 1962 is congeneric with *Ambostracon costatum* Hazel, 1962 (the type species of *Ambostracon*) (J.E. Hazel, Louisiana State University, written commun., 1986). *Patagonacythere* is therefore synonymous with *Ambostracon*. There are problems in demonstrating the priority of these two genera, and I do not provide here a cursory solution to a complex problem of synonymy.

*Patagonacythere* as described and illustrated by Benson (1964) is a completely different genus from Patagonia and Antarctica. Comparison of "*Patagonacythere*" *longiducta* specimens from Patagonia (collected by Whatley) differ from specimens of *Laperousecythere robusta*. *Laperousecythere* is similar, and possibly related by ancestry, to "*Patagonacythere*" of Benson and to *Australicythere*; all three genera belong to the Subfamily Urocythereidinae.

*Laperousecythere* is very common and characteristic of the cold-temperate Aleutian Province. Two species can be placed into the genus—*L. robusta* and *Patagonacythere yahtensis* (Tabuki, 1986).

**Distribution.**—Pleistocene through Holocene: Gulf of Alaska, Cook Inlet, Kodiak Shelf, south Bering Sea, northern Honshu (Japan). *Laperousecythere* is common in middle

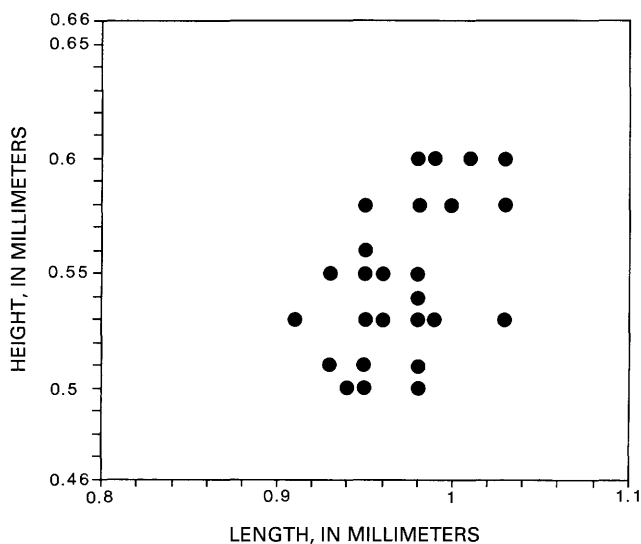


Figure 25. Plot of length versus height for *Laperousecythere robusta* (Tabuki, 1986).

to outer sublittoral habitats of the Gulf of Alaska (table 1). *Laperousecythere*, *Australicythere*, and "*Patagonacythere*" of Benson represent genera that are restricted geographically to polar regions. *Australicythere* and "*Patagonacythere*" live today in Argentine Patagonia and Antarctica, in climates ranging from cold-temperate to frigid. *Laperousecythere* is found in the Gulf of Alaska, south Bering Sea, and northern Honshu, Japan, in climates ranging from cold-temperate to subfrigid. The bipolar nature of these genera suggests that an ancestral taxon may have followed deeper, colder water isotherms toward the equator and emerged toward the poles.

#### LAPEROUSECYTHERE ROBUSTA (TABUKI, 1986)

Plate 10, figures 6–12; plate 11, figures 2, 3; text-figures 25, 26

*Patagonacythere robusta* Tabuki, 1986, p. 77–78, pl. 9, figs. 4–12; text-fig. 20–1.

"*Australicythere*" sp. A Brouwers, 1981, p. 8; Brouwers, 1982a, p. 11; Brouwers, 1982b, p. 8; Brouwers, 1982c, p. 2; Brouwers, 1983.

**Diagnosis.**—Characterized by subquadrate lateral outline; straight dorsum with overhanging ridge; wide caudal process with few blunt denticles; pronounced posterodorsal and anterodorsal cardinal angles; slight dimorphism; reticulate ornament arranged concentrically about subcentral tubercle; ventral ridge connecting to vertical posterior ridge and marginal anterior ridge; broad, flattened anterior and posterior rims; secondary pitting; tertiary papillae; recessed sieve plates; posterior vestibule; and deep ocular sinus.

**Measurements.**—Length-height plot based on 36 specimens (fig. 25).

**Remarks.**—*Laperousecythere robusta* is represented by hundreds of specimens of males, females, and juveniles.

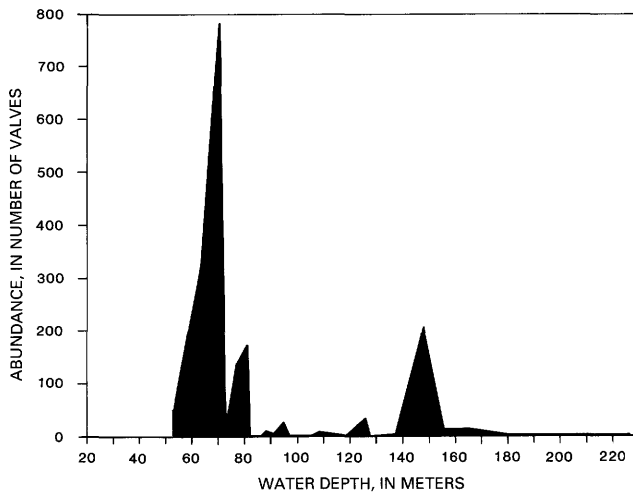


Figure 26. Plot of abundance versus water depth for *Laperousecythere robusta* (Tabuki, 1986).

Most of the occurrences are believed to be fossils, as the valves very rarely contain soft parts, and valves are predominantly opaque and weathered. Localities that contain *Laperousecythere* are on Tarr Bank, Fairweather Ground, and the platforms of Kayak, Montague, and Middleton Islands, all of which represent subcrops of the Yakataga Formation (Neogene and Quaternary).

**Occurrence.**—Assemblages II\*, III, V. Table 2.

**Distribution.**—Pliocene through Pleistocene: northern Honshu (Japan). Pleistocene through Holocene: Gulf of Alaska, Cook Inlet, Kodiak Island, Pribilof Islands. Middle-outer sublittoral (fig. 26).

**Material.**—354 adult valves, 1,625 juvenile valves.

**Illustrated specimens.**—USNM 408350, male left valve (pl. 11, fig. 2), cruise EGAL-75-KC, sample 52A, length 0.98 mm, height 0.58 mm. USNM 408351, female right valve (pl. 11, fig. 3), cruise EGAL-75-KC, sample 52A, length 0.96 mm, height 0.55 mm. USNM 408352, male right valve (pl. 10, figs. 6, 11), cruise EGAL-75-KC, sample 52A, length 0.95 mm, height 0.50 mm. USNM 408353, female left valve (pl. 10, fig. 7), cruise EGAL-75-KC, sample 52A, length 0.95 mm, height 0.58 mm. USNM 408354, female right valve (pl. 10, fig. 8), cruise EGAL-75-KC, sample 52A, length 0.95 mm, height 0.53 mm. USNM 408355, male left valve (pl. 10, figs. 9, 12), cruise EGAL-75-KC, sample 52A, length 0.98 mm, height 0.53 mm. USNM 408356, male left valve (pl. 10, fig. 10), cruise EGAL-75-KC, sample 52A, length 0.98 mm, height 0.58 mm.

*LAPEROUSECYTHERE YAHTSENSIS* N. SP.

Plate 10, figures 13–18; plate 11, figures 4, 5; plate 12, figures 1–10; text-figure 27

*Patagonacythere* sp. A Brouwers, 1981, p. 11; Brouwers,

1982b, p. 9; Brouwers, 1982c, p. 2; Brouwers, 1983; Tabuki, 1986, p. 52, text-fig. 13.

**Etyymology.**—After Yahtse Glacier, originating in the Chugach-Saint Elias Mountains, terminating in Icy Bay.

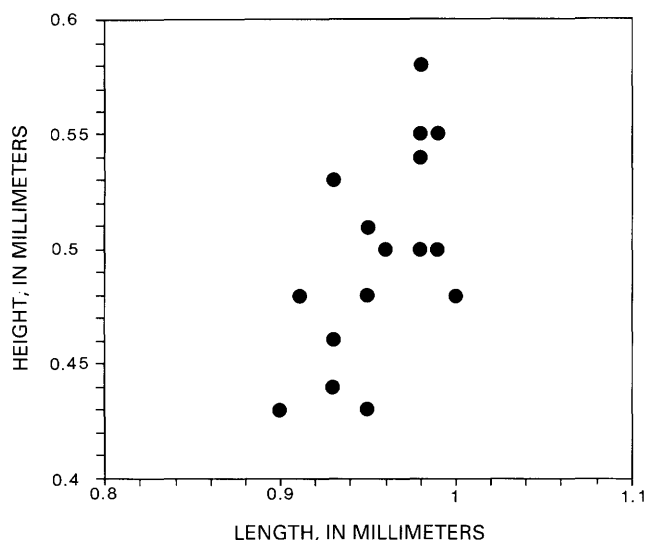
**Diagnosis.**—Characterized by elongate, subquadrate outline; extended anteroventral corner; straight, subparallel dorsal and ventral margins; drawn-out posteroventral corner, concave posterodorsum; marked dimorphism; radially arranged reticulation; heavy, irregular ventral ridge; J-shaped posterodorsal ridge; wide, arcuate flat posterior region; oblique J-shaped anterodorsal ridge; anterior margin with flange and thin ridge; secondary papillae and corrugations.

**Description.**—Adult valves elongate, subquadrate in lateral view. Dorsal margin straight; anterior margin smoothly curved with ventrally extended corner; ventral margin straight, subparallel to dorsal margin; posterior margin truncated, with blunt caudal process, drawn-out posteroventral corner, and concave posterodorsal region. Pronounced posterodorsal cardinal angle; obtuse anterodorsal cardinal angle with raised margin or hinge ear due to large anterior hinge element. Posteroventral margin with five blunt, thickened marginal denticles; anterior margin with numerous small, fine denticles. Left valve with pronounced anterodorsal cardinal angle; less overhanging anteroventral corner; weak concavity; and drawn-out posterior. Marked dimorphism: males with more elongate, lower lateral outline; drawn-out posterior end; and less calcified, thinner reticulation ridges. Greatest length through midline; greatest height through anterior hinge element.

Valve surface reticulate, with subcentral tubercle, ridges, and large ovoid eye tubercle. Reticulation arranged radially about subcentral tubercle. Heavily calcified, irregular ventral ridge extends obliquely nearly the valve length, terminating posteriorly as a tubercle. Posterodorsal corner with thick, massive, J-shaped ridge. Irregular, angular dorsal ridge overhangs most of margin. Posterior margin has wide, arcuate, flattened region; flattened region is smooth in females, covered with reticulation in males. Thick, J-shaped ridge proceeds from eye tubercle obliquely toward prominent, hemispherical subcentral tubercle. Anterior margin with narrow flange and parallel, thin marginal ridge. Secondary fine papillae and delicate corrugations on solum floors. 75 sieve-type normal pores evenly distributed over surface, occurring on reticulation ridges and as celate pores with apophysis. Recessed sieve plate, rimmed by thickened conulae.

Inner margin and line of concrescence coincide throughout. Inner lamella of even width throughout, follows valve outline. 51 radial pores, most anterior. Radial pores are long, straight, simple. Well-developed selvage. Small, elongate ocular sinus.

Hingement in right valve consists of bifid anterior tooth; large ovoid socket with heavy ventral rim; smooth median groove; and large, multilobate posterior tooth.



**Figure 27.** Plot of length versus height for *Laperousecythere yahtsensis* n. gen. n. sp.

Central muscle scars in subcentral depression or muscle tubercle. Adductor muscle scars form inclined row, occurring on steep posterior side of depression. Dorsal scar boomerang-shaped; dorsomedian scar split into posterior ovoid scar and anterior elongate scar; ventromedian scar split into posterior narrow elongate scar and anterior shorter, elongate scar; ventral scar very elongate, sinuous. Three small, sub-void frontal scars located along steep anterior side of muscle node. Few, large dorsal muscle scars.

**Measurements.**—Length-height plot based on 20 specimens (fig. 27).

**Comparisons.**—*Laperousecythere yahtsensis* n. sp. differs from *Patagonacythere dubia* (Brady, 1868) (Quaternary, North Atlantic) by its elongate, quadrate valve outline; pronounced dimorphism; fine reticulation ridges; wide anterior rim; lack of vestibular space; numerous radial pores; and hinge with smooth median element and strong ventral rim below anterior element.

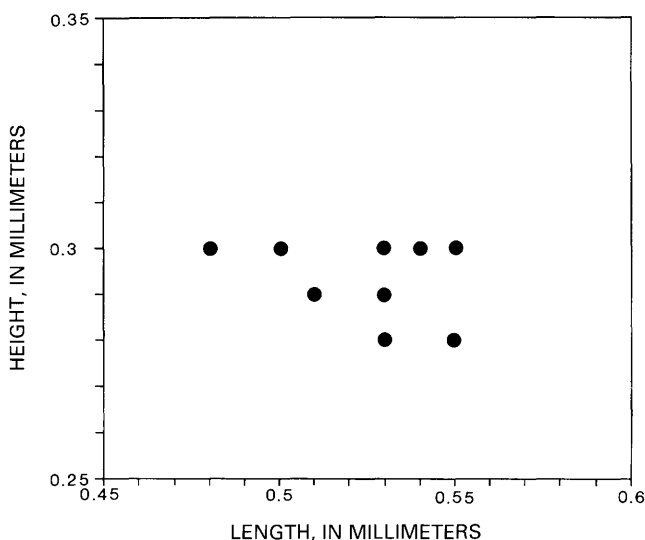
**Occurrence.**—Cruise EGAL-75-KC, samples 28, 32, 35, 39, 52A, 144U. Assemblage V. Table 2.

**Distribution.**—Pleistocene, Holocene(?): Gulf of Alaska, Cook Inlet and Kodiak Shelf, Pribilof Islands.

**Material.**—37 adult valves, 25 juvenile valves.

**Type specimens.**—Holotype: USNM 408357, female left valve (pl. 11, fig. 4), cruise EGAL-75-KC, sample 144U, length 0.93 mm, height 0.53 mm.

Paratypes: USNM 408358, male left valve (pl. 11, fig. 5), cruise EGAL-75-KC, sample 144U, length 0.98 mm, height 0.50 mm. USNM 408359, female left valve (pl. 10, fig. 13), cruise EGAL-75-KC, sample 52A, length 0.98 mm, height 0.58 mm. USNM 408360, female right valve (pl. 10, fig. 14), cruise EGAL-75-KC, sample 52A, length 0.98 mm, height 0.55 mm. USNM 408361, female right valve (pl. 10, figs. 15, 17, 18), cruise EGAL-75-KC, sample 28, length 0.98 mm, height 0.54 mm. USNM 408362, female left valve



**Figure 28.** Plot of length versus height for *Elofsonia susitnensis* Forester and Brouwers, 1985.

(pl. 10, fig. 16; pl. 12, fig. 1), cruise EGAL-75-KC, sample 28, length 0.98 mm, height 0.58 mm. USNM 408363, male right valve (pl. 12, figs. 2, 4), cruise EGAL-75-KC, sample 52A, length 0.90 mm, height 0.43 mm. USNM 408364, male left valve (pl. 12, fig. 3), cruise EGAL-75-KC, sample 52A, length 0.95 mm, height 0.43 mm. USNM 408365, female right valve (pl. 12, figs. 5, 6, 9), cruise EGAL-75-KC, sample 35, length 0.95 mm, height 0.48 mm. USNM 408366, male left valve (pl. 12, fig. 7), cruise EGAL-75-KC, sample 52A, length 1.00 mm, height 0.48 mm. USNM 408367, male right valve (pl. 12, fig. 8), cruise EGAL-75-KC, sample 35, length 0.96 mm, height 0.50 mm. USNM 408368, male right valve (pl. 12, fig. 10), cruise EGAL-75-KC, sample 52A, length 0.95 mm, height 0.48 mm.

Family LOXOCONCHIDAE Sars, 1925

Genus *ELOFSONIA* Wagner, 1957

**Type species.**—*Loxoconcha baltica* Hirschmann, 1909 (Type by subsequent designation.)

*ELOFSONIA SUSITNENSIS* FORESTER AND  
BROUWERS, 1985

Plate 12, figures 11, 12; text-figure 28

*Elofsonia susitnensis* Forester and Brouwers, 1985, p. 353–357, figs. 3.1–3.8, 7.3–7.4.

*Elofsonia* sp. A Brouwers, 1981, p. 10; Brouwers, 1982a, p. 9; Brouwers, 1983.

**Diagnosis.**—Characterized by reversed hingement relative to type species; simple-type normal pores; weakly developed, nonpapillate marginal reticulation; smooth median valve area; arched dorsum; prominent, squared cardinal angles; and continuous, arcuate vestibule.

**Measurements.**—Length-height plot based on 12 specimens (fig. 28).

**Occurrence.**—Assemblages I\*, II. Table 2.

**Distribution.**—Upper Pleistocene through Holocene: Gulf of Alaska, Prince William Sound, Norton Sound, Alaskan North Slope. Inner-middle sublittoral.

**Material:** 26 adult valves, 3 juvenile valves.

**Illustrated specimens.**—USNM 408369, left valve (pl. 12, fig. 11), cruise DC2-80-EG, sample 27, length 0.53 mm, height 0.29 mm. USNM 408370, right valve (pl. 12, fig. 12), cruise EGAL-75-KC, sample 144U, length 0.55 mm, height 0.28 mm.

Genus *LOXOCONCHA* Sars, 1866

**Type species.**—*Cythere rhomboidea* Fischer, 1855 (Type by subsequent designation.)

*LOXOCONCHA LUCIENSIS* N. SP.

Plate 13, figures 1, 2; plate 14, figures 4, 5; text-figure 29

*Loxoconcha* sp. F Brouwers, 1981, p. 11; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

**Etymology.**—After Lucia Glacier, an eastern arm of Malaspina Glacier.

**Diagnosis.**—Characterized by small size; rounded, subtriangular lateral outline; and retention of penultimate molt.

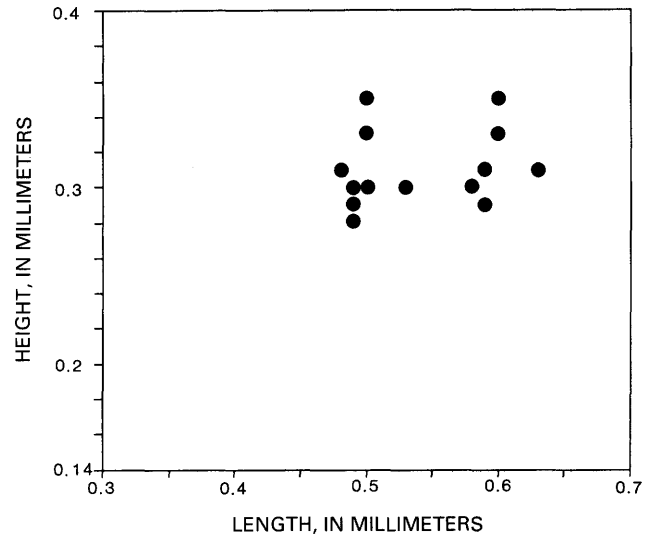
**Description.**—Adult valves short, subtriangular in lateral outline. Dorsal margin straight, inclined obliquely toward posterior; anterior margin evenly curved, smoothly rounded; ventral margin broadly concave, inclined sharply toward posterior; posterior margin truncated, with maximum width dorsal of midline. Posterior end narrow, convergent. Obtuse, rounded anterodorsal corner; sharp, slightly obtuse posterodorsal cardinal angle. Greatest length dorsal of midline; greatest height through anterior hinge element.

Valve surface covered with reticulation and ridges. Reticulation network consists of broad ridges with small ovoid pits or solums. Anterior and posterior margins with several rows of thin, parallel, concentric marginal ridges. Posterior with smooth marginal flange. Adult valves retain penultimate molt stage as part of valve surface. 26–27 normal pores evenly distributed over surface, occurring on reticulation ridges.

Inner margin and line of concrescence coincide throughout. Inner lamella widest at anterior; inner margin parallels valve outline. Very strong selvage. 6–10 radial pore canals, most anterior. Radial pores are moderate in length, straight, simple.

Hingement in right valve consists of anterior tripartite element—small quadrate socket, large knoblike tooth, and small quadrate socket; weakly crenulate median groove; and curved, dumbbell-shaped posterior tooth.

Four adductor muscle scars form slightly inclined row. Dorsal scar is ellipsoidal; dorsomedian scar is subquadrate; ventromedian scar is small, ovoid; ventral scar is subcircular.



**Figure 29.** Plot of length versus height for *Loxoconcha luciensis* n. sp.

Frontal muscle scar is broad, inflated, U-shaped. Two adjacent subovoid-elongate mandibular scars.

**Measurements.**—Length-height plot based on four specimens (fig. 29).

**Remarks.**—This taxon is not similar to any described species from the North Pacific and is unusual in retaining the penultimate molt. *L. luciensis* is a rare element in the Gulf of Alaska; I believe that its occurrence is fossil.

**Occurrence.**—Cruise EGAL-75-KC, samples 86, 221. Cruise DC2-80-EG, sample 195. Assemblages II, V. Table 2.

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

**Type specimens.**—Holotype: USNM 408379, left valve (pl. 13, fig. 1), cruise DC2-80-EG, sample 195, length 0.38 mm, height 0.20 mm.

Paratypes: USNM 408380, right valve (pl. 13, fig. 2), cruise DC2-80-EG, sample 195, length 0.35 mm, height 0.23 mm. USNM 408381, left valve (pl. 14, fig. 4), cruise EGAL-75-KC, sample 86, length 0.40 mm, height 0.25 mm. USNM 408382, right valve (pl. 14, fig. 5), locality EGAL-75-KC, sample 86, length 0.38 mm, height 0.28 mm.

*LOXOCONCHA* SP. G

Plate 13, figure 7

**Diagnosis.**—Characterized by rhomboid lateral outline; continuously curved, convex dorsum; anterior margin with maximum width ventral of midline; pronounced concavity; small, blunt caudal process located dorsal of midline; smoothly rounded lateral outline; smooth valve surface; deep, arcuate anterior vestibule; and shallow, continuous, crescentic posterior and posteroventral vestibule.

**Occurrence.**—Cruise EGAL-75-KC, sample 12B. Table 2.

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

**Material.**—1 adult valve.

**Illustrated specimen.**—USNM 408397, female left valve (pl. 13, fig. 7), cruise EGAL-75-KC, sample 12B, length 0.55 mm, height 0.38 mm.

Genus *SAGMATOCYTHERE* Athersuch, 1976

**Type species.**—*Loxoconcha napoliana* Puri, 1963 (Type by subsequent designation.)

*SAGMATOCYTHERE GOMBOSI* N. SP.

Plate 11, figures 7, 8; plate 12, figures 13–18; plate 14, figures 1, 2; text figure 30

*Loxoconcha* sp. E Brouwers, 1981, p. 10; Brouwers, 1982a, p. 9; Brouwers, 1983.

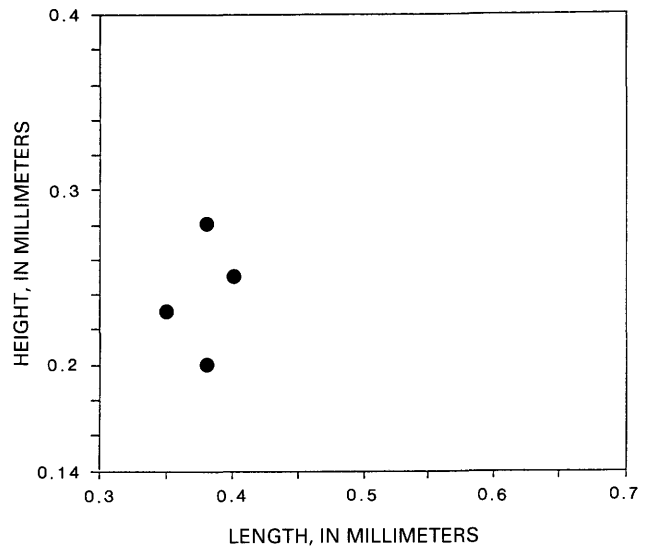
**Etymology.**—After Andrew Gombos, Exxon Production Research, Houston, a specialist in marine diatoms.

**Diagnosis.**—Characterized by subquadrate to subrectangular lateral outline; straight dorsum; pronounced dimorphism; reticulation large scale in males, fine scale in females; concentric anterior reticulation; overhanging ventral ridge with posteroventral tubercle; anterior and posterior smooth, flat marginal flange; small eye spot; coincident inner margin and line of concrescence.

**Description.**—Adult valves subquadrate to subrectangular in lateral outline. Dorsal margin straight; anterior margin smoothly curved; ventral margin broadly curved, with shallow vestibule; posterior margin truncated; well-developed, obtuse posterodorsal and anterodorsal cardinal angles. Pronounced dimorphism: males considerably longer than females. Greatest length through midline; greatest height through anterior hinge element.

Surface covered with reticulation of various sizes. Males with large reticulation, forming large ovoid to polygonal solums. Females with fine-scale reticulation, forming pattern with small ovoid solums. Reticulation pattern concentric along anterior margin and irregular elsewhere. Low ventral ridge overhangs venter, ending posteroventrally as large tubercle. Anterior and posterior margins have moderate, smooth, flattened flange. Central muscle-scar field reflected externally in shape and arrangement of larger median pits. Small, smooth, ellipsoidal eye spot. 47–49 sieve-type normal pores evenly distributed over surface, occurring on ridges. Recessed sieve plate and subcentral setal opening.

Inner margin and line of concrescence coincide throughout; inner margin parallels valve outline. Inner lamella widest at anterior. Weakly developed selvage. 9–13 radial pores, most anterior; radial pores are straight, simple.



**Figure 30.** Plot of length versus height for *Sagmatocythere gombosi* n. sp.

Hinge in left valve consists of tripartite anterior complex of rounded tooth, ovoid socket with thickened dorsal rim, and small ovoid tooth; smooth median bar; and tripartite posterior complex of small socket, rounded knoblike tooth, and small socket.

Four adductor muscle scars form vertical row. Dorsal scar is semicircular; dorsomedian scar is elongate, quadrate; the ventromedian scar is elongate, subquadrate; ventral scar is semicircular. U-shaped frontal scar. Pronounced ovoid fulcral point adjacent to median scars. Dorsal muscle scars are small, irregular in shape, few in number.

**Measurements.**—Length-height plot based on 14 specimens (fig. 30).

**Comparisons.**—*Sagmatocythere gombosi* n. sp. differs from *Loxoconcha subkotoriforma* Ishizaki, 1966 (Pliocene through lower Pleistocene, central Japan) by its straight to slightly concave dorsum; coarse reticulum; large posteroventral tubercle; anterior and posterior marginal flanges; strong, overhanging ventral ridge.

**Occurrence.**—Cruise EGAL-75-KC, samples 32, 34, 46, 52A, 144U, 159, 181. BFM-78-1. Assemblage V.

**Distribution.**—Pleistocene, Holocene(?): Gulf of Alaska, Cook Inlet, Kodiak Shelf, Pribilof Islands.

**Material.**—28 adult valves, 11 juvenile valves.

**Type specimens.**—Holotype: USNM 408371, female left valve (pl. 11, fig. 7), cruise EGAL-75-KC, sample 32, length 0.53 mm, height 0.33 mm.

**Paratypes:** USNM 408372, male left valve (pl. 11, fig. 8), cruise EGAL-75-KC, sample 32, length 0.60 mm, height 0.33 mm. USNM 408373, female left valve (pl. 12, fig. 13), cruise EGAL-75-KC, sample 34, length 0.49 mm, height 0.28 mm. USNM 408374, female right valve (pl. 12, fig. 14), cruise EGAL-75-KC, sample 32, length 0.50 mm, height 0.33 mm.

0.33 mm. USNM 408375, female left valve (pl. 12, fig. 15), cruise EGAL-75-KC, sample 52A, length 0.48 mm, height 0.31 mm. USNM 408376, male left valve (pl. 12, figs. 16, 17), cruise EGAL-75-KC, sample 34, length 0.59 mm, height 0.31 mm. USNM 408377, male right valve (pl. 12, fig. 18), cruise EGAL-75-KC, sample 32, length 0.63 mm, height 0.31 mm. USNM 408378, female left valve (pl. 14, figs. 1, 2), cruise EGAL-75-KC, sample 52A, length 0.50 mm, height 0.35 mm.

Genus *PALMOCONCHA* Swain and Gilby, 1974

*Type species.*—*Palmoconcha laevimarginata* Swain and Gilby, 1974 (Type by original designation.)

*PALMOCONCHA RUSSELLIENSIS* N. SP.

Plate 13, figures 3, 4; plate 14, figures 3, 6–12; text-figures 31, 32

*Loxoconcha* sp. A Brouwers, 1981, p. 10; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

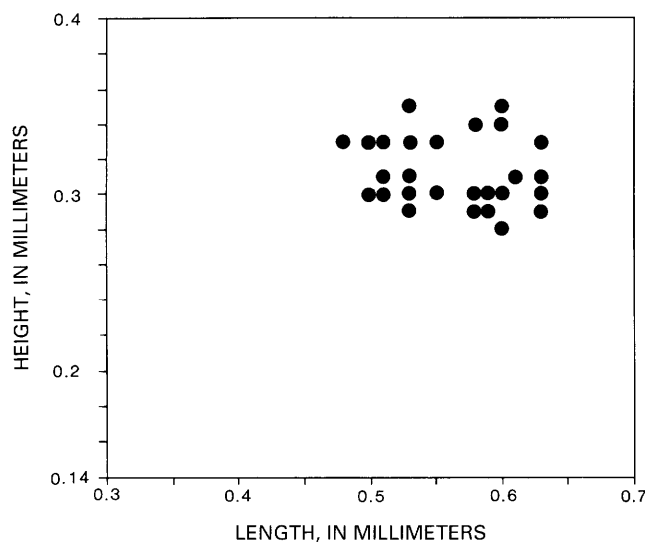
*Eymology.*—After Russell Fiord, the eastern arm of Yakutat Bay.

*Diagnosis.*—Characterized by subovoid to subquadrate lateral outline; straight dorsum; shallow concavity; pronounced dimorphism; pitted ornament arranged concentrically; series of low, parallel marginal ridges; anterior and posterior margins with smooth, flattened flange; small eye spot.

*Description.*—Adult valves subovoid to subquadrate in lateral view. Dorsal margin straight; anterior margin broadly rounded, with greatest extent ventral of midline; obtuse anterodorsal cardinal angle; ventral margin arched, with broad, shallow concavity; posterior margin broadly curved; obtuse posterodorsal cardinal angle. Pronounced dimorphism: males considerably longer, slightly lower than females, with stronger cardinal angles; females with arched dorsal margin. Greatest length through midline; greatest height through median hinge element.

Valve surface covered with ovoid pitting of various sizes, arranged concentric and parallel to valve outline. Series of low marginal ridges separate rows of pits along anterior, ventral, and posterior margins. Pits are large at middle of valve, becoming smaller marginally. Anterior and posterior margins have large, smooth, flattened flange. Central muscle-scar field reflected externally in shape and arrangement of larger median pits. Small, smooth, elongate eye spot. Convex ventral ridge overhangs concavity. 50–61 sieve-type normal pores evenly distributed over valve, occurring between pits and on marginal ridges. Recessed sieve plate and marginal setal opening.

Inner margin and line of concrescence coincide at venter. Shallow, arcuate anterior and posterior vestibules. Inner lamella widest at anterior; inner margin parallels valve outline. Well-developed selvage. Small ovoid ocular socket.



**Figure 31.** Plot of length versus height for *Palmoconcha russelliensis* n. sp.

15–18 radial pores, 1 false radial pore; pores are straight, short, simple.

Hinge in left valve consists of anterior quadrate socket and large rounded tooth; finely crenulate median groove; and tripartite posterior tooth-socket-tooth complex. Posterior complex consists of central rounded socket with dorsal rim and adjacent rounded tooth on each side; dorsal rim is continuous with teeth, forming dumbbell shape.

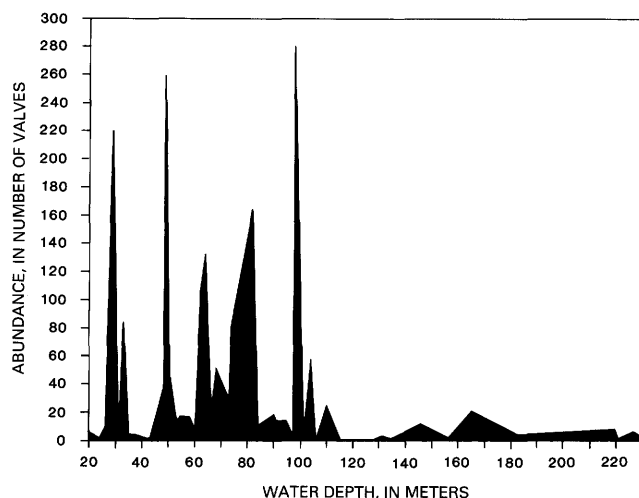
Four adductor muscle scars form arcuate row. Dorsal scar is ovoid; dorsomedian scar is subquadrate, with inflated posterior; ventromedian scar is narrow, elongate, with enlarged posterior; ventral scar is semicircular. Frontal scar is rounded, ovoid shape. Pronounced fulcral point with deep impression, rimmed anterodorsally by thickened shell material. Dorsal muscle scars are small, irregular in shape, few in number.

*Measurements.*—Length-height plot based on 36 specimens (fig. 31).

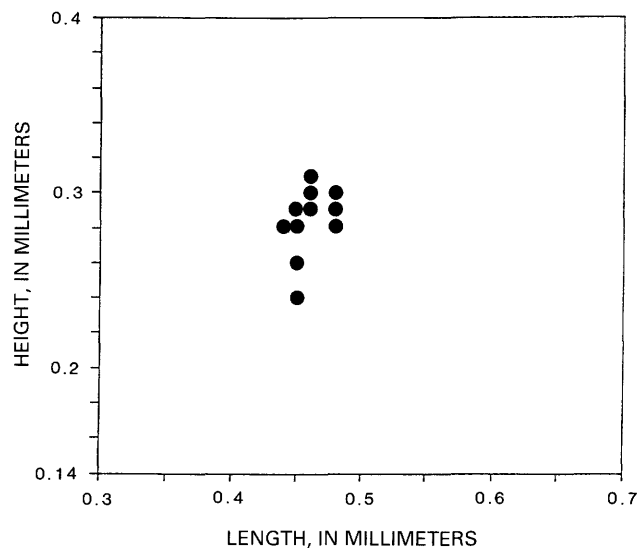
*Comparisons.*—*Palmoconcha russelliensis* n. sp. differs from *Loxoconcha japonica* Ishizaki, 1971 (Holocene, northeast Honshu) by its quadrate shape; convex venter; anterior and posterior marginal flanges; well-defined anterodorsal cardinal angle; and lack of sharp caudal process. *P. russelliensis* differs from *L. uranouchiensis* Ishizaki, 1968 (Quaternary, central Japan) by its straight dorsum; anterior and posterior marginal flanges; ovoid fossae; and hinge with large anterior tooth and elongate dumbbell-shaped posterior tooth. *P. russelliensis* differs from *L. helenae* Crouch, 1949 (Quaternary, central-northern California) by its narrow anterior and posterior marginal flanges; pointed posterior end; overhanging ventral ridge; and rounded, ovoid lateral outline.

*Occurrence.*—Assemblages I\*, II\*, III\*, IV\*. Table 2.





**Figure 32.** Plot of abundance versus water depth for *Palmoconcha russellensis* n. sp.



**Figure 33.** Plot of length versus height for *Palmoconcha krausei* n. sp.

**Distribution.**—Pleistocene through Holocene: Gulf of Alaska, Cook Inlet and Kodiak Shelf, Pribilof Islands. Sublittoral, upper bathyal (fig. 32).

**Material.**—1,150 adult valves, 1421 juvenile valves.

**Type specimens.**—Holotype: USNM 408383, female left valve (pl. 13, fig. 3), cruise DC2-80-EG, sample 195, length 0.53 mm, height 0.33 mm.

**Paratypes:** USNM 408384, male left valve (pl. 13, fig. 4), cruise DC2-80-EG, sample 195, length 0.60 mm, height 0.30 mm. USNM 408385, female left valve (pl. 14, fig. 3), cruise DC2-80-EG, sample 195, length 0.53 mm, height 0.35 mm. USNM 408386, female right valve (pl. 14, fig. 6), cruise DC2-80-EG, sample 195, length 0.50 mm, height 0.33 mm. USNM 408387, male left valve (pl. 14, figs. 7, 9), cruise DC2-80-EG, sample 63, length 0.60 mm, height 0.28 mm. USNM 408388, male right valve (pl. 14, fig. 8), cruise DC2-80-EG, sample 195, length 0.63 mm, height 0.33 mm. USNM 408389, female right valve (pl. 14, fig. 10), cruise DC2-80-EG, sample 195, length 0.48 mm, height 0.33 mm. USNM 408390, male left valve (pl. 14, figs. 11, 12), cruise DC2-80-EG, sample 195, length 0.63 mm, height 0.29 mm.

*PALMOCONCHA KRAUSEI* N. SP.

Plate 13, figures 5, 6; plate 14, figures 13–15; plate 15, figures 1–3, 6; text-figure 33

*Loxoconcha* sp. D Brouwers, 1981, p. 10; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

*Loxoconcha* sp. A Valentine, 1976, p. 23, pl. 7, figs. 4, 5.

**Etymology.**—After Professor Mary Kraus, University of Colorado, Boulder, who specializes in clastic sedimentology.

**Diagnosis.**—Characterized by subquadrate to subrectangular lateral outline; straight dorsum, converging at poste-

rior; broad, pronounced concavity; truncated posterior; pronounced dimorphism; males with fine-scale reticulate ornament; flat ridges; anterior and posterior margins with narrow, smooth flange; ovoid eye spot; shallow, arcuate anterior vestibule.

**Description.**—Adult valves subquadrate to subrectangular in lateral view. Dorsal margin straight, converging at posterior; anterior margin smoothly curved; ventral margin sinuous, with broad, pronounced concavity; posterior margin truncated; subdued, obtuse anterodorsal and posterodorsal cardinal angles. Pronounced dimorphism: males considerably longer, lower than females, with less extended posteroventral margin. Greatest length through midline; greatest height through anterior hinge element.

Valve surface covered with reticulation pattern forming large ovoid to elongate ellipsoidal solums. Valves are laterally flattened with no pronounced ridges. Females with large-scale reticulation; males with finer reticulation pattern. Anterior and posterior margins have narrow, smooth, flattened flange. Central muscle-scar field reflected externally in shape and arrangement of large median pits. Large, smooth, ovoid eye spot. 50–57 normal pores evenly distributed over surface, on reticulation ridges.

Inner margin and line of concrescence coincide at posterior and venter; shallow, arcuate anterior vestibule. Inner lamella widest at anterior. Moderately developed selvage. Seven to twelve radial pore canals, most anterior. Radial pores are short, straight, simple.

Hinge in left valve consists of anterior tripartite complex, with anterior bifid tooth, large, subquadrate median socket, and small ovoid posterior tooth; finely crenulate median bar; and posterior tripartite complex with anterior triangular socket, cylindrical median tooth, and large, ovoid,

posterior socket. Both anterior and posterior hinge elements open to valve interior at venter; anterior socket has thickened dorsal rim.

Four adductor muscle scars form vertical row. Dorsal scar is elongate, subquadrate; dorsomedian scar is elongate, I-shaped; ventromedian scar is elongate with inflated posterior; and ventral scar is semicircular. Fulcral point is deep, large, with prominent, thickened anterodorsal rim. Two adjacent subovoid mandibular scars located ventral of central scar field. Numerous, large, elongate dorsal scars between central scar field and hinge.

*Measurements.*—Length-height plot based on 19 specimens (fig. 33).

*Comparisons.*—*Palmoconcha krausei* n. sp. differs from *Loxoconcha helenae* Crouch, 1949 (Quaternary, central-northern California) by its narrow width; squared outline; narrow anterior and posterior marginal rims; inclined, convergent dorsum; pronounced dimorphism; low reticulation; and pronounced concavity. *P. krausei* differs from *L. uranouchiensis* Ishizaki, 1968 (Quaternary, central Japan) by its squared lateral outline; straight, inclined dorsum; anterior and posterior marginal flanges; rounded fossae; few radial pores; wide vestibule; strong anterior hinge tooth; and lack of terminal crenulae on the median hinge element.

*Occurrence.*—Cruise EGAL-75-KC, localities 11, 109, 115, 122A, 128, 134, 157, 159, 181, 422. Cruise DC1-79-EG, localities 45, 47. Cruise DC2-80-EG, localities 186, 195. Assemblage V. Table 2.

*Distribution.*—Middle Pliocene through Holocene: central and northern California, Washington, Oregon, Gulf of Alaska; warm- to cold-temperate marine climates.

*Material.*—72 adult valves, 33 juvenile valves.

*Type specimens.*—Holotype: USNM 408391, female left valve (pl. 13, fig. 5), cruise DC2-80-EG, sample 195, length 0.45 mm, height 0.28 mm.

Paratypes: USNM 408392, male left valve (pl. 13, fig. 6), cruise DC2-80-EG, sample 195, length 0.45 mm, height 0.24 mm. USNM 408393, female left valve (pl. 14, fig. 13), cruise DC2-80-EG, sample 195, length 0.48 mm, height 0.28 mm. USNM 408394, female right valve (pl. 14, fig. 14), cruise DC2-80-EG, sample 195, length 0.46 mm, height 0.29 mm. USNM 408395, male left valve (pl. 14, fig. 15; pl. 15, fig. 1), cruise DC2-80-EG, sample 195, length 0.45 mm, height 0.26 mm. USNM 408396, female left valve (pl. 15, figs. 2, 3, 6), cruise DC2-80-EG, sample 195, length 0.45 mm, height 0.24 mm.

Genus *LOXOCONCHIDEA* Bonaduce,  
Ciampo, and Masoli, 1976

*Type species.*—*Loxoconchidea minima* Bonaduce, Ciampo, and Masoli, 1976 (Type by original designation.)

# *LOXOCONCHIDEA DOLGOIENSIS* N. SP.

Plate 11, figure 6; plate 15, figures 4, 5, 7–16; text-figures 34, 35

*Loxoconcha* sp. B Brouwers, 1981, p. 10; Brouwers, 1982a, p. 12; Brouwers, 1982b, p. 9; Brouwers, 1983.

*Basslerites?* sp. Ishizaki and Matoba, 1985, p. 9, pl. 2, figs. 3, 4.

*Etymology.*—After Dolgoi Island northeast of Yakutat, southeast Alaska.

*Diagnosis.*—Characterized by elongate, ellipsoidal lateral outline; moderate dimorphism; smooth valve surface; anterior, posterior and ventral margins with flat flange or rim; two types of sieve-type normal pores: one without discrete sieve plate and one with recessed sieve plate rimmed by conulae; continuous vestibular space along anterior, venter, and posterior; split frontal scar.

*Description.*—Valves elongate, ellipsoidal in lateral view. Dorsal margin broadly arched; anterior margin evenly rounded, smoothly curved; ventral margin sinuous with broad, shallow concavity; posterior margin smoothly curved, with greatest width dorsal of midline. Dorsal and ventral margins converge posteriorly. No cardinal angles; valve outline smoothly curved. Left valve with pronounced posterodorsal corner; less convergent posterior; and high anterior. Moderate dimorphism: males have shorter, lower valve outline; more convergent posterior; low anterior; and shallow concavity. Greatest length through midline of valve; greatest height through anterior hinge element.

Valve surface completely smooth. Anterior, posterior, and ventral margins with narrow, flat flange or rim. 46–55 sieve-type normal pores evenly distributed over surface. Two different normal pores: one lacks a discrete sieve plate, with the sieve continuous with valve surface. This pore type is circular to elongate-ovoid, with setal opening at edge of sieve. The second normal pore type consists of smaller, discrete sieve plate, recessed into pore; pore is rimmed by thickened conulae.

Inner margin and line of concrescence do not coincide; continuous vestibular space occupies anterior, ventral, and posterior margins. Deep, crescentic anterior vestibule, thins along venter, and is thinnest above concavity. Deep, arcuate posterior vestibule. Inner margin parallels valve outline; inner lamella very wide at anterior, shallower along venter and posterior. Moderately developed selvage. 18–27 radial pore canals, four false radial pore canals; radial pores long, straight, simple.

Hingement in right valve consists of anterior tripartite complex consisting of socket-tooth-socket; smooth median groove; and posterior tripartite complex consisting of narrow elongate tooth, ellipsoidal high tooth, and low subquadrate tooth. Dorsal edge of right valve enfolded to receive left valve as accommodation groove.

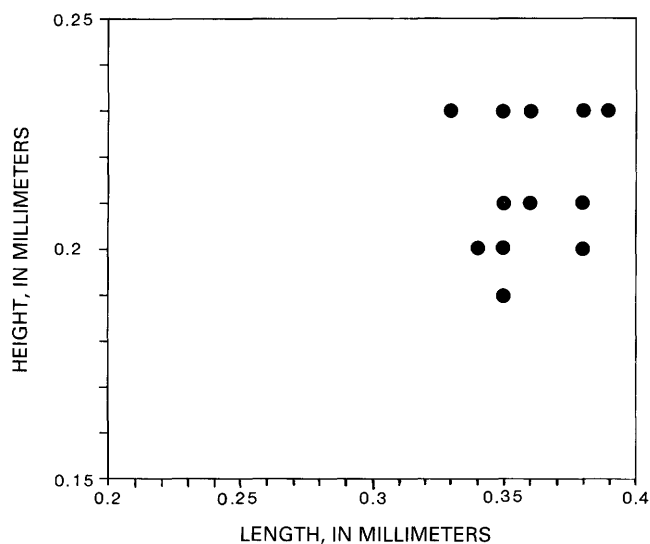


Figure 34. Plot of length versus height for *Loxoconchidea dolgoiensis* n. sp.

Four adductor muscle scars form inclined row. Dorsal scar is semicircular; dorsomedian scar is elongate, subrectangular; ventromedian scar is elongate, with inflated posterior; ventral scar is subcylindrical. Frontal scar split into large, inflated, kidney-shaped posterior scar and smaller, circular, anterior scar. Two small, subovoid mandibular scars. Many dorsal muscle scars, most very large, prominent.

**Measurements.**—Length-height plot based on 35 specimens (fig. 34).

**Comparisons.**—*Loxoconchidea dolgoiensis* n. sp. is similar to *Palmoconcha laevata* (Norman, 1865) (Quaternary, North Atlantic) in valve shape and outline, smooth valve surface, prominent anterior marginal rim, and subtle dimorphic differences. *L. dolgoiensis* differs by its less extended marginal rim, particularly along posterior; split rather than Y-shaped frontal scar; details of anterior and posterior hinge elements; and lack of prominent caudal process. *L. dolgoiensis* differs from *L. minima* Bonaduce, Ciampo, and Masoli, 1976 (Holocene, Bay of Naples) by its rounded outline; weak concavity; strong selvage; deep anterior vestibule; two types of sieve-type normal pores; split frontal, unsplit adductors; moderate dimorphism.

**Remarks.**—*Loxoconchidea* was described by Bonaduce, Ciampo, and Masoli (1976) from Holocene sediments of the Bay of Naples, where it forms a rare element of the middle and outer sublittoral depth zones. A.R. Lord (University College, London, written commun., 1986) has found specimens of *Loxoconchidea* in subsurface sediments of the North Sea, near the Pleistocene-Holocene boundary. The form identified as *Basslerites?* sp. by Ishizaki and Matoba (1985) is morphologically identical to *L. dolgoiensis*, and I have synonymized the taxa. The internal features of *Basslerites?* sp. were not illustrated by Ishizaki and Matoba (1985).

The elongate quadrate shape and marginal rim of *Loxoconchidea* are features shared by some species of *Palmocon-*

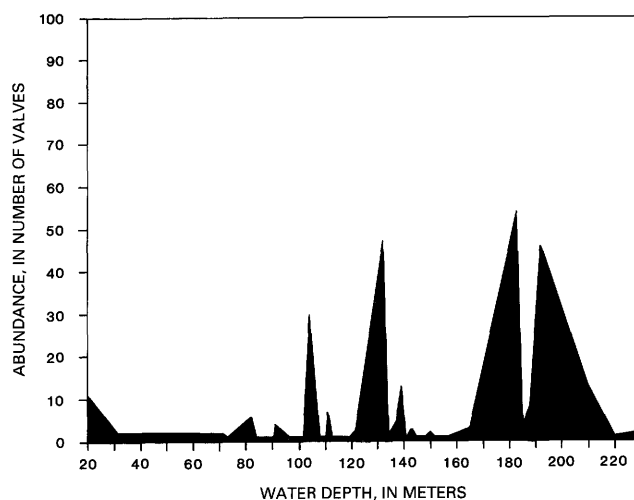


Figure 35. Plot of abundance versus water depth for *Loxoconchidea dolgoiensis* n. sp.

*cha* and *Hirschmannia*. *Palmoconcha* was described by Swain and Gilby (1974) for a Holocene Pacific subtropical loxoconchid with flattened, flangelike margins and coarsely pitted or reticulate ornament. Horne and Kilenyi (1981) described a loxoconchid genus from the North Atlantic, *Lindisfarnia*, which was subsequently synonymized with *Palmoconcha* (Horne and Whatley, 1985). *Hirschmannia* was described by Elofson (1941) for a Holocene loxoconchid with a compressed kidney shape, no caudal process, strong concavity, small marginal rim, and wide inner margin. *Loxoconchidea* is similar in having truncated anterior and posterior ends, narrow marginal rims, wide inner margin, and no caudal process; it differs in a large anterior vestibular space, marked dimorphism, elongate quadrate shape, two types of normal pores, and split frontal scar.

**Occurrence.**—Assemblages II\*, III\*, IV\*. Table 2.

**Distribution.**—Lower Pleistocene: central Japan. Pleistocene through Holocene: northeast Gulf of Alaska, Cook Inlet, Kodiak Shelf, North Sea. Middle-outer sublittoral, upper bathyal (fig. 35).

**Material.**—274 adult valves, 34 juvenile valves.

**Type specimens.**—Holotype: USNM 408398, left valve (pl. 11, fig. 6), cruise EGAL-75-KC, sample 105, length 0.39 mm, height 0.23 mm.

Paratypes: USNM 408399, female left valve (pl. 15, fig. 4), cruise DC2-80-EG, sample 186, length 0.35 mm, height 0.20 mm. USNM 408400, female right valve (pl. 15, figs. 5, 11), cruise DC2-80-EG, sample 186, length 0.38 mm, height 0.23 mm. USNM 408401, male left valve (pl. 15, fig. 7), cruise DC2-80-EG, sample 186, length 0.35 mm, height 0.19 mm. USNM 408402, right valve (pl. 15, fig. 8), cruise DC2-80-EG, sample 186, length 0.35 mm, height 0.23 mm. USNM 408403, left valve (pl. 15, fig. 9), cruise DC2-80-EG, sample 186, length 0.33 mm, height 0.23 mm. USNM 408404, female left valve (pl. 15, fig. 10), cruise DC2-80-EG, sample 186, length 0.34 mm, height 0.20 mm.

USNM 408405, right valve (pl. 15, figs. 12, 15), cruise DC2-80-EG, sample 186, length 0.38 mm, height 0.20 mm. USNM 408406, male right valve (pl. 15, fig. 13), cruise DC2-80-EG, sample 186, length 0.35 mm, height 0.20 mm. USNM 408407, left valve (pl. 15, figs. 14, 16), cruise DC2-80-EG, sample 186, length 0.35 mm, height 0.19 mm.

Family PARACYTHERIDEIDAE Puri, 1957

Genus PARACYTHERIDEA G.W. Mueller, 1894

*Type species.*—*Paracytheridea depressa* G.W. Mueller, 1894 (Type by original designation.)

PARACYTHERIDEA KHANTAACKENSIS N. SP.

Plate 13, figure 8; plate 16, figures 2-5

*Paracytheridea* sp. A Brouwers, 1982a, p. 12; Brouwers, 1983.

*Etymology.*—After Khantaak Island, which separates Yakutat from Yakutat Bay.

*Diagnosis.*—Characterized by elongate, subtrapezoid lateral outline; pronounced caudal process near dorsum; five strong anterior marginal denticles; high, pronounced ala overhanging venter and terminating at posteroventer as tubercle; posterior wishbone-shaped ridge; and wide anterior and posterior inner lamella.

*Description.*—Valves elongate, trapezoidal in lateral view. Dorsal margin straight; anterior margin evenly curved, smoothly rounded; ventral margin subparallel to dorsal margin; posterior margin with pronounced caudal process near dorsal margin; ventral half of posterior margin curves sharply to caudal process. Five strong, pointed anterior marginal denticles. Greatest length through caudal process; greatest width through anterior hinge element.

Valve surface covered with ridges; remainder of surface smooth. Ventral margin with high, pronounced ala. Alar ridge originates at anterior, curves down to form narrow, vertical ala which overhangs venter, and terminates at posteroventral tubercle. Tubercle connects to one end of wishbone-shaped ridge, open toward venter. Posteroventral end of wishbone forms large, thick, heavy denticle that projects obliquely away from valve. 12 simple-type normal pores distributed over valve, most anterior. Normal pores with marginal rim.

Inner margin and line of concrescence coincide throughout. Anterior and posterior inner lamella very wide, parallel to outline. Moderately developed selvage. 14 radial pore canals, most anterior. Radial pore canals along anterior very long, sinuous; anteroventral radial pore canals moderate in length, slightly curved, simple. Posterior margin with long, bifurcating radial pore canals and long, straight, simple radial pore canals.

Hingement in left valve consists of elongate, narrow anterior socket; small, knoblike anteromedian tooth; weakly crenulate median bar; posteromedian subquadrate tooth; and

elongate, narrow posterior socket. Median element with larger crenulations at terminal ends.

*Remarks.*—*P. khantaackensis* n. sp. is a rare but distinctive taxon in the Gulf of Alaska assemblage. No described forms of *Paracytheridea* are similar.

*Occurrence.*—Cruise DC2-80-EG, locality 195. Table 2.

*Distribution.*—Pleistocene(?), Holocene: eastern Gulf of Alaska. Middle sublittoral.

*Type specimens.*—Holotype: USNM 408408, left valve (p. 13, fig. 8), cruise DC2-80-EG, sample 195, length 0.50 mm, height 0.23 mm.

Paratypes: USNM 408409, left valve (pl. 16, figs. 2, 5), cruise DC2-80-EG, sample 195, length 0.45 mm, height 0.20 mm. USNM 408410, left valve (pl. 16, fig. 4), cruise DC2-80-EG, sample 195, length 0.45 mm, height 0.18 mm. USNM 408411, left valve (pl. 16, fig. 3), cruise DC2-80-EG, sample 195, length 0.46 mm, height 0.25 mm.

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**Table 2.** Occurrence of the 27 ostracode species in the 223 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. Sample numbers are listed across the top of the table]

[illegible]

**Table 2.** Occurrence of the 27 ostracode species in the 223 bottom-grab samples collected during three cruises in the Gulf of Alaska.—Continued

CRUISE EGAL-75-KC																												
SAMPLE NUMBER . . . . .	72	73	74	75	76	77	78	80	83	84	86	87	88	91	92	94	95	96	97	98	99	103	104	105	106	107	108	109
<i>Acanthocythereis dunelmensis</i>	53	179	25	3	5	9	38	12	1	7	48	25		3	9	20	24	9	5	7	23		147	69	50			6
<i>Robertsonites tuberculatus</i>	66	1	1		5			2			11	11	1		7	24	1	1		3		2	138	1				6
<i>Ambtonia tongassensis</i>																												3
<i>Celtia palmensis</i>											3											5		1				7
<i>Celtia blizhnii</i>																												
<i>Celtia pointmanbiensis</i>					1																							
<i>Finmarchinella</i> (F.) <i>finmarchica</i>																												
<i>Finmarchinella</i> (B.) <i>angulata</i>																												
<i>Finmarchinella</i> (B.) <i>barentzovoensis</i>																										1		
<i>Finmarchinella</i> (B.) <i>guyotensis</i>																												
<i>Hemicythere hazeli</i>																										2		4
<i>Normanicythere leioderma</i>																												
<i>Aurila malaspinensis</i>								1																				
<i>Hemicythere emarginata</i>																												
<i>Robustaurila jollaensis</i>																												
<i>Coquimba hanaii</i>																												
<i>Ambostracon tweedsmuiensis</i>					2																							1
<i>Laperousecythere robusta</i>		1			136	1		6					1		1													1
<i>Laperousecythere yahtsensis</i>																												
<i>Elofsonia susitnensis</i>																												
<i>Sagmatocythere gombosi</i>																												
<i>Loxoconcha luciensis</i>											2																	
<i>Palmoconcha russellensis</i>		14	19								37					4			6	2		4	14					10
<i>Palmoconcha krausei</i>																												2
<i>Loxoconcha</i> sp. G																												
<i>Loxoconchidea dolgoiensis</i>	1	2										2				1		1						54	46	4		
<i>Paracytheridea khantaakensis</i>																												

TABLE 2

**Table 2.** Occurrence of the 27 ostracode species in the 223 bottom-grab samples collected during three cruises in the Gulf of Alaska.—Continued

CRUISE EGAL-75-KC																												
SAMPLE NUMBER . . . . .	110	111	112	115	117	118	120	122A	123	125	127	128	129	130	132	133	134	138	141	144U	145	146	147	149	150	153	154	155
<i>Acanthocythereis dunelmensis</i>	3	9	2	6	8	1	1	20	9		8			1				2	2	1	4	5	1	41	22	149	7	
<i>Robertsonites tuberculatus</i>	6	8	1	31	2	2	9										1		4		3			3	37	63		
<i>Ambtonia tongassensis</i>		1		11			2	17																				
<i>Celtia palmensis</i>		1		113	2	1	268	1	1	1		1	94				6											
<i>Celtia blizhnii</i>							5								4		27											
<i>Celtia pointmanbiensis</i>												1							8	14								
<i>Finmarchinella (F.) finmarchica</i>																			5	14						1		
<i>Finmarchinella (B.) angulata</i>																	1											
<i>Finmarchinella (B.) barentzovoensis</i>																												
<i>Finmarchinella (B.) guyotensis</i>																			11	38								
<i>Hemicythere hazeli</i>				92				4				14				1	1	9			1							
<i>Normanicythere leioderma</i>																												
<i>Aurila malaspinensis</i>				37			1					4	1				11			12								
<i>Hemicythere emarginata</i>																												
<i>Robustaurila jollaensis</i>				18													3											
<i>Coquimba hanaii</i>				8								2							1									
<i>Ambostracon tweedsmuiresis</i>				4															10	78								
<i>Laperousecythere robusta</i>												1							122	350						3		2
<i>Laperousecythere yahtsensis</i>																				22								
<i>Elofsonia susitnensis</i>																												
<i>Sagmatocythere gombosi</i>																				2								
<i>Loxoconcha luciensis</i>																												
<i>Palmoconcha russellensis</i>	2			133	1		3	1		1		6	12		1		6							5	1		10	
<i>Palmoconcha krausei</i>				9				1				3					1											
<i>Loxoconcha sp. G</i>																												
<i>Loxoconchidea dolgoiensis</i>		1							13	2	3				2							3	3	2	30	5		
<i>Paracytheridea khantaakensis</i>																												

**Table 2.** Occurrence of the 27 ostracode species in the 223 bottom-grab samples collected during three cruises in the Gulf of Alaska.—Continued

CRUISE EGAL-75-KC																												
SAMPLE NUMBER . . . . .	157	158	159	161	162	163	164B	165	166	167	170A	170B	171	173	174	176	180	181	183	184	202	204	205	208	210	211	212	213
<i>Acanthocythereis dunelmensis</i>	38	11	48												1			23	5	3			12		4	1	3	16
<i>Robertsonites tuberculatus</i>	23	8	16															161					8		3	2		5
<i>Ambtonia tongassensis</i>	3		2															81										4
<i>Celtia palmensis</i>								1		1	2		1		6	33	166	26		2							15	
<i>Celtia blizhnii</i>																											1	
<i>Celtia pointmanbiensis</i>			1																									
<i>Finmarchinella</i> (F.) <i>finmarchica</i>																												
<i>Finmarchinella</i> (B.) <i>angulata</i>																												
<i>Finmarchinella</i> (B.) <i>barentzovoensis</i>																												
<i>Finmarchinella</i> (B.) <i>guyotensis</i>	6		9																									
<i>Hemicythere hazeli</i>	2		1	1	5	2	2											32		1							3	
<i>Normanicythere leioderma</i>			1																									
<i>Aurila malaspinensis</i>	130		76						1									14									1	
<i>Hemicythere emarginata</i>																												
<i>Robustaurila jollaensis</i>	8																											
<i>Coquimba hanaii</i>	6		4																									
<i>Ambostracon tweedsmuiensis</i>	38		20															11										
<i>Laperousecythere robusta</i>	9	3	13																		1			1				
<i>Laperousecythere yahtsensis</i>																												
<i>Elofsonia susitnensis</i>	1		2		4	1	3		1									2										
<i>Sagmatocythere gombosi</i>			3															5										
<i>Loxoconcha luciensis</i>																												
<i>Palmoconcha russellensis</i>	29	1	21					2				1	1	1	1	1	11	84		1							14	
<i>Palmoconcha krausei</i>	11		12															6										
<i>Loxoconcha</i> sp. G																												
<i>Loxoconchidea dolgoiensis</i>																			4	9		1	1		2			
<i>Paracytheridea khantaakensis</i>																												



**Table 2.** Occurrence of the 27 ostracode species in the 223 bottom-grab samples collected during three cruises in the Gulf of Alaska.—Continued

CRUISE EGAL-75-KC																												
SAMPLE NUMBER . . . . .	285	286	288	289	290	296	297	306	307	312	313	314	319	320	324	325	326	328	331	332	333	336	338	339	341	344	360	422
<i>Acanthocythereis dunelmensis</i>	16	8	1			19	10	6	9	2	1	1	4	7	24	2	6	12	2	32	5		14	6	3	1		
<i>Robertsonites tuberculatus</i>	18			28		113							1					4		10	1	1	66	24				
<i>Ambtonia tongassensis</i>						16								1	2	1		1					5	3				
<i>Celtia palmensis</i>				2											2			2	6				2	1				
<i>Celtia blizhnii</i>					56															1								
<i>Celtia pointmanbiensis</i>																												
<i>Finmarchinella (F.) finmarchica</i>																												
<i>Finmarchinella (B.) angulata</i>																												
<i>Finmarchinella (B.) barentzovoensis</i>																												
<i>Finmarchinella (B.) guyotensis</i>																			1									
<i>Hemicythere hazeli</i>																			1									
<i>Normanicythere leioderma</i>																												
<i>Aurila malaspinensis</i>																												
<i>Hemicythere emarginata</i>																												
<i>Robustaurila jollaensis</i>																												
<i>Coquimba hanaii</i>																												
<i>Ambostracon tweedsmuiensis</i>																												
<i>Laperousecythere robusta</i>																												
<i>Laperousecythere yahtsensis</i>																												
<i>Elofsonia susitnensis</i>																												
<i>Sagmatocythere gombosi</i>																												
<i>Loxoconcha luciensis</i>																												
<i>Palmoconcha russellensis</i>	1			17		5	4					1							15	4			1	5			1	1
<i>Palmoconcha krausei</i>																												4
<i>Loxoconcha sp. G</i>																												
<i>Loxoconchidea dolgoiensis</i>															3					1					2			
<i>Paracytheridea khantaakensis</i>																												

TABLE 2





Table 2. Occurrence of the 27 ostracode species in the 223 bottom-grab samples collected during three cruises in the Gulf of Alaska.—Continued

CRUISE DC2-80-EG																															
SAMPLE NUMBER . . . . .	24	27	41	48	60	62	63	67	70	73	82	86	89	91	94	97	99	155	167	168	169	170	174	177	180	183	186	189	192	195	
<i>Acanthocythereis dunelmensis</i>							237	357	513	253	44	281	6		44	18						51	25	13	8	1	40	30	14	70	
<i>Robertsonites tuberculatus</i>					2		18	71	64	36	1	29	1							2	1	9							2	42	
<i>Ambtonia tongassensis</i>							21	69	217	153		43	4									3	1	2						25	
<i>Celtia palmensis</i>	1		1		281	221	153	151	76	39	169	14	24			14	39	1	14	36	24	4		1		1	3			45	
<i>Celtia blizhnii</i>		6	1		219	163	178	123	87	34	134	19	68															2		15	
<i>Celtia pointmanbiensis</i>																															
<i>Finmarchinella</i> (F.) <i>finmarchica</i>																															
<i>Finmarchinella</i> (B.) <i>angulata</i>																															
<i>Finmarchinella</i> (B.) <i>barentzovoensis</i>								1																							
<i>Finmarchinella</i> (B.) <i>guyotensis</i>																															
<i>Hemicythere hazeli</i>								1			1																			1	
<i>Normanicythere leioderma</i>																															
<i>Aurila malaspinensis</i>					2		2	2																						894	
<i>Hemicythere emarginata</i>																															
<i>Robustaurila jollaensis</i>																															
<i>Coquimba hanaii</i>																															
<i>Ambostracon tweedsmuiensis</i>																															
<i>Laperousecythere robusta</i>														1																	
<i>Laperousecythere yahtsensis</i>																															
<i>Elofsonia susitnensis</i>		1	1				1		3																						
<i>Sagmatocythere gombosi</i>																															
<i>Loxoconcha luciensis</i>																														2	
<i>Palmoconcha russellensis</i>	1	2		4	17	8	104	146	281	58	82	25				7	3		17	52	4		1				2			164	
<i>Palmoconcha krausei</i>																														43	
<i>Loxoconcha</i> sp. G																															
<i>Loxoconchidea dolgoiensis</i>									13			1			11	5						1	4	1	7	2	47	13	2	6	
<i>Paracytheridea khantaakensis</i>																														4	

TABLE 2



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## PLATES 1–16

Contact photographs of the plates in this report are available, at cost, from U.S. Geological Survey Library,  
Federal Center, Denver, Colorado 80225

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## PLATE 1

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

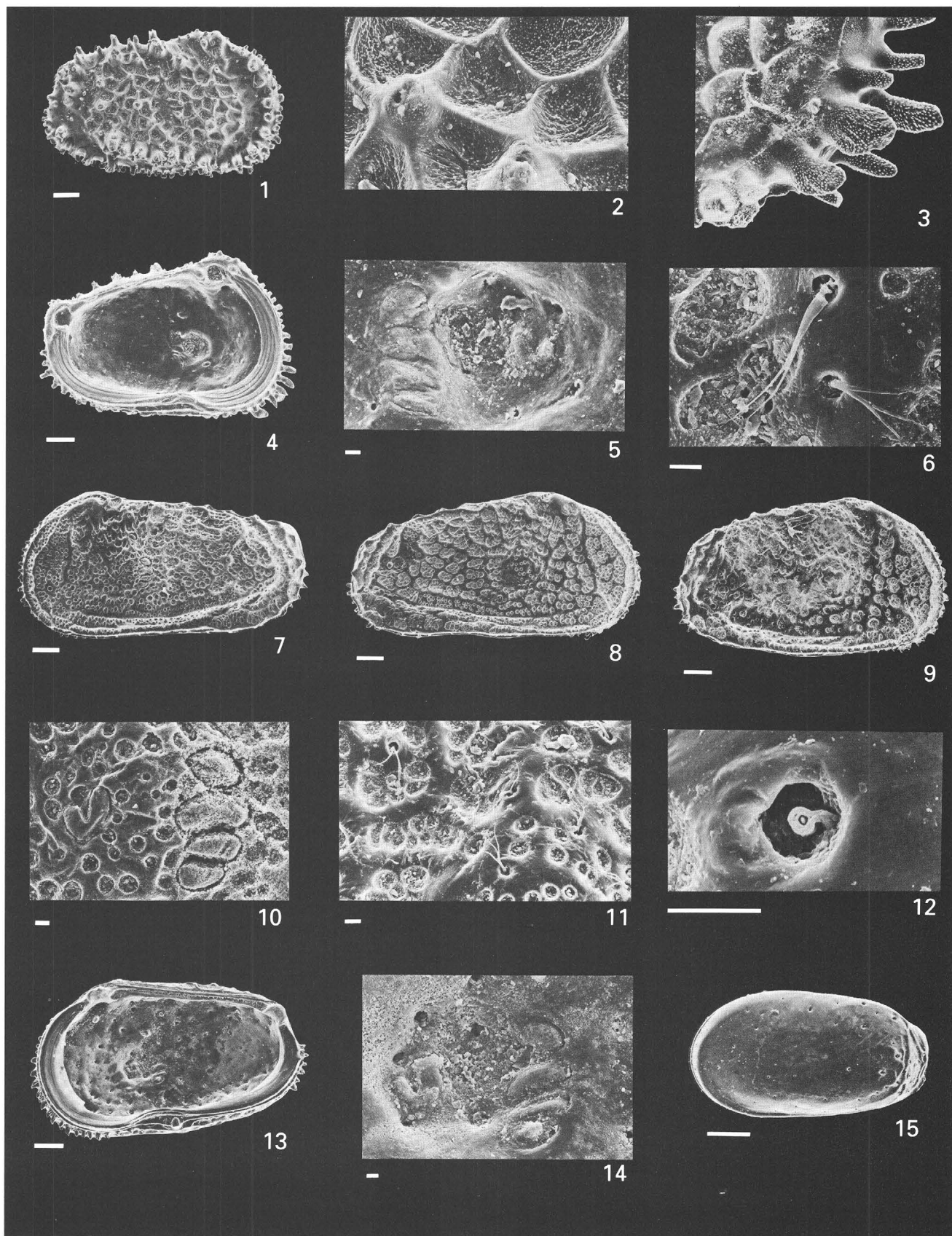
Figures 1–5. *Acanthocythereis dunelmensis* (Norman, 1865) (p. 3).

1. Exterior female right valve. USNM 408260.
2. Close-up view of secondary ornament. USNM 408261.
3. Close-up view of anteroventral marginal denticles. USNM 408259.
4. Interior female left valve. USNM 408262.
5. Central muscle-scar tubercle. USNM 408263.

6–14. *Robertsonites tuberculatus* (Sars, 1866) (p. 7).

6. Close-up view of pores, branching setae. USNM 408266.
7. Exterior male left valve. USNM 408267.
8. Exterior male right valve. USNM 408268.
9. Exterior female right valve. USNM 408266.
10. Close-up view of externally reflected central muscle scars. USNM 408267.
11. Close-up view of ornament and pores. USNM 408268.
12. Close-up view of pore. USNM 408268.
13. Interior female right valve. USNM 408269.
14. Central muscle-scar field. USNM 408269.

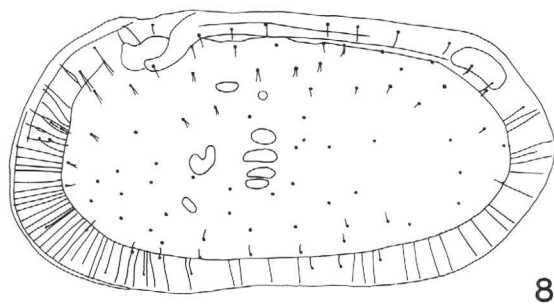
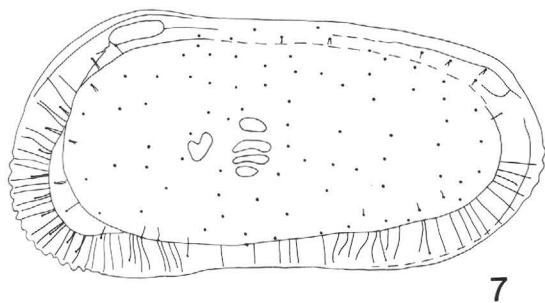
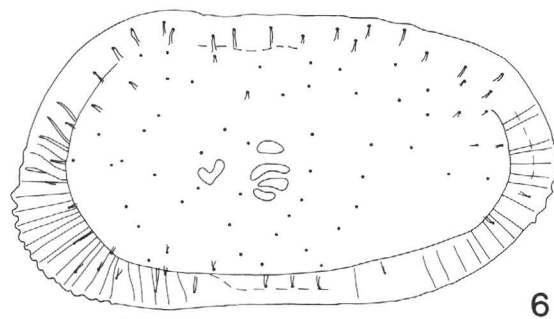
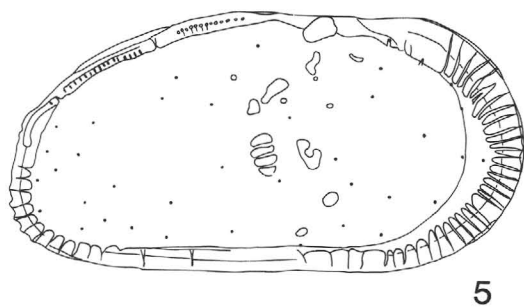
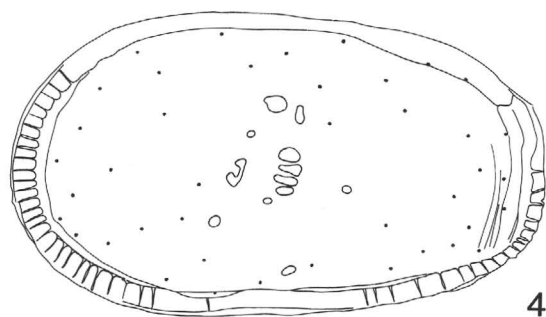
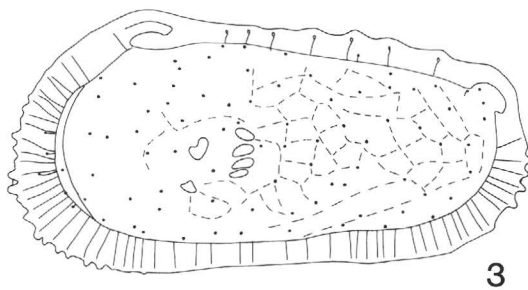
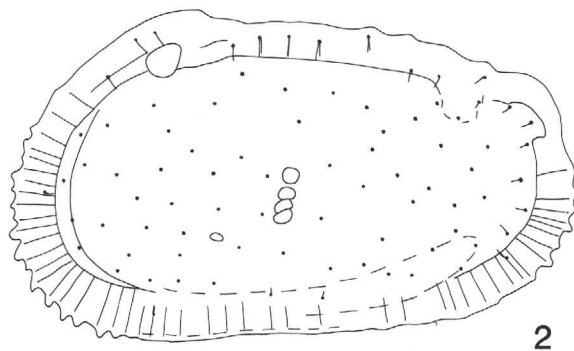
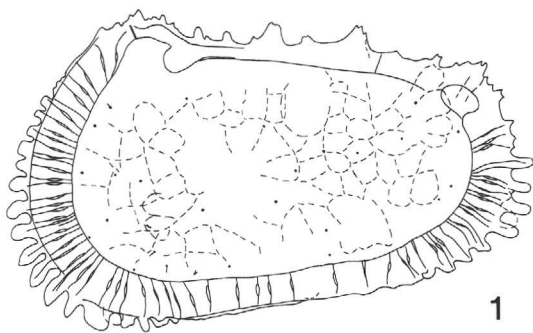
15. *Ambtonia tongassensis* n. sp. (p. 8). Exterior left valve. USNM 408272.



## PLATE 2

[All figures are camera lucida drawings]

- Figures 1. *Acanthocythereis dunelmensis* (Norman, 1865) (p. 3).  
Exterior left valve, length 1.10 mm. USNM 408258.
- 2, 3. *Robertsonites tuberculatus* (Sars, 1866) (p. 7).  
2. Exterior female left valve, length 0.95 mm. USNM 408264.  
3. Exterior male left valve, length 1.00 mm. USNM 408265.
- 4, 5. *Ambtonia tongassensis* n. sp. (p. 8).  
4. Exterior female left valve, length 0.59 mm. USNM 408270.  
5. Exterior male right valve, length 0.59 mm. USNM 408271.
- 6, 7. *Celtia palmensis* n. sp. (p. 10).  
6. Exterior female left valve, length 1.01 mm USNM 408276.  
7. Exterior male left valve, length 0.99 mm. USNM 408277.
8. *Celtia blizhnii* n. sp. (p. 11).  
Exterior female left valve, length 0.89 mm. USNM 408284.



### PLATE 3

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

Figures 1–5. *Ambtonia tongassensis* n. sp. (p. 8).

1. Exterior male right valve. USNM 408273.
2. Interior female right valve. USNM 408274.
3. Central muscle-scar field. USNM 408274.
4. Exterior male left valve. USNM 408275.
5. Exterior male right valve. USNM 408273.

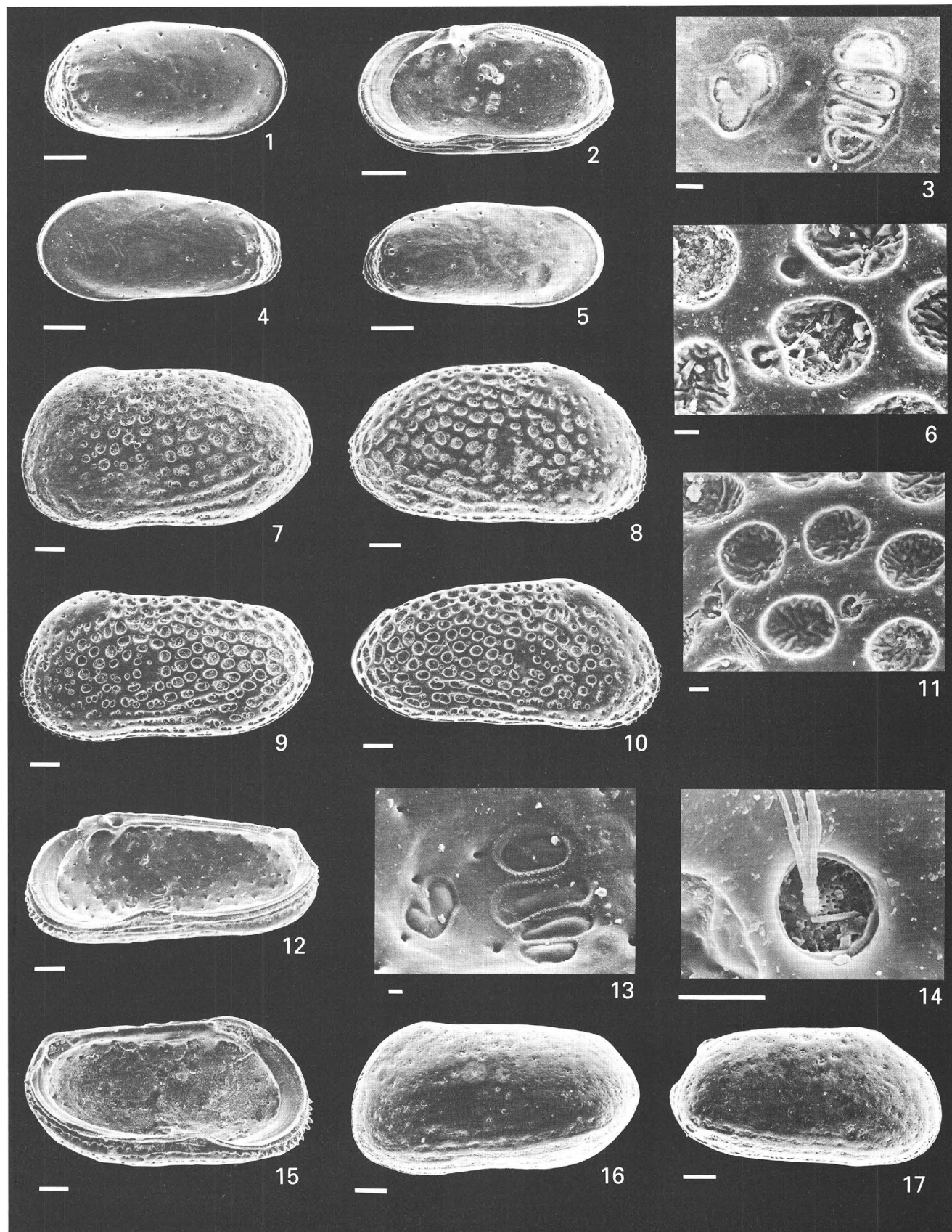
6–15. *Celtia palmensis* n. sp. (p. 10).

6. Close-up view of secondary ornament, pore. USNM 408278.
7. Exterior female left valve. USNM 408279.
8. Exterior female right valve. USNM 408280.
9. Exterior male left valve. USNM 408278.
10. Exterior male right valve. USNM 408281.
11. Close-up view of secondary ornament, pores with setae. USNM 408281.
12. Interior male right valve. USNM 408282.
13. Central muscle-scar field. USNM 408282.
14. Close-up view of recessed sieve plate with seta. USNM 408281.
15. Interior female left valve. USNM 408283.

16–17. *Celtia blizhnii* n. sp. (p. 11).

16. Exterior female left valve. USNM 408286.
17. Exterior female right valve. USNM 408287.

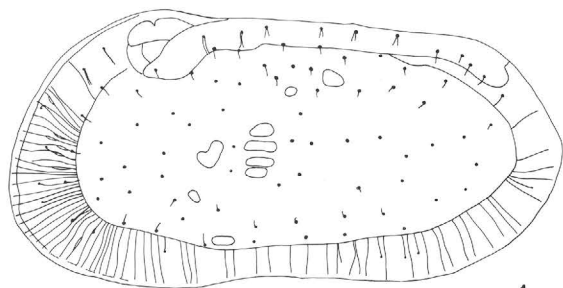




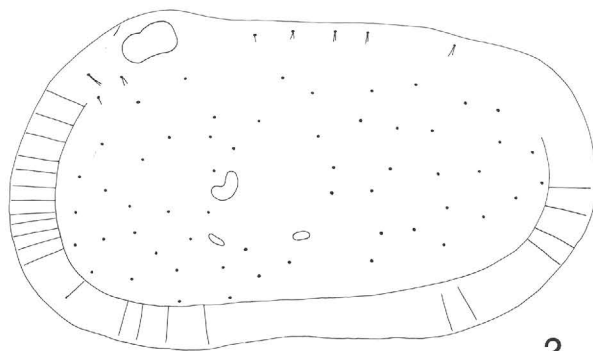
## PLATE 4

[All figures are camera lucida drawings]

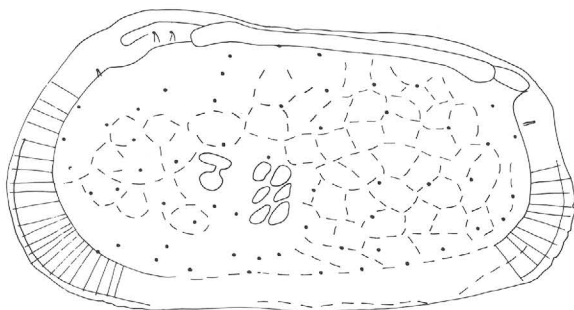
- Figure 1. *Celtia blizhnii* n. sp. (p. 11). Exterior male left valve, length 0.86 mm. USNM 408285.
2. *Celtia pointmanbiensis* n. sp. (p. 12). Exterior female left valve, length 0.98 mm. USNM 408292.
- 3–4. *Finmarchinella* (*Finmarchinella*) *finmarchica* (Sars, 1866) (p. 14).
3. Exterior female left valve, length 0.80 mm. USNM 408301.
4. Exterior male left valve, length 0.69 mm. USNM 408302.
5. *Finmarchinella* (*Barentsovia*) *angulata* (Sars, 1866) (p. 15). Exterior female right valve, length 0.68 mm. USNM 408310.
6. *Finmarchinella* (*Barentsovia*) *barentzovoensis* (Mandelstam, 1957) (p. 15). Exterior juvenile right valve, length 0.55 mm. USNM 408311.
- 7–8. *Finmarchinella* (*Barentsovia*) *guyotensis* n. sp. (p. 16).
7. Exterior female left valve, length 0.78 mm. USNM 408312.
8. Exterior male left valve, length 0.69 mm. USNM 408313.



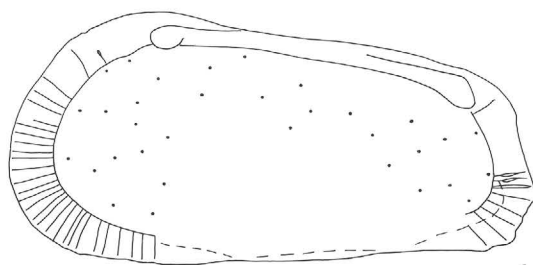
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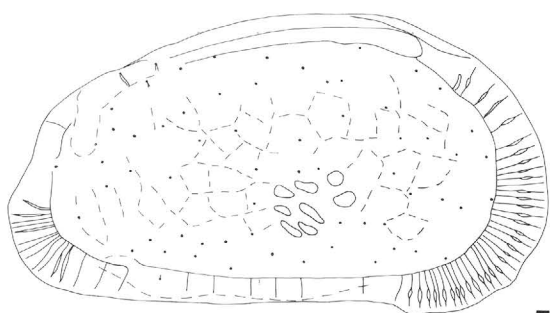
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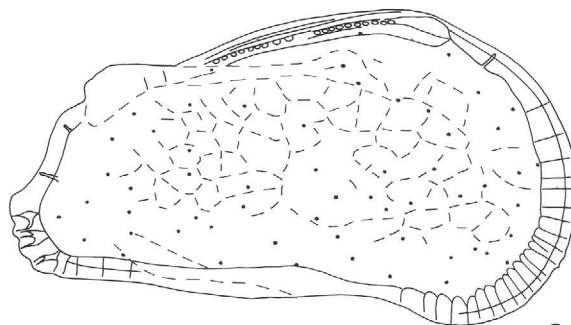
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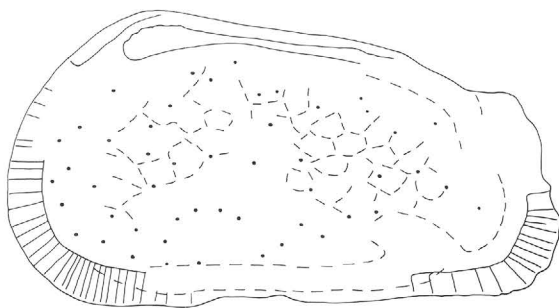
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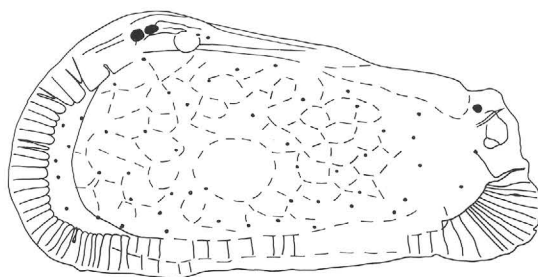
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## PLATE 5

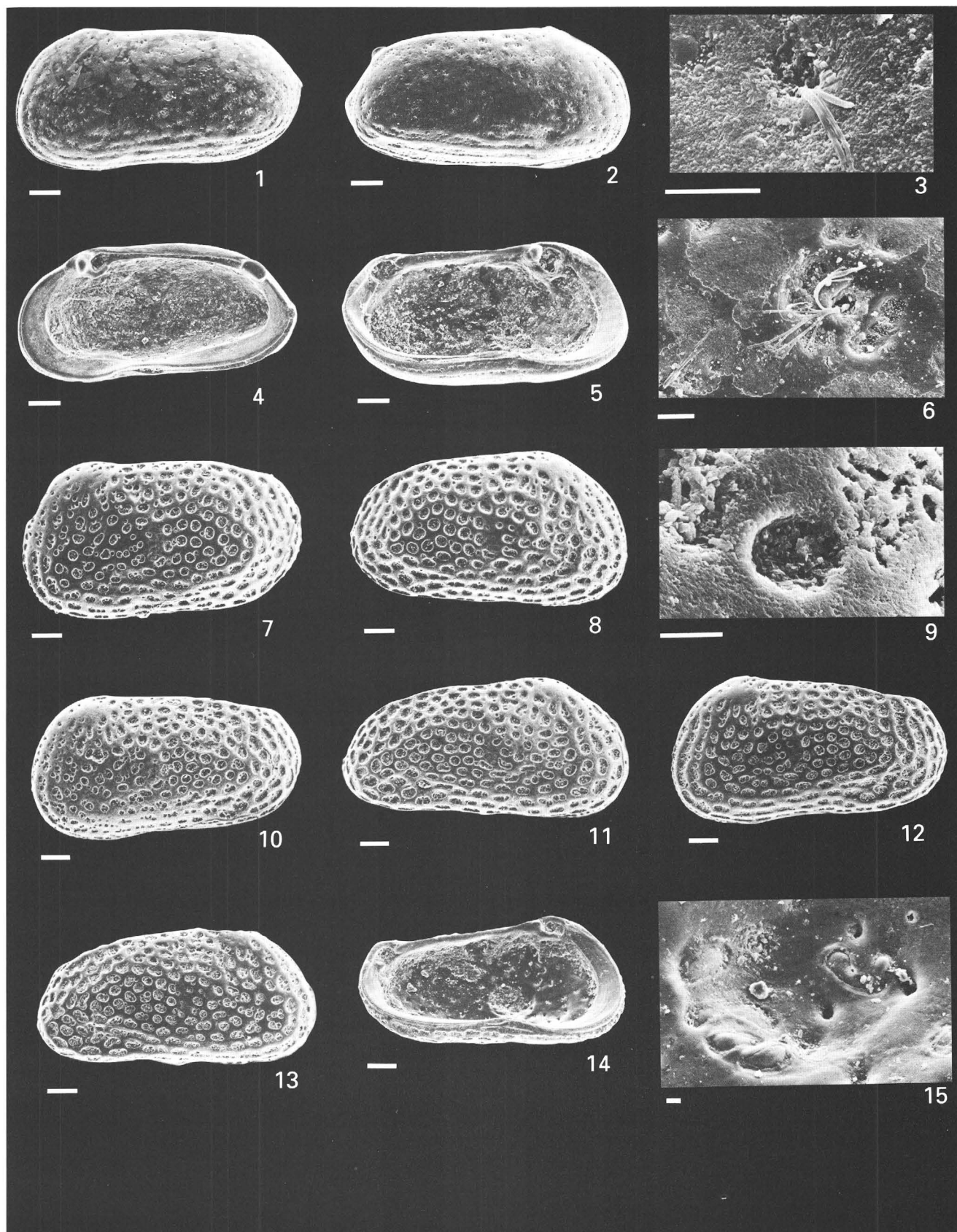
[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1–2, 4–5, 7–8, 10–14; bar scale equals 10 micrometers for figs. 3, 6, 9, 15]

Figure 1–6. *Celtia blizhnii* n. sp. (p. 11).

1. Exterior male left valve. USNM 408288.
2. Exterior male right valve. USNM 408289.
3. Close-up view of pore. USNM 408286.
4. Interior male right valve. USNM 408290.
5. Interior female left valve. USNM 408291.
6. Close-up view of pore with seta, etched valve surface. USNM 408288.

7–15. *Celtia pointmanbiensis* n. sp. (p. 12).

7. Exterior female left valve. USNM 408293.
8. Exterior female right valve. USNM 408294.
9. Close-up view of ornament. USNM 408295.
10. Exterior male left valve. USNM 408296.
11. Exterior male right valve. USNM 408297.
12. Exterior male left valve. USNM 408298.
13. Exterior male right valve. USNM 408295.
14. Interior male left valve. USNM 408299.
15. Central muscle-scar field. USNM 408300.



## PLATE 6

[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1–2, 4–8, 11–14; bar scale equals 10 micrometers for figs. 3, 9–10, 15]

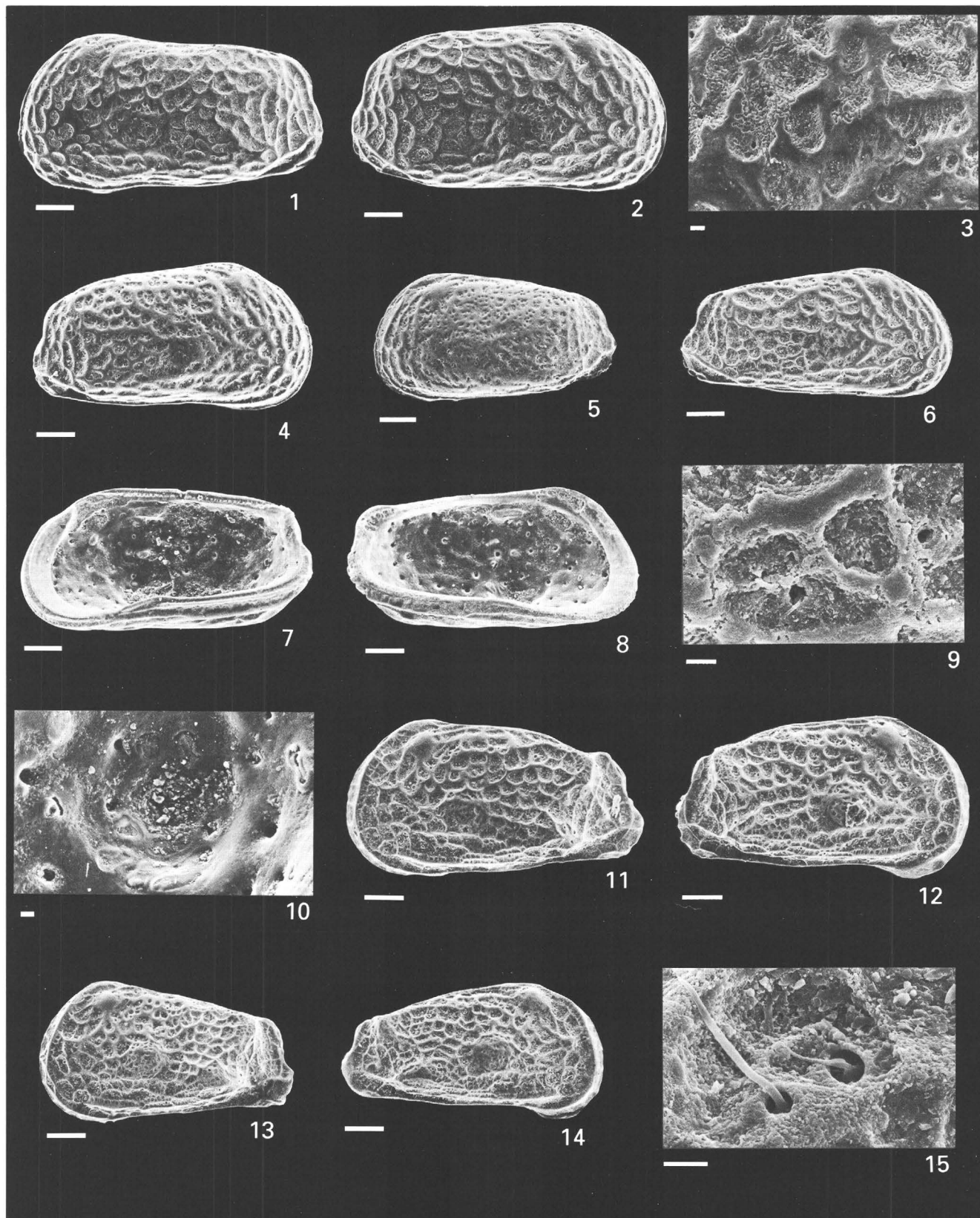
Figures 1–10. *Finmarchinella* (*Finmarchinella*) *finmarchica* (Sars, 1866) (p. 14).

1. Exterior female left valve. USNM 408303.
2. Exterior female right valve. USNM 408304.
3. Close-up of ornament, pores. USNM 408303.
4. Exterior female right valve. USNM 408305.
5. Exterior male left valve. USNM 408306.
6. Exterior male right valve. USNM 408307.
7. Interior female right valve. USNM 408308.
8. Interior female left valve. USNM 408309.
9. Close-up view of ornament, pores. USNM 408307.
10. Central muscle-scar field. USNM 408309.

11–15. *Finmarchinella* (*Barentsovia*) *guyotensis* n. sp. (p. 16).

11. Exterior female left valve. USNM 408314.
12. Exterior female right valve. USNM 408315.
13. Exterior male left valve. USNM 408316.
14. Exterior male right valve. USNM 408317.
15. Close-up view of pores. USNM 408315.





## PLATE 7

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

Figures 1–2. *Finmarchinella (Barentsovia) guyotensis* n. sp. (p. 16).

1. Interior female right valve. USNM 408318.
2. Close-up view of central muscle scars. USNM 408318.

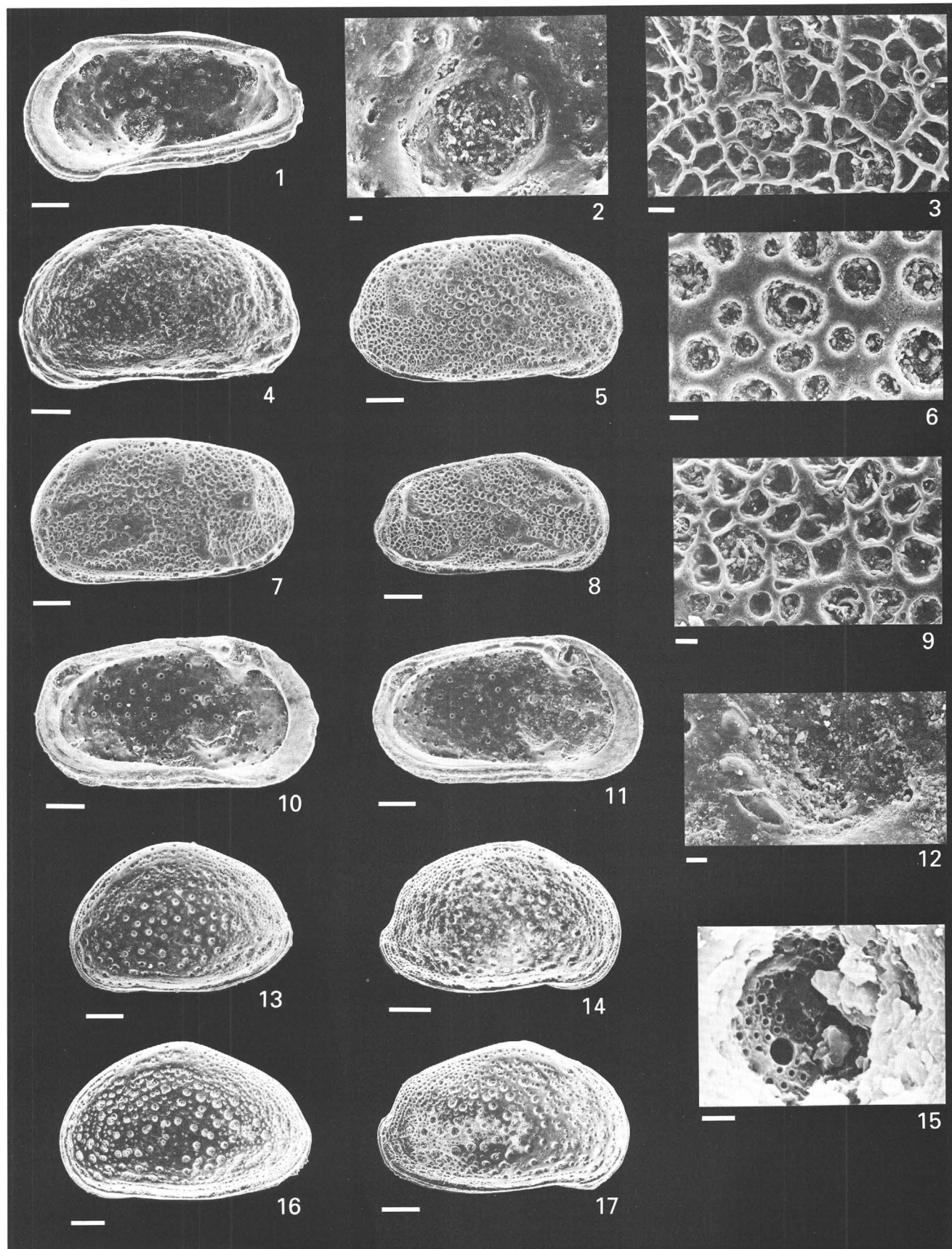
3–12. *Hemicythere hazeli* n. sp. (p. 18).

3. Close-up view of ornament. USNM 408321.
4. Exterior female left valve. USNM 408322.
5. Exterior female right valve. USNM 408323.
6. Close-up view of ornament and pores. USNM 408323.
7. Exterior male left valve. USNM 408324.
8. Exterior male right valve. USNM 408321.
9. Close-up view of ornament. USNM 408323.
10. Interior female left valve. USNM 408325.
11. Interior female left valve. USNM 408326.
12. Central muscle scars. USNM 408326.

13–17. *Aurila malaspinensis* n. sp. (p. 19).

13. Exterior male left valve. USNM 408329.
14. Exterior male right valve. USNM 408330.
15. Close-up view of sieve pore. USNM 408331.
16. Exterior female left valve. USNM 408332.
17. Exterior male right valve. USNM 408329.

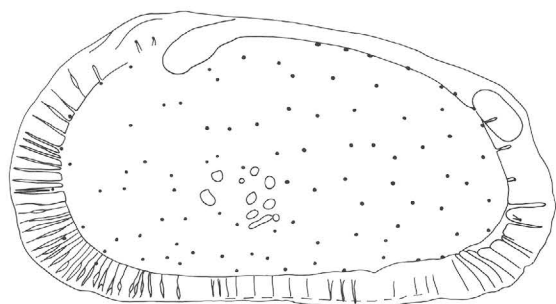




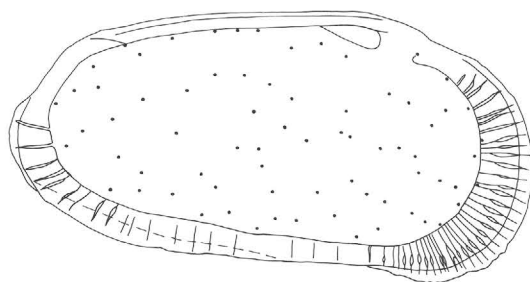
## PLATE 8

[All figures are camera lucida drawings]

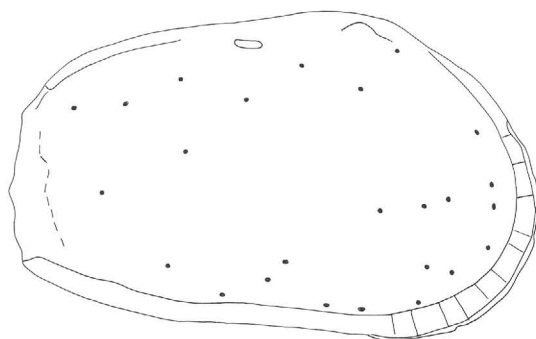
- Figures 1–2. *Hemicythere hazeli* n. sp. (p. 18).
1. Exterior female left valve, length 0.58 mm. USNM 408319.
  2. Exterior male right valve, length 0.60 mm. USNM 408320.
3. *Normanicythere leioderma* (Norman, 1869) (p. 19). Exterior juvenile right valve, length 0.60 mm. USNM 408327.
4. *Aurila malaspinensis* n. sp. (p. 19). Exterior female left valve, length 0.75 mm. USNM 408328.
5. *Hemicythere emarginata* (Sars, 1866) (p. 17). Exterior female right valve, length 0.80 mm. USNM 408335.
6. *Robustaurila jollaensis* (LeRoy, 1943) (p. 21). Exterior female left valve, length 0.78 mm. USNM 408336.
7. *Coquimba hanaii* n. sp. (p. 22). Exterior male left valve, length 0.78 mm. USNM 408340.
8. *Ambostracon tweedsmuirensis* n. sp. (p. 23). Exterior male left valve, length 0.83 mm. USNM 408343.



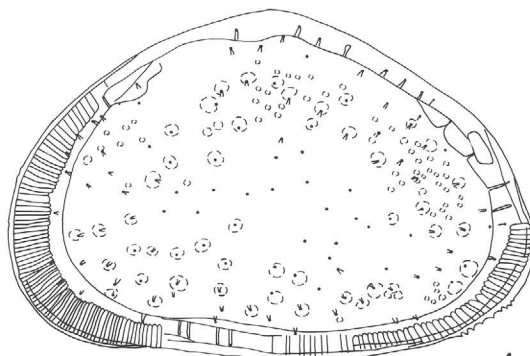
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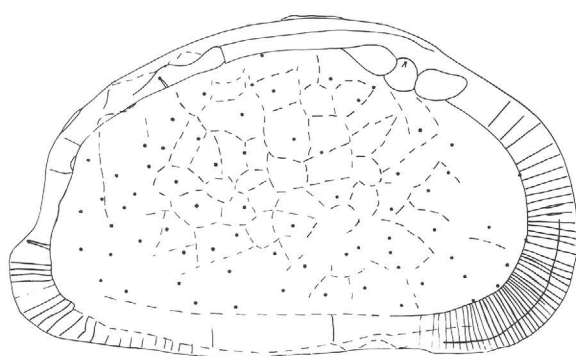
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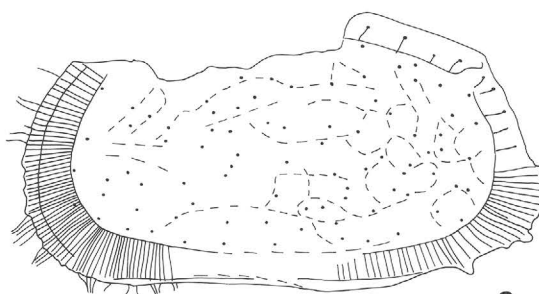
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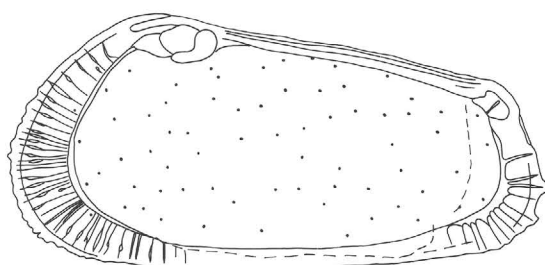
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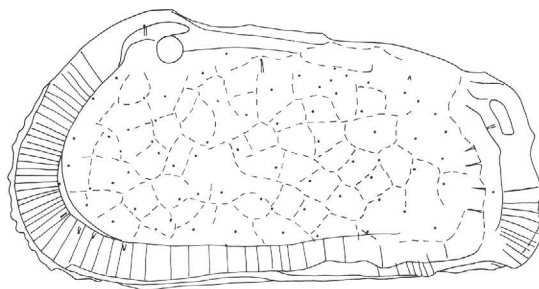
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## PLATE 9

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

Figures 1–5. *Aurila malaspinensis* n. sp. (p. 19).

1. Interior male right valve. USNM 408333.
2. Interior male left valve. USNM 408334.
3. Close-up view of ornament, etched valve surface. USNM 408332.
4. Central muscle scars. USNM 408334.
5. Central muscle-scar field. USNM 408333.

6–9. *Robustaurila jollaensis* (LeRoy, 1943) (p. 21).

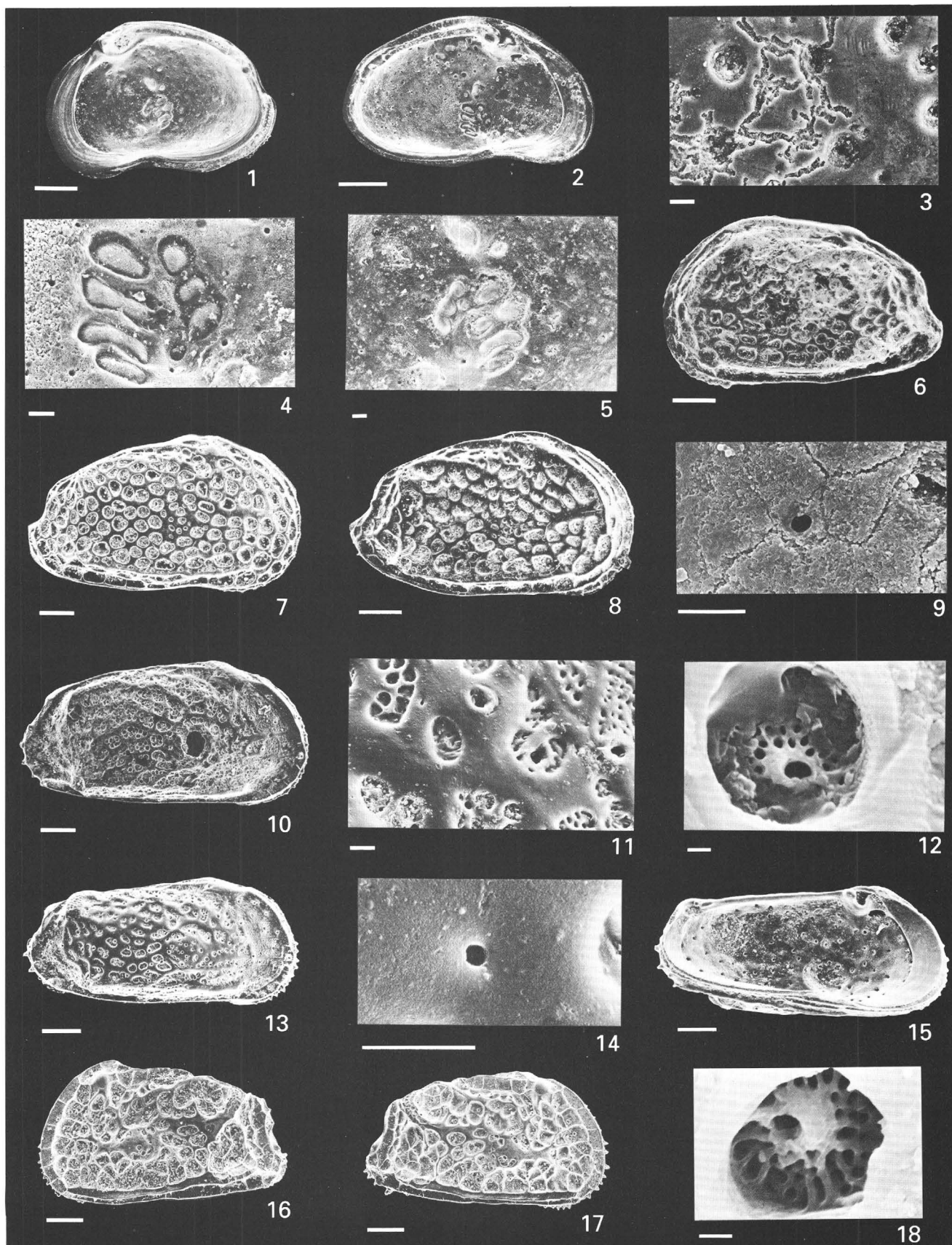
6. Exterior juvenile left valve. USNM 408337.
7. Exterior juvenile right valve. USNM 408338.
8. Exterior juvenile right valve. USNM 408339.
9. Close-up view of normal pore. USNM 408338.

10–15. *Coquimba hanaii* n. sp. (p. 22).

10. Exterior female right valve. USNM 408341.
11. Close-up view of ornament, male. USNM 408342.
12. Close-up view of sieve pore. USNM 408342.
13. Exterior right valve. USNM 408342.
14. Close-up view of normal pore. USNM 408342.
15. Interior female left valve. USNM 408343.

16–18. *Ambostracon tweedsmuiensis* n. sp. (p. 23).

16. Exterior female left valve. USNM 408345.
17. Exterior female right valve. USNM 408346.
18. Close-up view of sieve pore. USNM 408346.



## PLATE 10

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

Figures 1–5. *Ambostracon tweedsmuirensis* n. sp. (p. 23).

1. Exterior male left valve. USNM 408347.
2. Close-up view of secondary ornament, normal pores. USNM 408346.
3. Central muscle-scar field. USNM 408348.
4. Interior right valve. USNM 408348.
5. Interior female left valve. USNM 408349.

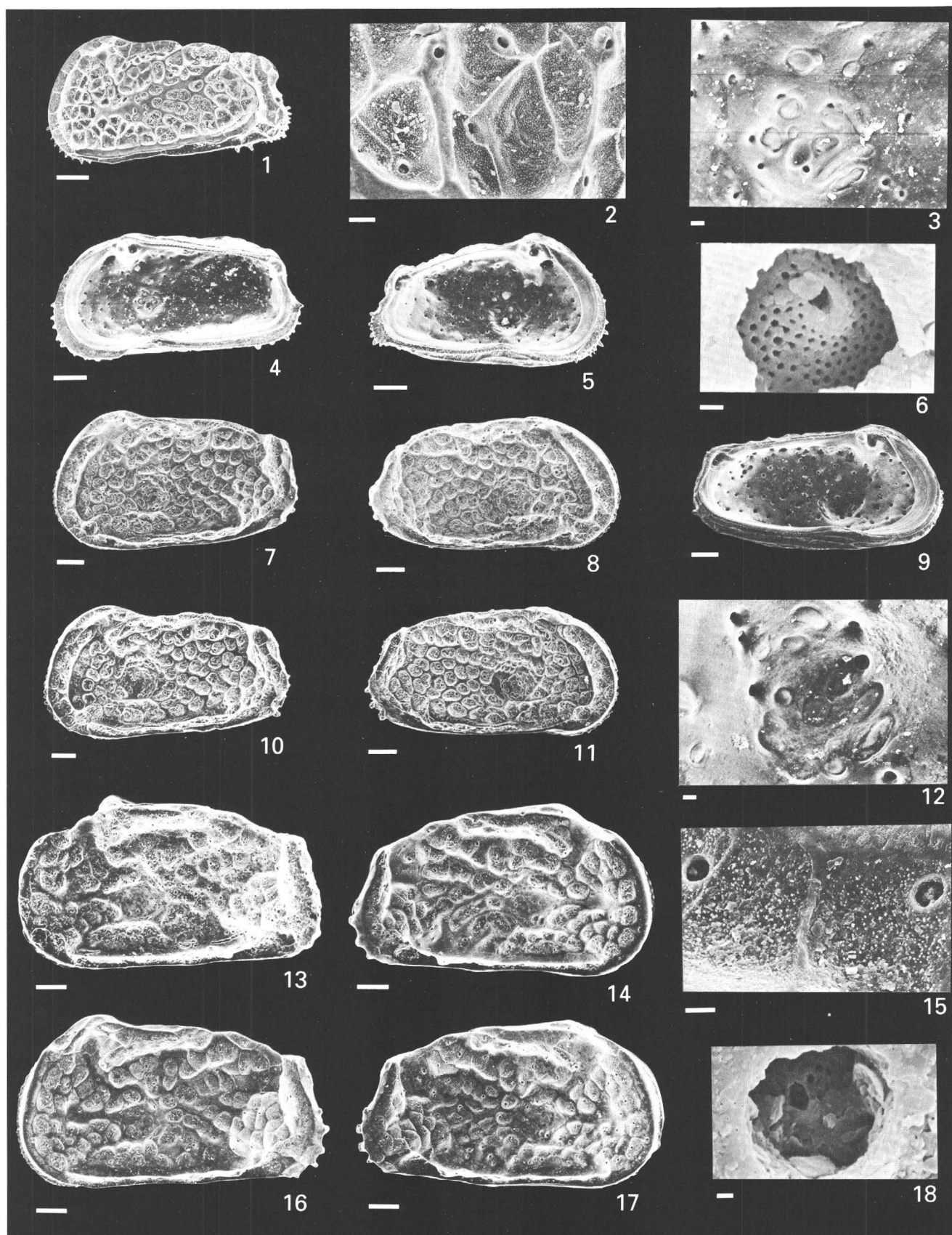
6–12. *Laperousecythere robusta* (Tabuki, 1986) n. gen. (p. 25).

6. Close-up view of sieve pores, female. USNM 408352.
7. Exterior female left valve. USNM 408353.
8. Exterior female right valve. USNM 408354.
9. Interior male left valve. USNM 408355.
10. Exterior male left valve. USNM 408356.
11. Exterior male right valve. USNM 408352.
12. Central muscle-scar field. USNM 408355.

13–18. *Laperousecythere yahtsensis* n. gen. n. sp. (p. 26).

13. Exterior female left valve. USNM 408359.
14. Exterior female right valve. USNM 408360.
15. Close-up view of ornament, normal pores. USNM 408361.
16. Exterior female left valve. USNM 408362.
17. Exterior female right valve. USNM 408361.
18. Close-up view of sieve pores. USNM 408361.





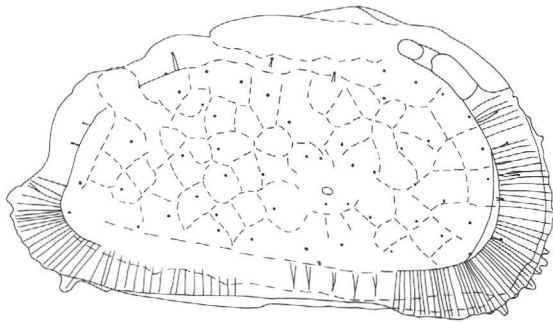
AMBOSTRACON AND LAPEROUSECYTHERE

## PLATE 11

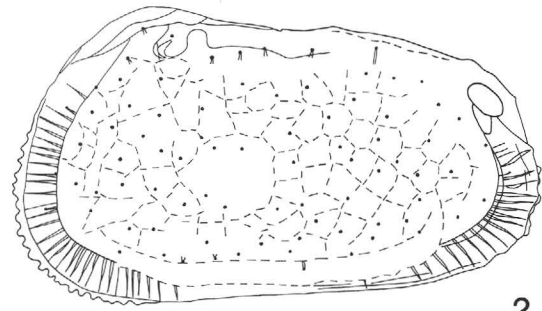
[All figures are camera lucida drawings]

- Figure 1. *Ambostracon tweedsmuirensis* n. sp. (p. 23). Exterior female right valve, length 0.79 mm. USNM 408344.
- 2–3. *Laperousecythere robusta* (Tabuki, 1986) (p. 25).
2. Exterior male left valve, length 0.98 mm. USNM 408350.
  3. Exterior female right valve, length 0.96 mm. USNM 408351.
- 4–5. *Laperousecythere yahtsensis* n. sp. (p. 26).
4. Exterior female left valve, length 0.93 mm. USNM 408357.
  5. Exterior male left valve, length 0.98 mm. USNM 408358.
6. *Loxoconchidea dolgoiensis* n. sp. (p. 32). Exterior left valve, length 0.39 mm. USNM 408398.
- 7–8. *Sagmatocythere gombosi* n. sp. (p. 29).
7. Exterior female left valve, length 0.53 mm. USNM 408371.
  8. Exterior male left valve, length 0.60 mm. USNM 408372.

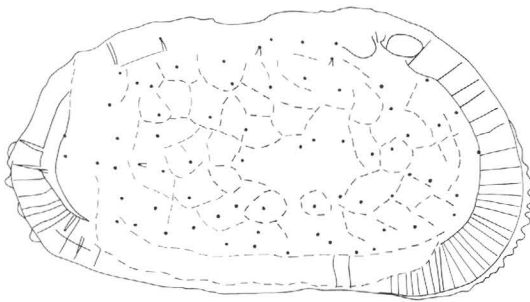




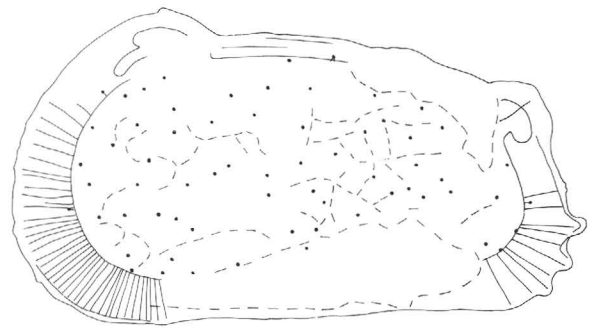
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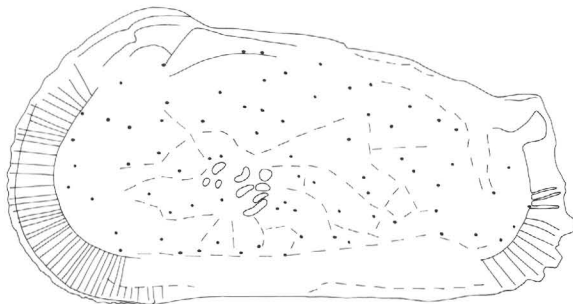
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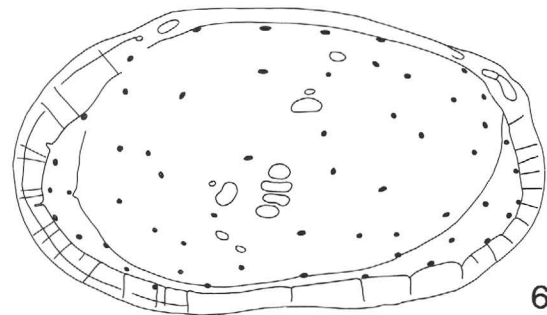
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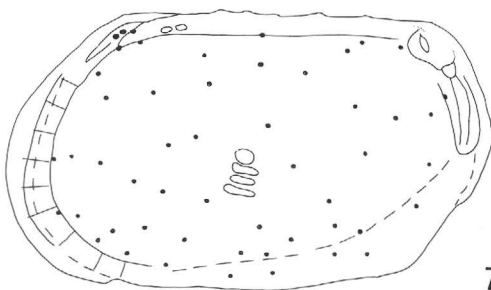
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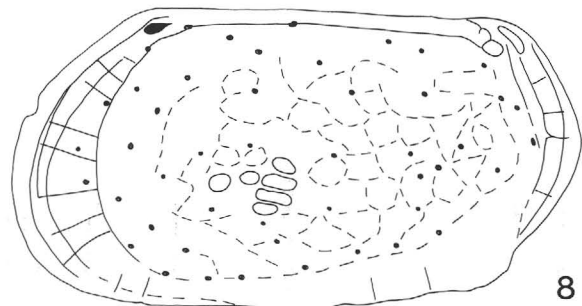
5



6



7



8

## PLATE 12

[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 2–3, 7–16, 18; bar scale equals 10 micrometers for figs. 1, 4–5, 17; bar scale equals 1 micrometer for fig. 6]

Figures 1–10. *Laperousecythere yahtsensis* n. sp. (p. 26).

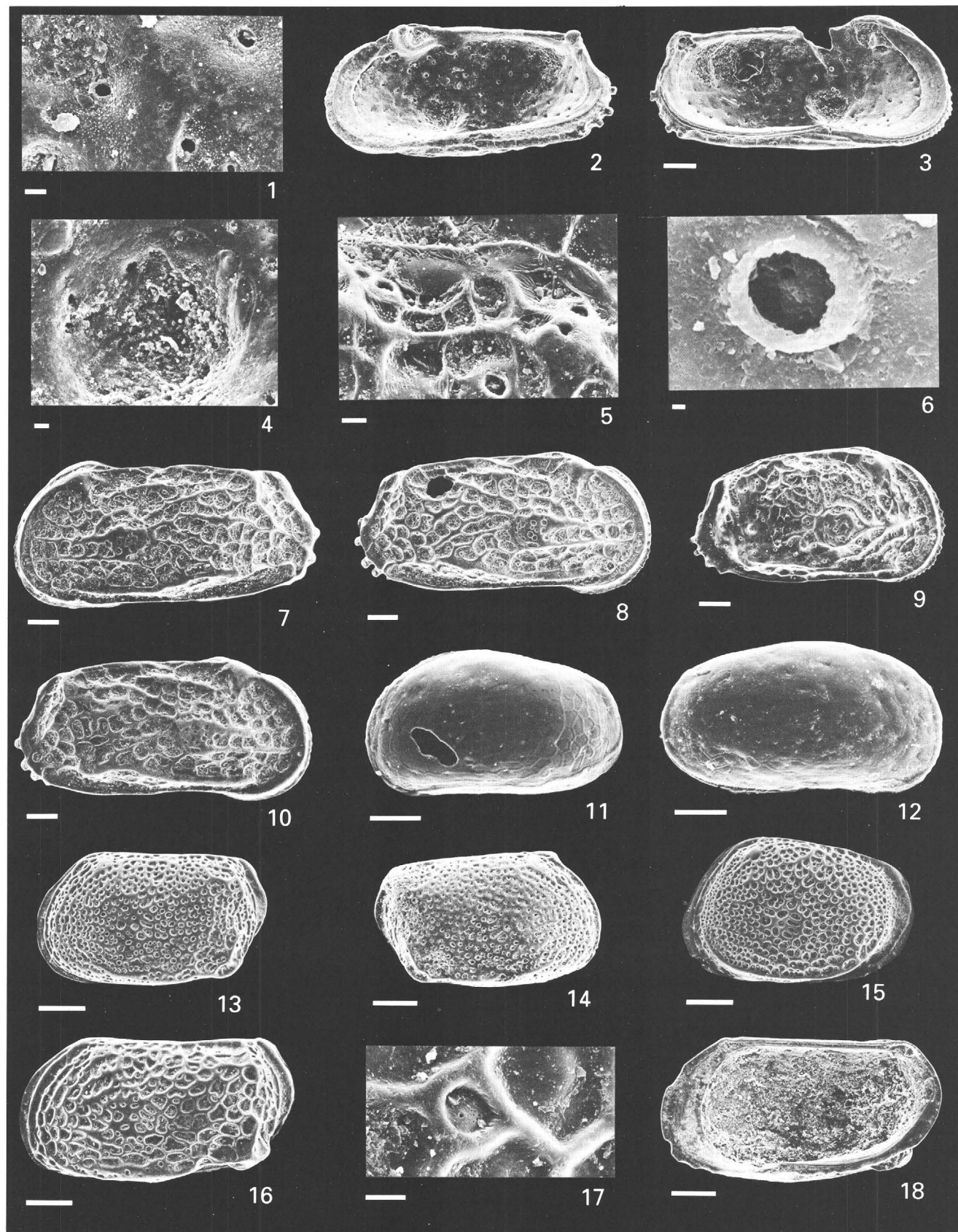
1. Close-up view of ornament, normal pores. USNM 408362.
2. Interior male right valve. USNM 408363.
3. Interior male left valve. USNM 408364.
4. Central muscle-scar field. USNM 408363.
5. Close-up view of ornament. USNM 408365.
6. Close-up view of sieve plate in normal pore. USNM 408365.
7. Exterior male left valve. USNM 408366.
8. Exterior male right valve. USNM 408367.
9. Exterior female right valve. USNM 408365.
10. Exterior male right valve. USNM 408368.

11–12. *Elofsonia susitnensis* Forester and Brouwers, 1985 (p. 27).

11. Exterior left valve. USNM 408369.
12. Exterior right valve. USNM 408370.

13–18. *Sagmatocythere gombosi* n. sp. (p. 29).

13. Exterior female left valve. USNM 408373.
14. Exterior female right valve. USNM 408374.
15. Exterior female left valve. USNM 408375.
16. Exterior male left valve. USNM 408376.
17. Close-up view of ornament, pores. USNM 408376.
18. Interior male right valve. USNM 408377.



## PLATE 13

[All figures are camera lucida drawings]

Figures 1–2. *Loxoconcha luciensis* n. sp. (p. 28)

1. Exterior left valve, length 0.38 mm. USNM 408379.
2. Exterior right valve, length 0.35 mm. USNM 408380.

3–4. *Palmoconcha russellensis* n. sp. (p. 30).

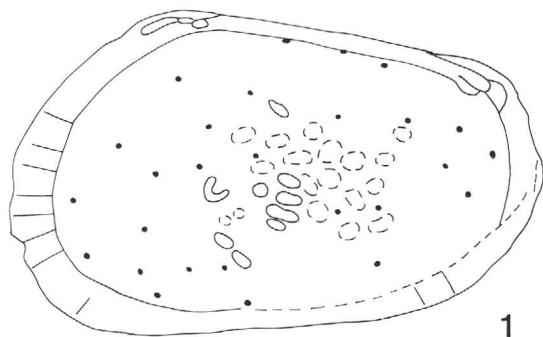
3. Exterior female left valve, length 0.53 mm. USNM 408383.
4. Exterior male left valve, length 0.60 mm. USNM 408384.

5–6. *Palmoconcha krausei* n. sp. (p. 31).

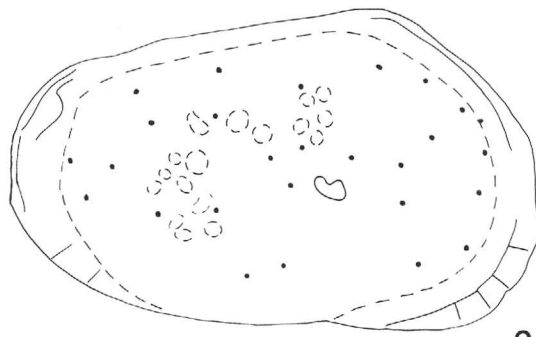
5. Exterior female left valve, length 0.45 mm. USNM 408391.
6. Exterior male left valve, length 0.45 mm. USNM 408392.

7. *Loxoconcha* sp. *G* (p. 28). Exterior female left valve, length 0.55 mm. USNM 408397.

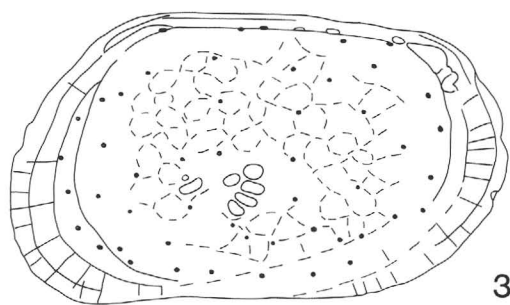
8. *Paracytheridea khantaakensis* n. sp. (p. 33). Exterior left valve, length 0.50 mm. USNM 408408.



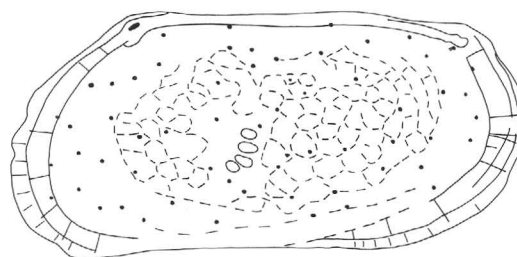
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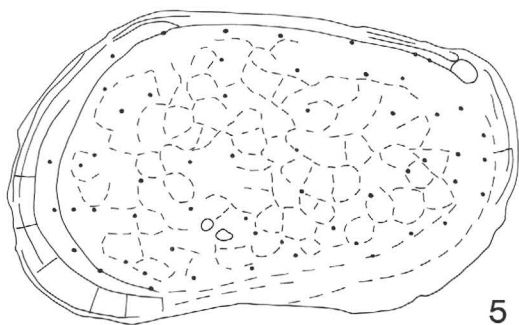
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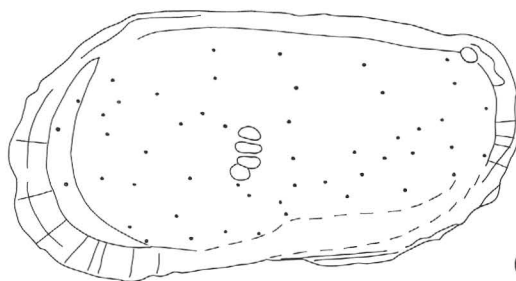
3



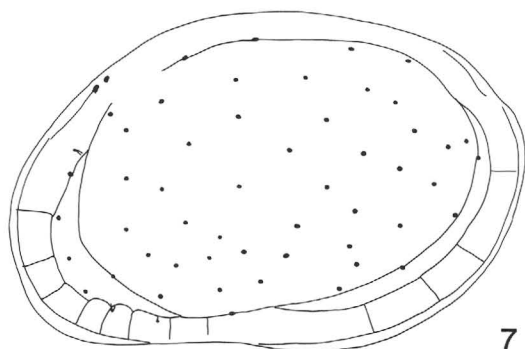
4



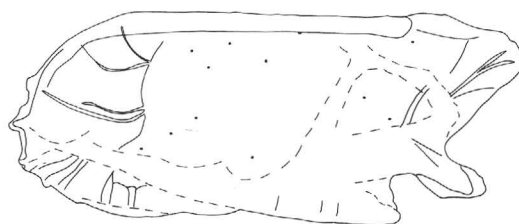
5



6



7



8

## PLATE 14

[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1, 3-8, 10-11, 13-15; bar scale equals 10 micrometers for figs. 2, 12; bar scale equals 1 micrometer for fig. 9]

Figures 1-2. *Sagmatocythere gombosi* n. sp. (p. 29).

1. Interior female left valve. USNM 408378.
2. Central muscle-scar field. USNM 408378.

3, 6-12. *Palmoconcha russellensis* n. sp. (p. 30).

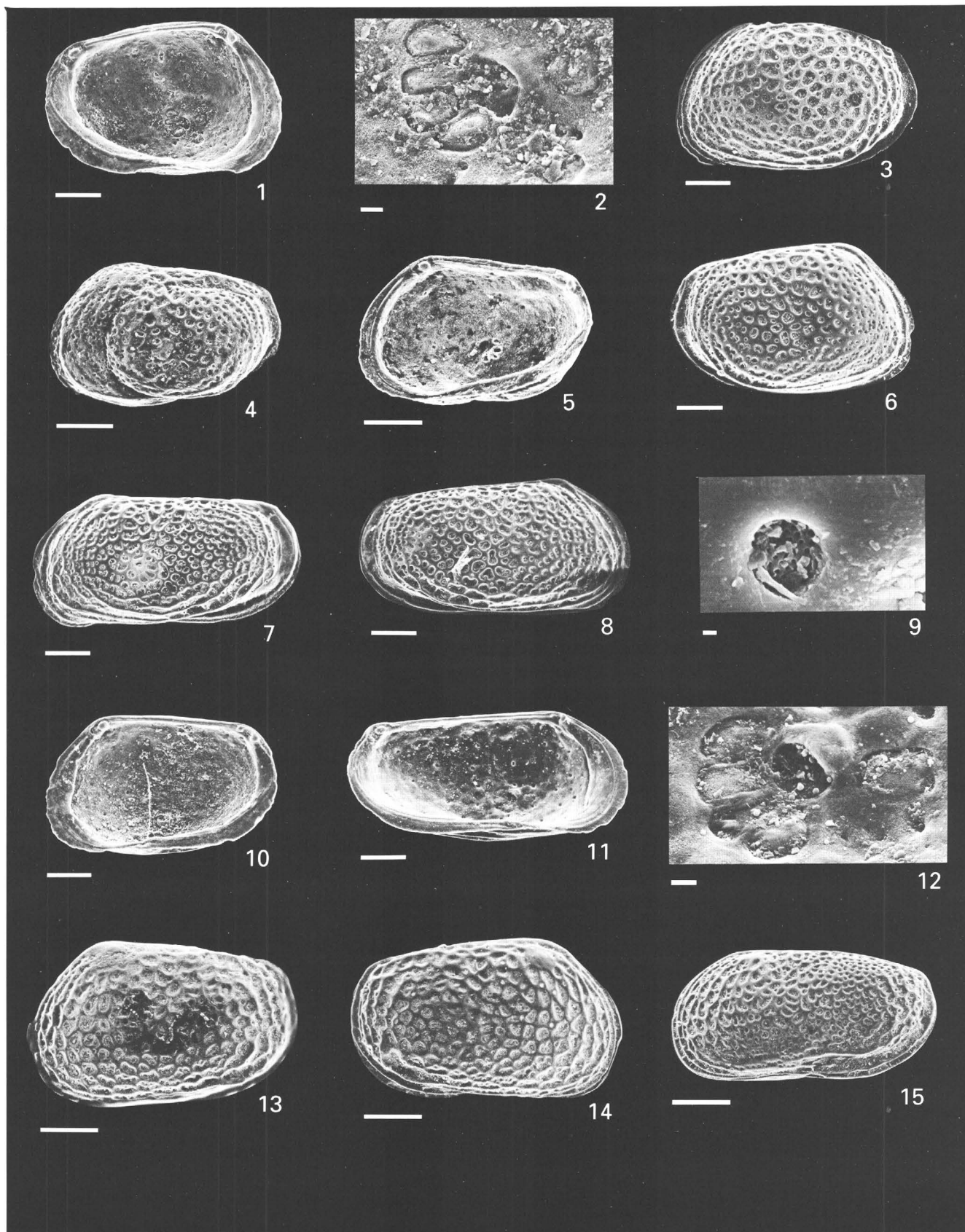
3. Exterior female left valve. USNM 408385.
6. Exterior female right valve. USNM 408386.
7. Exterior male left valve. USNM 408387.
8. Exterior male right valve. USNM 408388.
9. Close-up view of recessed sieve plate, remnant seta. USNM 408387.
10. Interior female right valve. USNM 408389.
11. Interior male left valve. USNM 408390.
12. Central muscle-scar field. USNM 408390.

4-5. *Loxoconcha luciensis* n. sp. (p. 28).

4. Exterior left valve. USNM 408381.
5. Interior right valve. USNM 408382.

13-15. *Palmoconcha krausei* n. sp. (p. 31).

13. Exterior female left valve. USNM 408393.
14. Exterior female right valve. USNM 408394.
15. Exterior male left valve. USNM 408395.



## PLATE 15

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

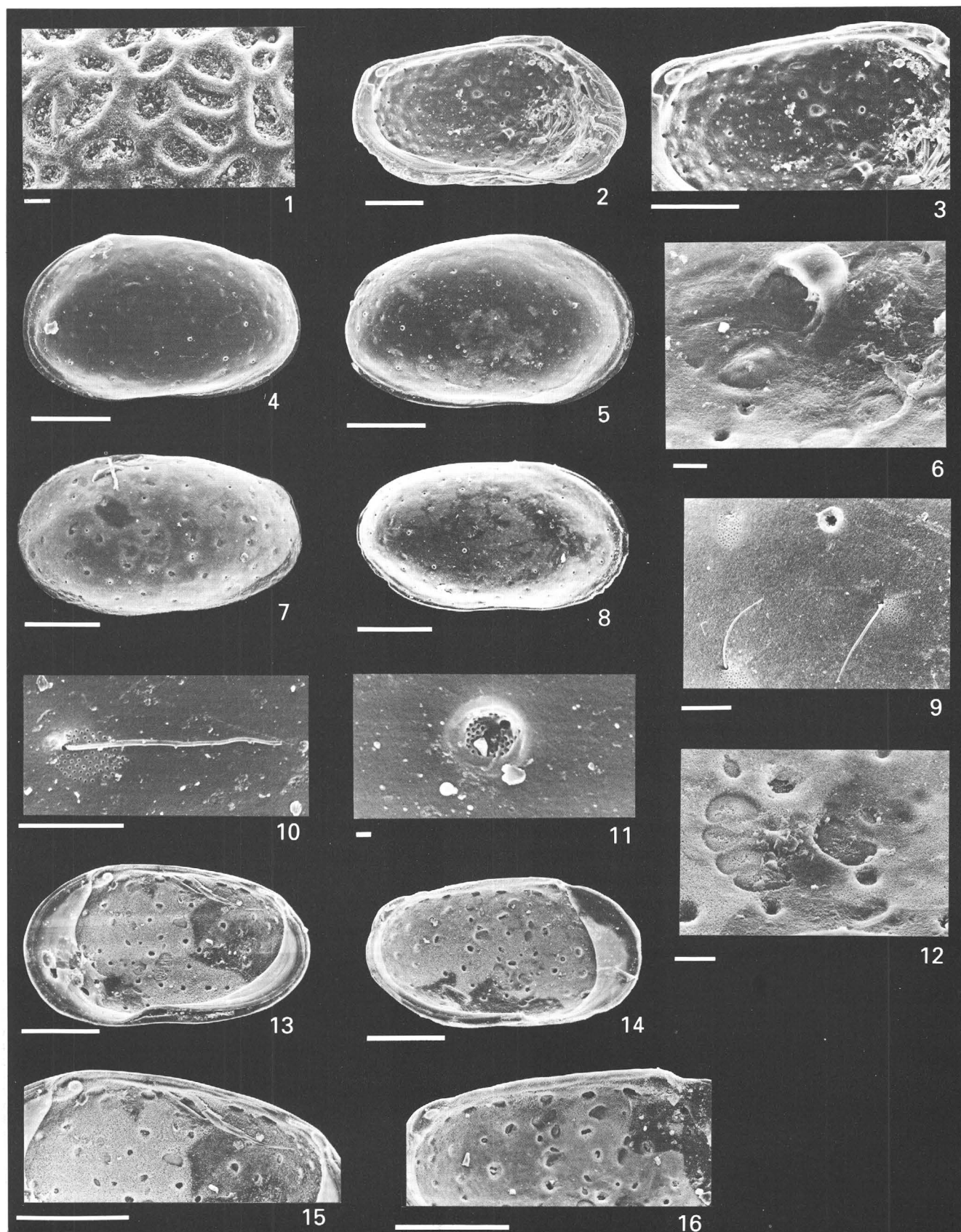
Figures 1–3, 6. *Palmoconcha krausei* n. sp. (p. 31).

1. Close-up view of external reflections of central muscle scars. USNM 408395.
2. Interior female left valve. USNM 408396.
3. Close-up view of hingement, left valve. USNM 408396.
6. Central muscle-scar field. USNM 408396.

4–16. *Loxoconchidea dolgoiensis* n. sp. (p. 32).

4. Exterior left valve. USNM 408399.
5. Exterior right valve. USNM 408400.
7. Exterior male left valve. USNM 408401.
8. Exterior right valve. USNM 408402.
9. Close-up view of sieve, simple pores with seta. USNM 408403.
10. Close-up view of sieve pore, seta. USNM 408404.
11. Close-up view of sieve pore. USNM 408400.
12. Central muscle-scar field. USNM 408405.
13. Interior male right valve. USNM 408406.
14. Interior left valve. USNM 408407.
15. Close-up view of hingement, right valve. USNM 408405.
16. Close-up view of hingement, left valve. USNM 408407.





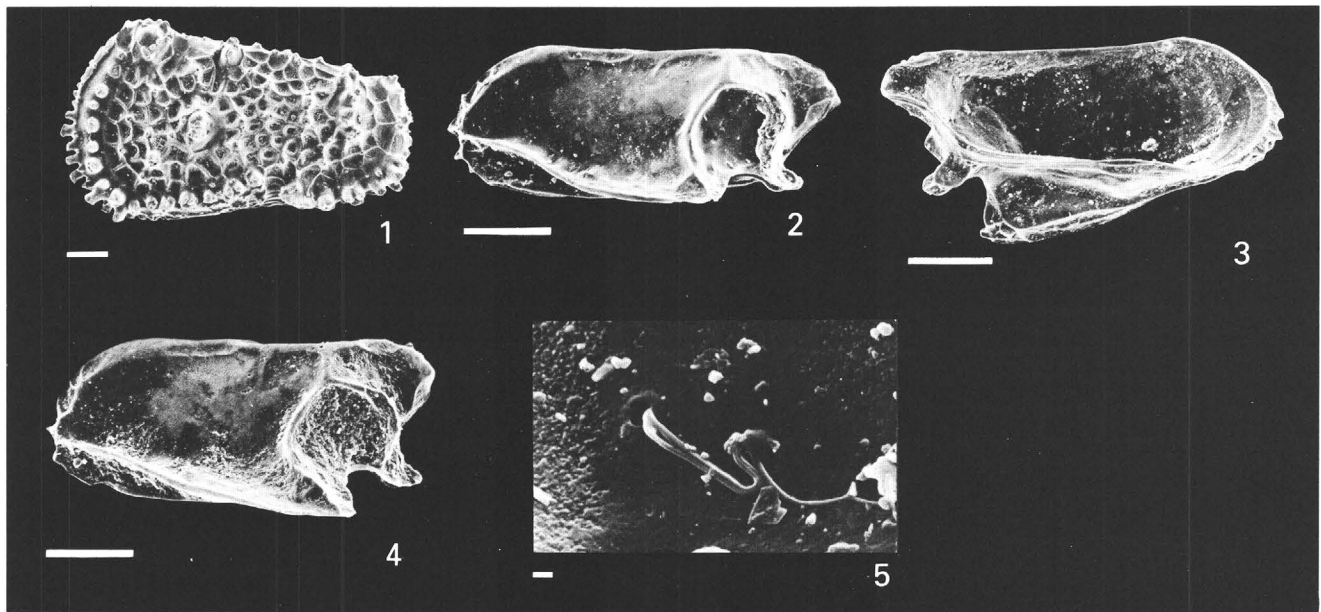
## PLATE 16

[All figures are scanning electron photomicrographs. Bar scale equals 100 micrometers for figs. 1–4; bar scale equals 1 micrometer for fig. 5]

Figure 1. *Acanthocythereis dunelmensis* (Norman, 1865) (p. 3). Exterior male left valve. USNM 408259.

2–5. *Paracytheridea khantaakensis* n. sp. (p. 33).

2. Exterior left valve. USNM 408409.
3. Interior left valve. USNM 408411.
4. Exterior left valve. USNM 408410.
5. Close-up view of normal pore with seta. USNM 408409.



*ACANTHOCYTHEREIS AND PARACYTHERIDEA*







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