Ostracoda of the Family Cytheruridae from the Gulf of Panama

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ABSTRACT

The present paper represents the first in a series on ostracoda from Gulf of Panama, and deals with Cytheruridae which comprise 31 species distributed among nine genera. Three genera: *Serrocytherura*, *Nearocytherura*, and *Lobosocytheropteron*; and twelve species: *Eucytherura sanjoensis*, *E. pinasensis*, *Cytherura nodosa*, *C. purii*, *Semicytherura reticuliforma*, *Serrocytherura panamaensis*, *Kangarina complicata*, *K. delicata*, *K. pervadera*, *Lobosocytheropteron perlasensis*, *L. bartolomensis* and *L. pinasensis*, are described as new.

Several microstructures peculiar to certain genera were recognized with the aid of the scanning electron microscope. Noteworthy are: 1) the weak reticulation in the lateral surface in forms referred to *Kangarina*; 2) in *Eucytherura*, each solum has sieve-plate-like coarse perforations, which correspond to internal openings; 3) in *Paracytheridea*, the presence of papillae, rings, sieve plates and simple pores armored by papillae; and 4) relatively large, simple internal openings in forms of *Kangarina* that serve to distinguish "*Kangarina*."

Under the scanning electron microscope the wide extension of calcified posterior inner lamella which has been a basis for *Semicytherura* is not necessarily distinct from non-calcified one. Under the circumstances, in this report, the species referred to *Semicytherura* are based on the wide extension of posterior inner lamella observed without concern as to whether well calcified or not.

Using frequency of occurrence rather than presence-absence data, four main distributional patterns are recognized among the cytherurid species. The major patterns and their subdivisions are:

I. Widespread pattern: These forms prevail widely on the entire shelf area.

I-A. Bahia San Miguel subdivision: *Semicytherura sandbergi* and *Nearocytherura bananaformis* are found abundantly in the Bahia San Miguel as well as in the outer area. This distribution suggests that those forms do not have any preference for particular environmental condition in this Gulf.

I-B. Punta Garachiné subdivision: *Kangarina pervadera*, *Eucytherura guaymasensis*, and *Cytheropteron assimiloides* are distributed widely, but are absent from Bahia San Miguel, and seem to show preferences for the outer shelf area.

II. Eastern pattern: The forms in this pattern are distributed in the eastern half of the Gulf, with rare occurrence from the other realms.

II-A. Archipelago subdivision: Among the eastern pattern, *Paracytheridea tschoppi*, *P. clara*, and *Cytherura nodosa* occurred dominantly in the areas around Archipielago de las Perlas and Bahia San Miguel, showing a preference for shallow water.

II-B. Bahia Piñas subdivision: *Lobosocytheropteron pinasensis* and *L. bartolomensis* frequently occurred off Bahia Piñas, showing a preference for outer shelf area.

II-C. Off Bahia Piñas subdivision: The forms prevail in the restricted to the southeastern part of the Gulf and are not found on inner shelf. This subdivision may show a narrow tolerance to the environmental condition and represented by *Kangarina complicata*.

III. West-Central pattern: The forms representing this pattern prevail frequently in the southwestern to central parts of the Gulf and are very rarely found from the other realm. The pattern is represented by *Kangarina delicata* and *Eucytherura sanjoensis* which are dominant at depths

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of about 100 m.

IV. Outer Shelf pattern: Four species are found in low numbers at three stations with depths more than 1000 m. Three of these species are not found on inner shelf. These are *Lobosocytheropteron*? sp. A, *L.*? sp. B, and *L.*? sp. C.

INTRODUCTION

The Gulf of Panama is an embayment of the Pacific Ocean on the western continental platform of the Isthmus of Panama and the northwestern part of the continent of South America, lying between 7° and 9° N Latitude and between 78° and 80°20′ W Longitude. It forms the Pacific access to the Panama Canal (Figs. 1, 2).

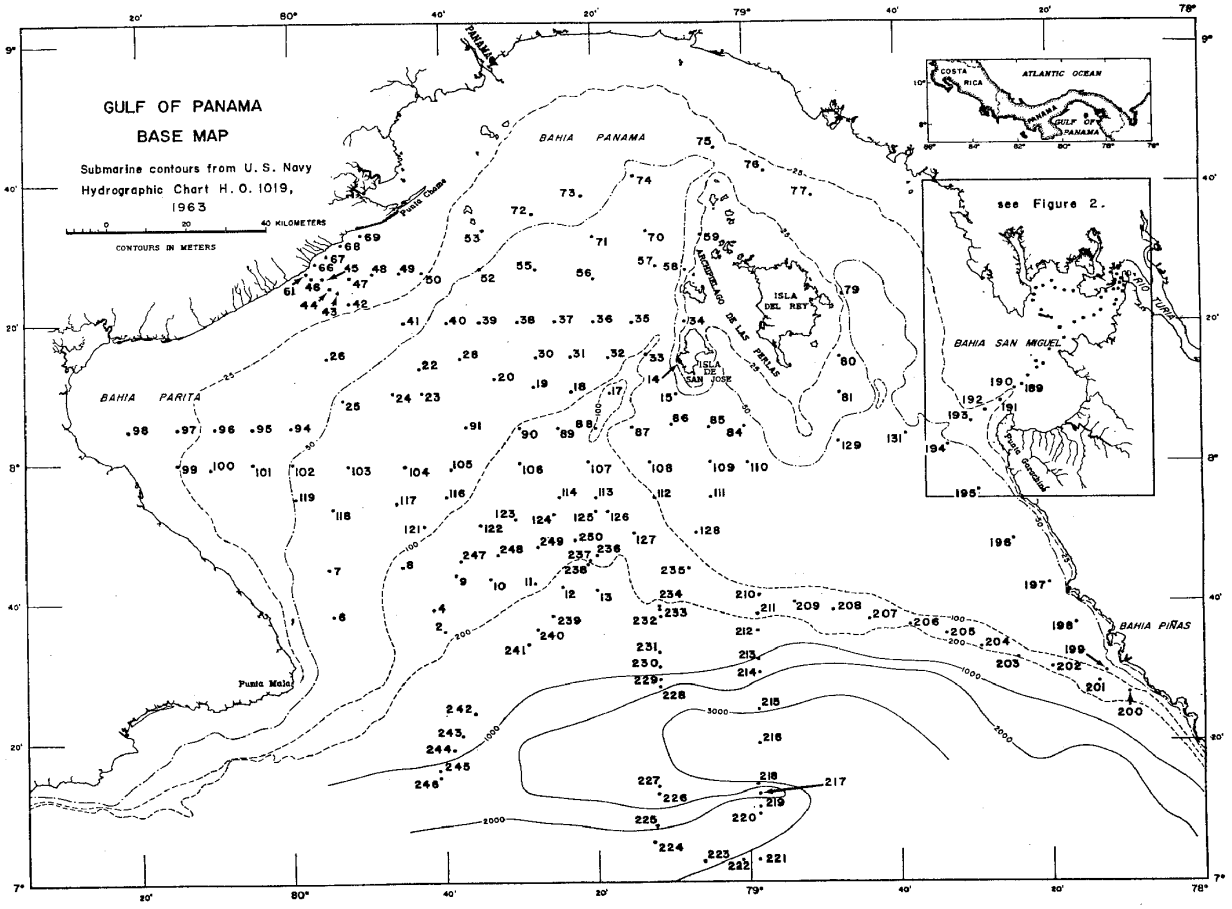

Fig. 1. Station locations in the Gulf of Panama with bathymetry.

The work on the Recent Ostracoda around the Gulf was pioneered by Brady (1869) who reported ostracode faunal list of Colon, Panama. His work was followed by Hartmann (1953–1959) for San Salvador, and Swain and Gilby (1967) for Corinto Bay, western Nicaragua. The Cenozoic forms were described first by Coryell and Fields (1937) from the Miocene Gatun Formation of Panama, and followed with many papers by van den Bold (1946–1967) for Caribbean region.

The Gulf of Panama is in an unique geographic position to delineate the southern fauna of the Pacific Coast and its relationship with northern and Caribbean regions.

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SAMPLES AND OUTLINE OF GULF OF PANAMA

The samples were collected at 234 stations in the Gulf by Glenn B. Morey on a 1963 Cruise of the Scripps Oceanographic vessel *Bonacca*. Each sample consisted of a 10 dram (2.25 cubic inch or 36.696 ml) plastic vial filled with sediment from the dredge sample at each station. The ecological data (Table 1) were provided by Dr. Abraham Golik who worked on the Foraminifera. Salinity and temperature were measured at about every other station, and oxygen concentration measurements were made at a few of the deeper water stations. The samples were taken from almost all areas of the Gulf from beach to the deep water bottom of 3276 m, thus making possible delineation of the distributional ecology of Ostracoda.

The bathymetric features are shown in Fig. 1. The primary deep, which lies transverse to the mouth of the Gulf, and the secondary deep longitudinally in the middle of the Gulf separate it into two parts. The western half shows simple bathymetric change, reducing depth gradually toward the shore. The eastern half is more complicated; there are shallow and sheltered bays located around Archipielago de las Perlas and Bahia San Miguel (Figs. 1, 2).

The temperature of the bottom waters of the Gulf ranges from 27°C in Bahia Parita to 2°C at the deeper stations on the continental slope; the central portion of the Gulf ranges from 20°C to 15°C, and changes rapidly to 5°C on the continental slope (Fig. 3). There are no measurements available for Bahia San Miguel.

The salinity of the bottom waters of the Gulf of Panama proper range from normal marine salinities to slightly less than normal salinity. Bottom waters of the main portion of the outer shelf exceed salinities of 34.0‰ (Fig. 4). Marginal areas of the Gulf have lower salinities of 30 to 33‰, especially north and east of the Archipielago de las Perlas. Within Bahia San Miguel, salinity ranges from 29‰ opposite Punta Garachiné to 20.8‰ at station 170 in the tidal channel of Rio Turia.

The sediments, in general, are medium-grained sand and fine-grained sand with frequent sandy clay, clay and a few pebbly sands on the continental shelf, and almost entirely clay on the continental slope. On the basis of mineral composition, the sediments are divided into five patterns. These characters and distributions are (Fig. 5):

Table 1. Station locations, depth, bottom sediments, salinity, temperature, and oxygen measurements of bottom water

Station	1	2	3	4	5	6	7	8
Latitude (N)	7 31.5	7 36.0	7 40.0	7 39.0	7 37.5	7 35.5	7 45.0	7 45.0
Longitude (W)	79 45.5	79 40.0	79 35.5	79 41.5	79 46.5	79 52.5	79 55.0	79 45.5
Depth (m)	172	172	141	165	112	82	68	110
Bottom sediment	-	-	-	CL	-	FS	MS	FS
Temperature (°C)	-	14.68	-	15.74	-	17.64	-	16.58
Salinity (o/oo)	-	34.935	-	34.889	-	34.783	-	34.849
Oxygen (ml/l)	-	0.76	-	0.91	-	-	-	-

Abbreviation for sediments; CL, Clay; SCL, Sandy clay; FS, Fine-grained sand; MS, medium-grained sand; SG, Sandy gravel; and CA, calcarenite.

9	10	11	12	13	14	15	16	17	18	19
7 44.0	7 43.5	7 43.0	7 42.5	7 42.5	8 14.0	8 10.0	8 09.0	8 10.0	8 10.0	8 11.0
79 38.5	79 34.0	79 29.0	79 24.5	79 20.0	79 09.0	79 09.0	79 13.0	79 18.0	79 23.0	79 28.0
134	168	188	285	316	22	69	91	95	95	89
FS	FS	FS	CL	CL	CA	CA	-	FS	FS	FS
-	14.96	-	13.46	-	-	19.30	-	17.14	-	-
-	34.930	-	34.916	-	-	34.639	-	34.822	-	-
-	0.92	-	-	-	-	-	-	-	-	-

20	21	22	23	24	25	26	27	28	29	30
8 12.0	8 12.5	8 13.5	8 10.0	8 10.0	8 09.0	8 15.0	8 15.0	8 15.0	8 15.0	8 15.0
79 33.0	79 38.0	79 43.0	79 42.5	79 46.5	79 53.0	79 55.0	79 47.0	79 37.5	79 32.0	79 27.5
91	84	77	88	69	57	42	57	77	90	88
-	-	-	FS	MS	MS	-	-	MS	-	MS
17.02	-	19.39	-	20.16	-	26.02	-	18.71	-	16.80
34.766	-	34.454	-	34.327	-	32.923	-	34.546	-	34.794
-	-	-	-	-	-	-	-	0.61	-	-

31	32	33	34	35	36	37	38	39	40	41
8 15.0	8 15.0	8 15.0	8 20.0	8 20.0	8 20.0	8 20.0	8 20.0	8 20.0	8 20.0	8 20.0
79 23.0	70 18.0	79 13.0	79 08.0	79 15.0	79 20.0	79 25.0	79 30.0	79 35.0	79 39.5	79 45.0
91	88	91	38	88	88	82	79	88	73	40
SCL	FS	CL	SCL	SCL	MS	SCL	FS	SCL	CL	SCL
-	17.11	-	-	17.05	17.22	-	17.36	-	18.76	-
-	34.798	-	-	34.787	34.751	-	34.751	-	34.534	-
-	-	-	-	-	-	-	-	-	-	-

Table 1 (continued)

42	43	44	45	46	47	48	49	50	51	52
8 23.0	8 24.5	8 25.0	8 26.5	8 26.5	8 26.5	8 27.0	8 27.0	8 27.0	8 27.5	8 27.5
79 52.0	79 53.5	79 54.5	79 55.5	79 57.0	79 52.0	79 49.0	79 45.5	79 42.5	79 40.0	79 35.0
24	26	20	15	10	16	16	16	26	46	51
CL	CL	FS	-	-	CL	CL	-	-	-	-
27.72	-	-	-	-	-	-	-	-	-	-
30.359	30.906	31.061	30.317	31.783	31.114	30.687	30.492	30.480	-	-
-	-	-	-	-	-	-	-	-	-	-

53	54	55	56	57	58	59	60	61	62	63
8 33.0	8 32.5	8 27.5	8 26.5	8 28.0	8 27.5	8 32.5	8 27.0	8 27.0	8 27.0	8 27.0
79 34.5	79 28.0	79 27.5	79 20.0	79 12.0	79 08.0	79 06.0	79 57.5	79 58.0	79 58.0	79 58.0
51	55	79	77	70	38	27	12	8	8	4
-	-	-	MS	FS	FS	FS	-	FS	-	-
-	-	18.64	-	21.38	-	27.71	-	-	-	-
31.544	-	34.572	-	34.212	-	30.205	31.324	31.178	30.998	30.343
-	-	-	-	-	-	-	-	-	-	-

64	65	66	67	68	69	70	71	72	73	74
8 27.0	8 27.0	8 28.5	8 29.5	8 31.0	8 32.5	8 33.0	8 32.5	8 35.5	8 38.0	8 41.0
79 58.0	79 58.0	79 57.0	79 55.0	79 53.0	79 50.5	79 13.0	79 20.0	79 28.0	79 21.5	79 14.5
beach	beach	5	8	9	10	68	64	46	46	51
-	-	FS	-	FS	FS	CL	-	-	CL	-
-	-	-	-	-	-	-	23.10	25.37	-	24.97
-	-	30.490	30.658	30.802	30.829	-	33.753	33.071	-	33.320
-	-	-	-	-	-	-	-	-	-	-

75	76	77	78	79	80	81	82	83	84	85
8 45.0	8 41.5	8 38.0	8 31.5	8 24.0	8 15.0	8 10.0	8 10.0	8 10.0	8 05.0	8 05.0
79 04.0	78 57.5	78 51.0	78 47.5	78 47.5	78 47.5	78 47.5	78 54.0	79 00.0	79 00.5	79 05.0
42	33	33	37	47	37	30	22	20	69	75
CL	-	-	-	-	-	CA	-	-	FS	CL
25.84	27.12	27.87	-	26.78	-	27.84	-	-	-	-
32.943	30.750	29.322	-	31.687	-	30.884	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

Table 1 (continued)

86	87	88	89	90	91	92	93	94	95	96
8 05.5	8 05.0	8 05.0	8 05.0	8 05.0	8 05.0	8 05.0	8 05.0	8 05.0	8 05.0	8 05.0
79 10.0	79 15.0	79 20.0	79 25.0	79 30.0	79 37.0	79 45.0	79 52.5	80 00.0	80 05.0	80 10.0
77	97	99	102	101	91	79	58	46	40	33
FS	CL	FS	MS	FS	-	-	-	-	-	CL
17.18	-	-	15.83	-	16.99	-	-	26.14	25.82	27.35
34.806	-	-	34.885	-	34.966	-	-	32.864	32.974	32.510
-	-	-	-	-	-	-	-	-	-	-

97	98	99	100	101	102	103	104	105	106	107
8 05.0	8 05.0	8 00.0	7 59.5	8 00.0	8 00.0	7 59.5	7 59.5	7 59.0	8 00.0	8 00.0
80 15.0	80 21.5	80 15.0	80 10.5	80 05.0	80 00.0	79 52.5	79 45.0	79 39.0	79 30.0	79 21.0
27	26	27	37	38	51	66	80	99	102	108
-	SCL	-	FS	-	CL	MS	FS	MS	MS	MS
26.70	27.58	27.94	26.06	27.39	-	-	17.13	16.22	15.80	-
32.810	32.530	29.894	33.002	32.562	-	-	34.748	34.851	34.896	-
-	-	-	-	-	-	-	-	-	-	-

108	109	110	111	112	113	114	115	116	117	118
8 00.0	8 00.0	8 00.0	7 55.0	7 55.0	7 55.0	7 55.0	7 55.0	7 55.0	7 54.0	7 53.5
79 13.0	79 05.0	79 00.0	79 05.0	79 12.0	79 20.0	79 27.0	79 33.5	79 39.5	79 46.5	79 54.5
97	79	66	84	101	128	126	106	90	68	53
FS	-	FS	SCL	FS	MS	MS	-	MS	MS	CL
-	15.81	-	-	15.83	-	15.50	-	16.44	-	24.81
-	34.815	-	-	34.918	-	34.936	-	34.829	-	33.537
-	-	-	-	-	-	-	-	0.60	-	-

119	120	121	122	123	124	125	126	127	128	129
7 55.0	7 50.0	7 51.0	7 51.5	7 52.0	7 52.5	7 53.0	7 53.0	7 50.0	7 50.0	8 03.0
79 59.5	79 50.0	79 42.5	79 35.0	79 30.5	79 25.5	79 20.0	79 18.5	79 15.0	79 07.0	78 48.0
40	62	73	91	99	102	106	155	106	93	58
SCL	-	MS	MS	MS	MS	MS	MS	MS	FS	FS
-	-	17.71	-	15.90	-	15.90	15.40	-	16.79	-
-	-	34.676	-	34.891	-	34.915	34.931	-	34.862	-
-	-	-	-	1.04	-	-	-	-	-	-

Table 1 (continued)

130	131	132	133	134	135	136	137	138	139	140
8 04.0	8 04.0	8 05.0	8 27.0	8 25.9	8 25.6	8 25.2	8 24.8	8 23.8	8 23.9	8 24.4
78 42.5	78 39.0	78 35.0	78 11.5	78 10.2	78 11.4	78 11.3	78 09.9	78 10.0	78 11.2	78 12.0
58	104	51	3	2	4	1	2	1	1	1
-	SG	no	-	CL	CL	CL	CL	CL	CL	CL
-	-	sample	-	-	-	-	-	-	-	-
-	-	-	-	23.515	21.853	22.179	20.984	21.680	21.532	23.198
-	-	-	-	-	-	-	-	-	-	-

141	142	143	144	145	146	147	148	149	150	151
8 23.6	8 23.9	8 20.4	8 21.4	8 22.8	8 23.8	8 24.6	8 24.8	8 25.6	8 24.6	8 24.2
78 13.0	78 13.4	78 20.1	78 20.8	78 22.0	78 22.0	78 21.7	78 20.6	78 19.4	78 18.7	78 17.9
10	20	8	2	2	-	21	5	9	17	8
CL	-	CL	CL	CL	CL	CL	CL	CL	CL	CL
-	-	-	-	-	-	-	-	-	-	-
23.447	-	26.602	26.834	26.283	27.320	26.670	26.145	26.087	26.221	25.499
-	-	-	-	-	-	-	-	-	-	-

152	170	171	172	173	174	175	176	177	178	179
8 24.1	8 27.5	8 27.4	8 26.2	8 25.2	8 24.2	8 22.9	8 22.4	8 21.4	8 20.7	8 20.3
78 16.5	78 10.2	78 10.7	78 10.7	78 10.7	78 10.7	78 10.8	78 11.4	78 13.0	78 14.1	78 15.3
5	33	38	38	31	24	26	24	20	29	20
CL	CL	CL	CL	CL	CL	CL	MS	CL	CL	CL
-	-	-	-	-	-	-	-	-	-	-
25.405	20.832	20.937	21.771	22.178	22.402	23.214	22.835	24.687	25.019	25.747
-	-	-	-	-	-	-	-	-	-	-

180	181	182	183	184	185	186	187	188	189	190
8 20.2	8 18.9	8 19.8	8 17.7	8 15.9	8 14.1	8 14.7	8 13.3	8 12.1	8 11.2	8 10.4
78 19.7	78 18.5	78 16.8	78 17.9	78 19.8	78 21.7	78 20.7	78 21.8	78 22.9	78 23.6	78 24.6
38	26	24	22	27	26	18	15	13	13	24
CL	CL	CL	SCL	CL	CL	CL	CL	CL	SCL	SCL
-	-	-	-	-	-	-	-	-	-	-
27.497	27.387	26.828	28.414	29.403	29.562	27.483	27.905	28.313	28.698	29.378
-	-	-	-	-	-	-	-	-	-	-

Table 1 (continued)

191	192	193	194	195	196	197	198	199	200	201
8 08.8	8 07.3	8 05.8	8 02.2	7 56.0	7 49.0	7 43.0	7 36.0	7 30.0	7 27.0	7 28.5
78 26.6	78 28.5	78 30.5	78 33.5	78 29.5	78 25.0	78 20.0	78 17.0	78 13.0	78 10.0	78 14.0
33	38	44	57	71	88	84	88	77	157	148
CL	CL	SCL	SG	SG	FS	FS	SCL	CL	CL	CL
-	-	-	22.20	17.60	17.57	17.41	16.84	17.28	-	-
29.362	29.195	32.934	33.649	34.844	34.836	34.852	34.917	34.909	-	-
-	-	-	-	-	-	-	-	-	-	-

202	203	204	205	206	207	208	209	210	211	212
7 30.5	7 32.0	7 33.5	7 35.5	7 36.5	7 37.5	7 39.0	7 40.0	7 41.0	7 38.5	7 36.0
78 20.0	78 24.5	78 29.5	78 34.0	78 39.0	78 44.0	78 49.0	78 54.0	78 59.0	78 59.0	78 59.0
119	115	137	113	113	113	119	117	117	128	505
FS	FS	-	CL	MS	FS	FS	FS	SCL	CL	CL
15.60	-	15.90	-	15.41	-	16.16	-	15.94	15.50	8.52
34.939	-	34.957	-	34.941	-	34.936	-	34.944	34.951	34.667
-	-	-	-	-	-	-	-	-	1.20	0.11

213	214	215	216	217	218	219	220	221	222	223
7 32.0	7 30.0	7 25.0	720.0	7 13.0	7 14.0	7 11.0	7 10.0	7 03.5	7 03.5	7 03.5
78 59.0	78 59.0	78 59.0	78 59.0	78 59.0	78 59.0	78 59.0	78 59.0	78 59.0	79 01.0	79 06.0
1025	1749	2900	3138	1775	2447	2035	2599	3276	3038	2741
CL	-	CL	CL	CL	CL	CL	CL	CL	CL	CL
4.33	2.85	2.00	1.99	2.59	2.04	2.27	2.02	-	1.96	1.98
34.592	34.636	34.675	34.678	34.661	34.678	34.656	34.671	-	34.677	34.671
1.07	1.73	2.42	2.46	2.01	2.42	2.07	2.35	-	2.44	2.42

224	225	226	227	228	229	230	231	232	233	234
7 06.0	7 04.0	7 13.0	7 14.0	7 28.0	7 29.0	7 31.0	7 33.0	7 38.0	7 39.0	7 39.0
79 12.5	79 12.5	79 12.0	79 12.0	79 12.0	79 12.0	79 12.0	79 12.0	79 12.0	79 12.0	79 12.0
2203	1715	2225	2602	1629	1052	752	562	425	336	262
CL	CL	-	CL	CL	CL	CL	CL	SCL	SCL	SCL
2.13	2.60	2.16	2.00	-	4.59	6.78	7.60	9.00	10.19	12.96
34.676	34.617	34.664	34.671	-	34.592	34.626	34.639	34.695	34.598	34.882
2.18	1.94	2.18	2.41	-	1.00	0.36	0.21	0.11	0.16	0.55

Table 1 (continued)

235	236	237	238	239	240	241	242	243	244	245
7 45.0	7 47.0	7 46.0	7 46.0	7 38.0	7 36.0	7 34.0	7 24.0	7 21.0	7 19.0	7 16.0
79 07.0	79 20.0	79 21.0	79 21.0	79 26.0	79 28.0	79 29.0	79 36.0	79 38.0	79 39.0	79 41.0
104	119	165	194	230	309	410	640	823	952	1151
-	CL	CL	CL	SCL	SCL	CL	CL	CL	CL	CL
16.76	15.84	13.95	-	10.58	13.57	8.97	7.24	5.92	5.20	4.38
34.888	34.909	35.008	-	34.777	34.898	34.695	34.629	34.591	34.590	34.596
1.54	1.45	0.77	-	0.22	0.71	0.18	0.28	0.58	0.86	1.10

246	247	248	249	250	251	252
7 15.0	7 46.0	7 47.0	7 48.0	7 49.0	8 24.0	8 33.0
79 41.0	79 38.0	79 33.0	79 28.0	79 23.0	79 17.0	79 20.0
1404	139	154	150	154	82	64
CL	SCL	FS	SCL	FS	-	-
3.26	-	-	16.38	15.02	-	-
34.628	-	-	34.933	34.957	-	-
1.54	-	-	0.88	1.08	-	-

1) sediments around the Archipielago de las Perlas; abundant broken shell material,

2) between Punta Chame and Bahia Parita, and for some distance into the central Gulf; sediments have an abundance of fresh quartz, both angular fragments and euhedral crystals,

3) western part of the central Gulf, plus Bahia Panama and Bahia Parita; sediments have a mixture of angular quartz and more or less well rounded glauconitic and lithic grains,

4) eastern part of the Gulf; sediments with a predominance of well rounded glauconitic and lithic grains, and

5) clays of the continental slope, often with radiolaria and diatoms.

In this study the entire 20 to 150 mesh fraction of each sample was searched for Ostracoda.

The figured specimens are deposited in the University of Minnesota Paleontological Collections, as Abbr. UMPC 12255 to 12346.

OSTRACODA DISTRIBUTION IN THE GULF OF PANAMA

Of 234 stations, ostracode specimens were found in samples from 121 stations distributed widely in the Gulf, covering almost all ecological realms.

The ostracode frequency depends clearly upon sediment character, water depth, and salinity. The following general statements can be made: 1) more prolific samples were encountered on poorly sorted, medium- to fine-grained sand bottom than on sandy clay and clay bottom; 2) stations at slope or abyssal depths contain only a few specimens or in many cases are entirely barren; 3) increasing salinity corresponds with increases in

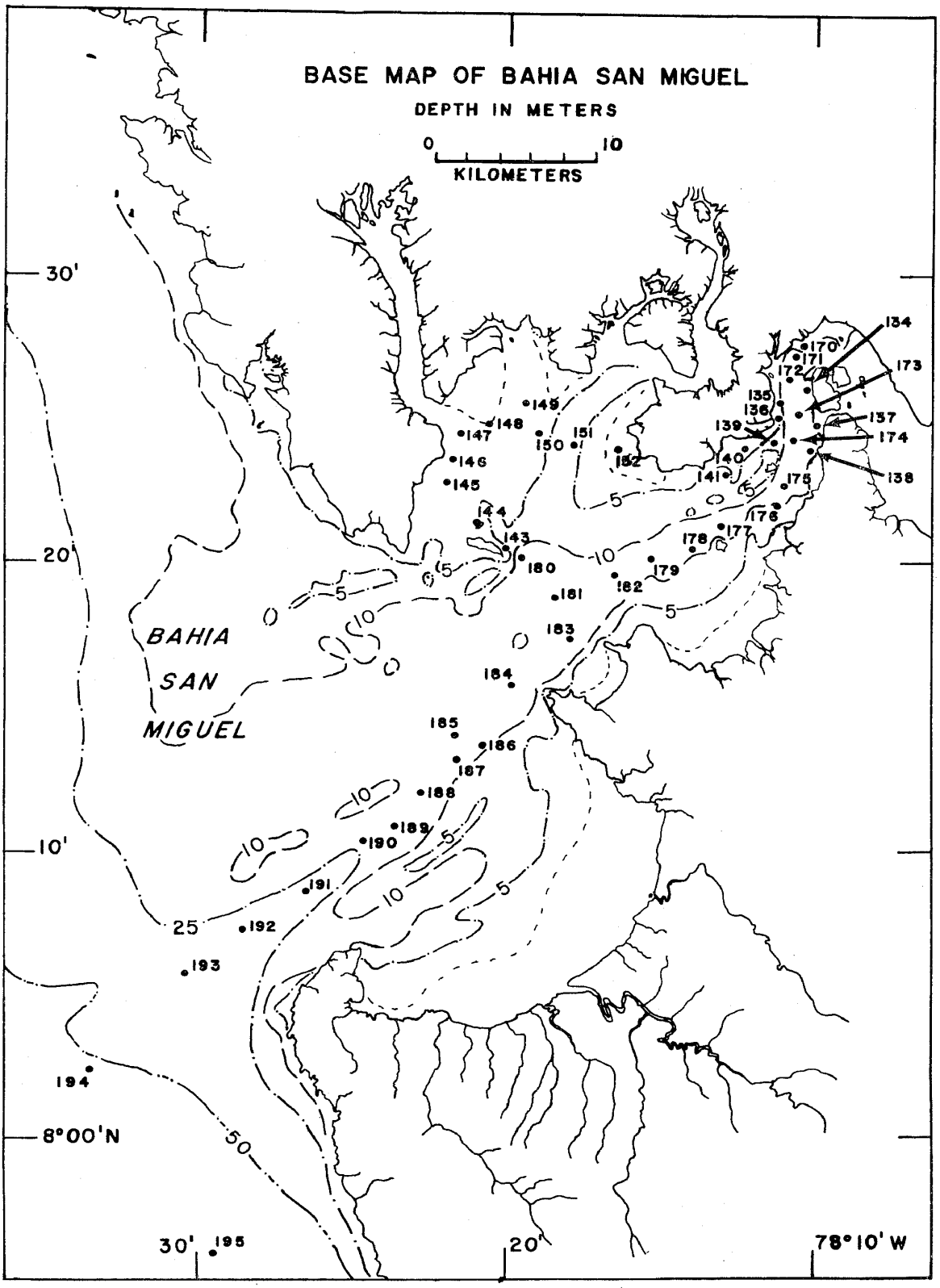

Fig. 2. Station locations in Bahia San Miguel with bathymetry.

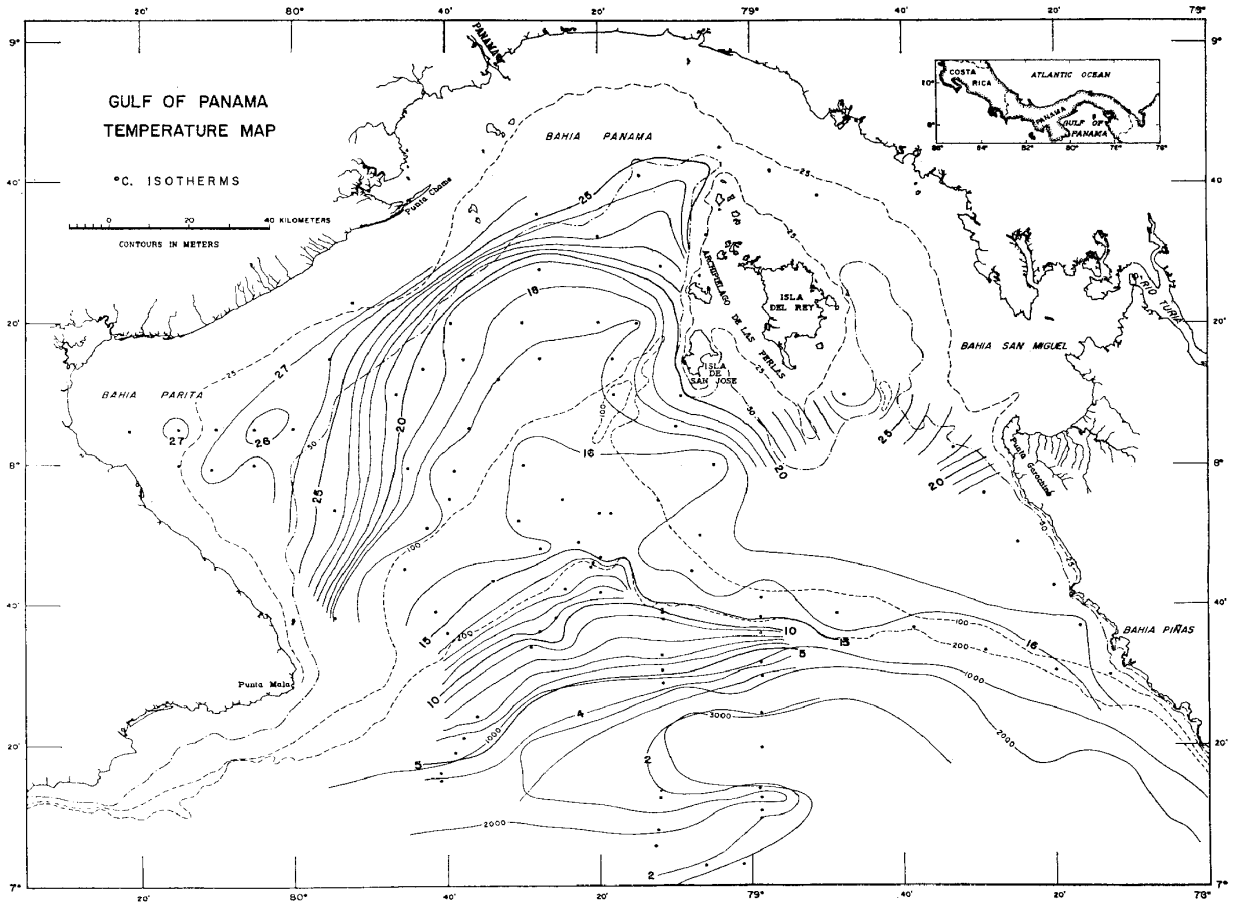

Fig. 3. Map showing the temperature gradients in the Gulf of Panama.

both number of specimens and species in estuarine and shallow shelf areas (Bahia San Miguel).

At present, more than 100 ostracode species are expected to be recognized from all the stations. The Cytheruridae of the Gulf comprise 31 species distributed among nine genera. Nearly half of the species do not occur frequently enough for detailed examination. Therefore, in this report, only a brief statement will be given as to the distribution of 17 species, some of which are relatively dominant in the shelf area, and rare deep water forms.

On the shelf area of the Gulf, several species that prevail widely are *Semicytherura sandbergi*, *Kangarina pervadera*, *Nearocytherura bananaformis*, *Eucytherura guaymasensis*, and *Cytheropteron assimiloides*. Among these *Semicytherura sandbergi* is the most widely distributed, and is dominant in the areas off Bahia Piñas, near the outer edge of the Gulf, west of the Archipielago de las Perlas, off Bahia Parita and part of Bahia San Miguel. *Nearocytherura bananaformis* is, in general, sparsely but widely distributed in entire gulf area and relatively common at the mouth of Bahia San Miguel. *Kangarina pervadera* also occurs widely in the Gulf with dominant occurrence off Bahia Piñas and Bahia Parita; it predominates in the shallow area near the Archipielago de las Perlas but is not known from the Bahia San Miguel. *Eucytherura guaymasensis* is dominant off Punta Mala, Bahia Parita, and Bahia Piñas, but is rare in the general Gulf area. It occurs in shallow water near Archipielago de las Perlas and Bahia Parita: more or less similar in distribution is *Cytheropteron assimiloides* which may be fond of more open sea water because of its more restricted dominant occurrence off Bahia Piñas and Punta Mala.

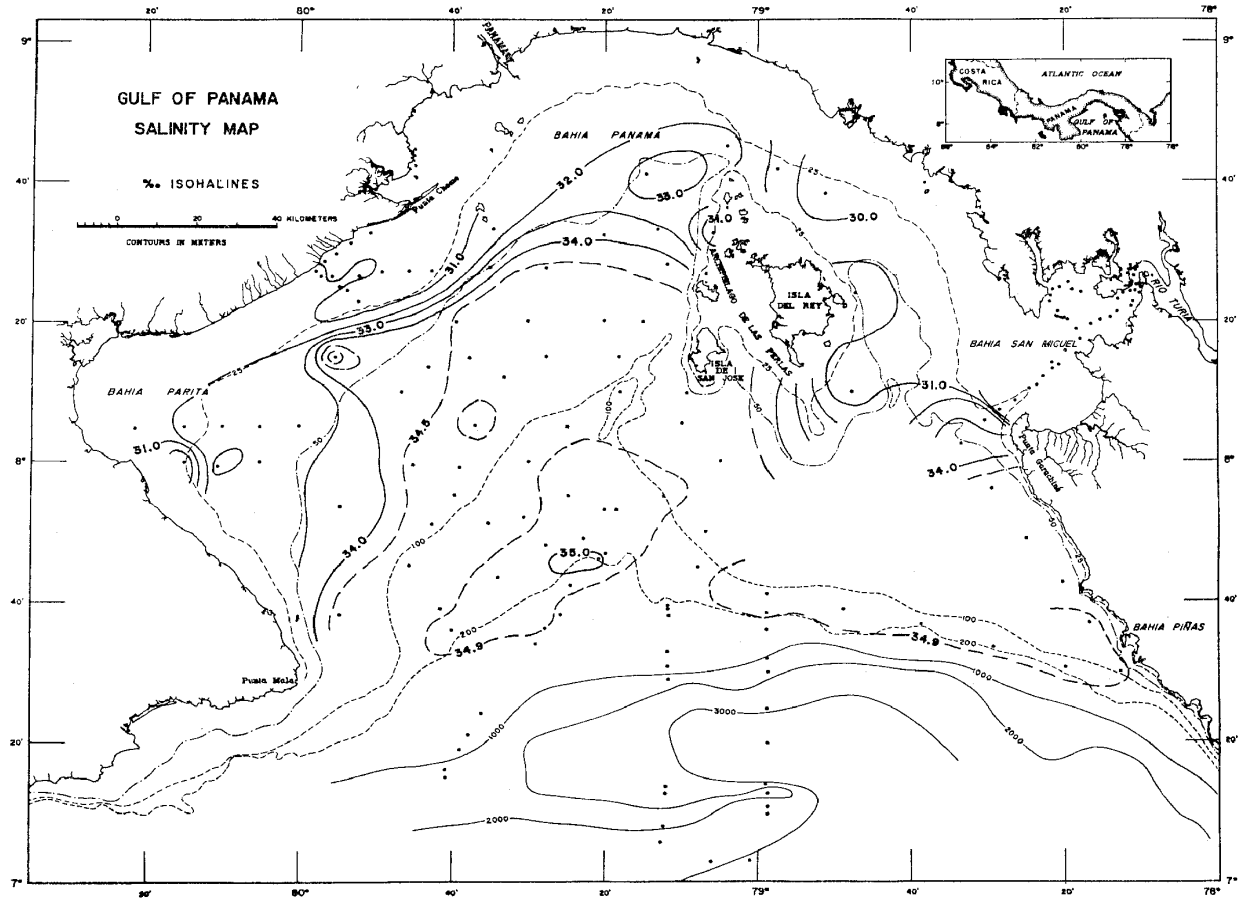

Fig. 4. Map showing the salinity distribution in the Gulf of Panama.

Several species seem to flourish only in the eastern half of the shelf area, although some of these are also found in central part. These are: *Paracytheridea tschoppi, P. clara, Cytherura nodosa, Kangarina complicata, K. quellita, Lobosocytheropteron pinasensis,* and *L. bartolomensis. Paracytheridea tschoppi, Cytherura nodosa,* and *Paracytheridea clara* are widely distributed in the eastern half of the Gulf. The former two species are relatively abundant around the Archipielago de las Perlas and Bahia San Miguel and the other species occur only around the Archipielago de las Perlas. *Kangarina quellita, Lobosocytheropteron pinasensis,* and *L. bartolomensis* occur frequently in the eastern half of the Gulf. The former species occurs abundantly between Punta Garachiné and Archipielago de las Perlas and may show its preference for intermediate depth. In contrast the latter two forms dominate around Bahia Piñas, suggesting their preference for open sea and/or deeper waters. *Kangarina complicata* is exceptional among the cytherurid species of the Gulf of Panama; its distribution is narrowly restricted to a southeastern quarter of the Gulf and is abundant around Bahia Piñas.

The two species having frequent occurrence in the western half to central part of shelf area of the Gulf are *Kangarina delicata* and *Eucytherura sanjoensis.* Both species are often found in the area west of Archipielago de las Perlas, but are very sporadic in eastern half. *Eucytherura sanjoensis* is dominant at depths of more or less 100 m in west-central part of the Gulf.

As to cytherurid species in the deep-water area off the shelf, only a few fragmental data are available. In the realm deeper than 1000 m, only four species (*Lobosocythero-*

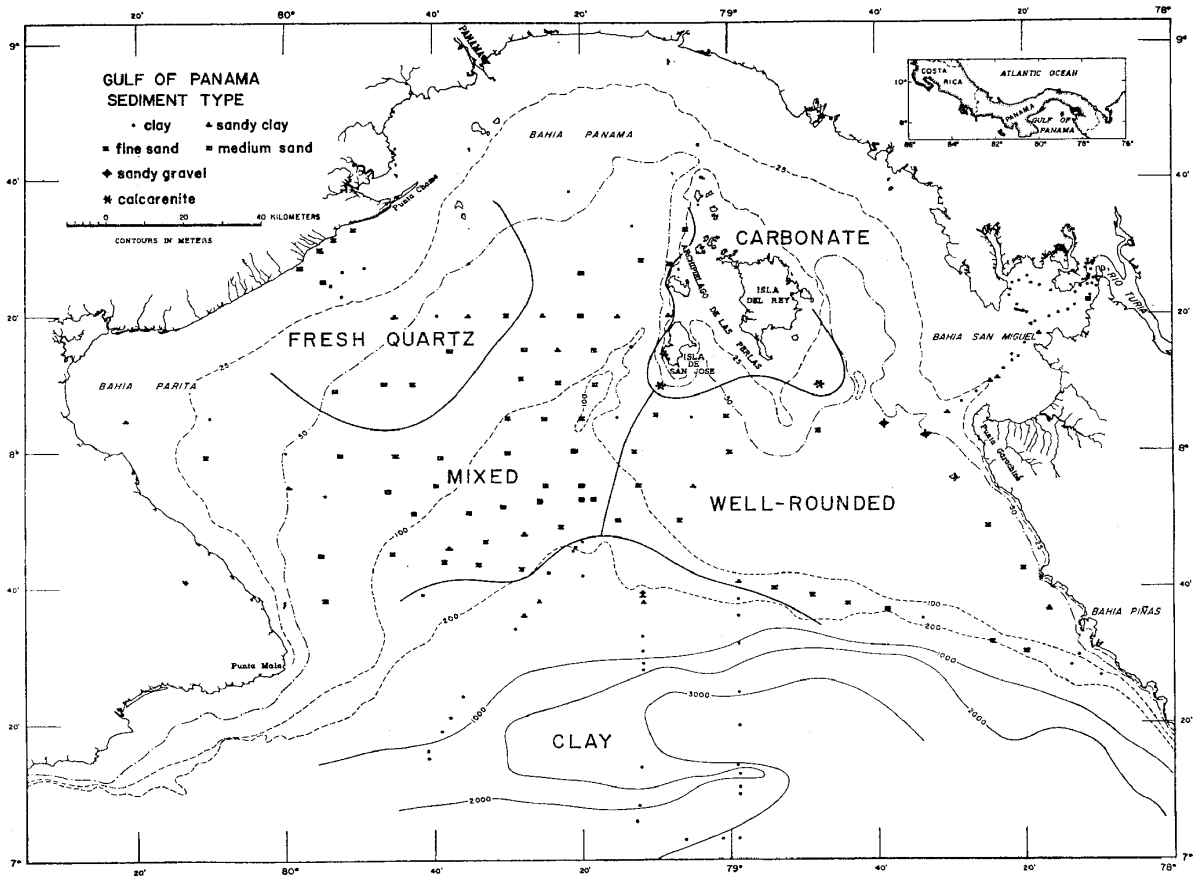

Fig. 5. Map showing the bottom sediment type and distribution of each sediment pattern based on mineral composition.

pteron bartolomensis, *L.*? sp. A, *L.*? sp. B, and *L.*? sp. C) are very rarely found at only a few stations. *Lobosocytheropteron bartolomensis* is, as already stated above, abundant off Bahia Piñas in deep sea and/or open sea waters, although its distribution is also rather wide on the shelf. On the other hand, the other three species are very narrowly and rarely distributed: *Lobosocytheropteron*? sp. A is found at only two stations at depths of 262 m and 1404 m; *Lobosocytheropteron*? sp. B is found rarely at six stations, all of which are at depths more than 110 m; *Lobosocytheropteron*? sp. C is represented by only one valve found at depth of 3276 m. Therefore, it is suggested that the three unnamed species of *Lobosocytheropteron*? may be confined to deep water.

There appear to be four patterns of cytherurid ostracode species distribution, some of which may be subdivided, taking their relative frequencies into consideration. They are:

I. Widespread pattern:

I-A. Bahia San Miguel subdivision: *Semicytherura sandbergi* and *Nearocytherura bananaformis*,

I-B. Punta Garachiné subdivision: *Kangarina pervadera*, *Eucytherura guaymasensis*, and *Cytheropteron assimiloides*,

II. Eastern pattern:

II-A. Archipielago subdivision: *Paracytheridea tschoppi*, *P. clara*, and *Cytherura nodosa*,

II-B. Bahia Piñas subdivision: *Lobosocytheropteron pinasensis* and *L. bartolomensis*,

II-C. Off Bahia Piñas subdivision: *Kangarina complicata*,

III. West-Central pattern: *Kangarina delicata* and *Eucytherura sanjoensis*, and

IV. Outer Shelf pattern: *Lobosocytheropteron*? sp. A, *L.*? sp. B, and *L.*? sp. C.

MORPHOLOGY OF CYTHERURIDAE

Among the forms of Cytheruridae, there are several important discriminating characters. These are: outline, ornamentation, hingement, arrangement of scars, and marginal characters, especially features of the inner lamella.

In this report, several micro-ornamentation features of the carapace are also used for discrimination. Emphasis has been placed upon the width of the extension of the posterior inner lamella, the presence or absence of a vestibule, and the presence or absence of Y-shaped marginal pore canals in the posterior end.

The amount of calcification of the posterior inner lamella is not easy to be estimated. Viewed under the SEM the wide extension of well-calcified posterior inner lamella, which has been a basis for recognizing *Semicytherura*, is not necessarily distinct from that of the inner lamella not fully calcified. The wide extension of posterior inner lamella is found in forms referred to *Kangarina*, although seemingly not fully calcified. Other cytherurid forms referable to *Paracytheridea*, *Cytheropteron*, *Lobosocytheropteron*, and *Eucytherura* do not possess this extension. Therefore, the practical observation is made on the presence or absence of a wide extension rather than on the degree of calcification of the posterior inner lamella. In this report, the species referred to *Semicytherura* are based on the presence of the posterior extension whether it is well calcified or not.

All the cytherurid forms from the Gulf of Panama may be separated into four groups by the presence of: 1) a vestibule, 2) Y-shaped marginal pore canals in posterior end, and 3) wide extension of posterior inner lamella.

Group 1. This group consists of three genera of *Cytherura*, *Nearocytherura*, and "*Kangarina*," characterized by Y-shaped marginal pore canals in posterior end, no vestibule, and wide extension of posterior inner lamella.

Group 2. This group is characterized by having Y-shaped marginal pore canals in posterior end, wide extension of posterior inner lamella, and no vestibule, and is represented by *Semicytherura*, *Serrocytherura*, and *Kangarina*.

Group 3. This group consists of *Paracytheridea* and has none of the three characters mentioned above.

Group 4. This group consists of *Cytheropteron*, *Lobosocytheropteron*, and *Eucytherura*, and is characterized by a distinct vestibule in anterior marginal area, no wide extension of posterior inner lamella and Y-shaped marginal pore canals in posterior end.

Hinge structure and muscle scar patterns both were used for generic determinations. In Group 1, *Nearocytherura* can be distinguished from *Cytherura* and "*Kangarina*" by having subdivided adductor muscle scars in upper two rows of four; *Cytherura* can be separated from "*Kangarina*" by the smooth median element of the hinge instead of the bifid anterior end and polylobate posterior end of the latter.

In Group 2, *Serrocytherura* can be easily separated from the others by the coarsely denticulate median element of its hinge and V-shaped frontal scar that opens anteriorly; *Semicytherura* can be separated from *Kangarina* by the smooth median element of its hinge instead of the bifid or trilobate anterior end and polylobate posterior end of the median

element of the latter genus. *Paracytheridea* in Group 3, is characterized by its peculiar muscle scar pattern, proceeding from subcentral depression upward to mingle with distinct, large dorsal scars.

In Group 4, *Eucytherura* may be easily distinguished from the others by a hinge with smooth, very prominent anterior and posterior teeth, and a coarsely denticulate median element; also by the possession of small, rounded adductor muscle scars with two separated small frontal scars instead of an oblong one. *Cytheropteron* is separated from *Lobosocytheropteron* by the distinct median element of the hinge: the posterior half of the latter consists of a tooth-socket-tooth-socket series with a postjacent trilobate posterior tooth.

In addition to this characteristic hingement, *Kangarina* also possess a particular character; its internal lamella is especially wide along the posterior half of the ventral margin. This character is found only in *Kangarina* and "*Kangarina.*" The two can be distinguished from each other by the simple, widely spaced relatively large internal openings of normal pore canals of the former, in contrast to those of the latter in which there are celate sieve plates open internally. A fluted caperation in each fossa is also a particular external character of "*Kangarina.*"

The forms of *Eucytherura* are very interesting in possessing the unfamiliar perforations in each solum, all of which, in most cases, precisely correspond to internal openings. Those relatively coarse perforations starting from the internal surface may suggest a different pattern of perforation from the usual sieve-plate pore canals. At present the writers consider them as clustered simple pore canals free from the muri.

Among cytherurid forms from the Gulf of Panama, complete sieve plates can be seen only in *Paracytheridea.* The three species of *Paracytheridea* have consistently complete lateral sieve plates armored by fine or coarse papillae. In addition, this genus always has simple pores also armored by papillae, small rings of circular ornamentation on the lateral surface, and distinct subcentral nodes. Aside from the subcentral nodes, none of the characters is observed in other cytherurids.

Incomplete sieve plates possessing a few to several celate irregular perforations are found in *Serrocytherura, Cytheropteron,* and *Lobosocytheropteron. Lobosocytheropteron,* moreover, possesses a rather deep and horizontally elongated pit in posterior third of dorsal margin of right valve and many small pits arranged in one to several lines in the posterior half of ventral margin. None of the pits seems to have fine structure.

The most particular and consistent external cytherurid micro-ornamentation may be the micro-reticulation in *Kangarina.* This ornamentation small-scaled reticulation is not clear under an optical microscope, but with the scanning electron microscope, the reticulation is observed on all the species of *Kangarina* studied. This character may require that "*Kangarina*" of this paper be separated from *Kangarina,* because the former does not possess this ornamentation. Thus "*Kangarina*" may differ from *Kangarina* in two important points: numerous internal celate sieve-plate pore canals and regular fluted caperation instead of large, widely spaced simple pores and consistent micro-reticulation.

A warty tubercle penetrated at its center by a simple pore is always observed in *Eucytherura,* but not in other cytherurids. Thus, this character may be also a feature of *Eucytherura* in addition to clustered, numerous simple pore canals.

Table 2. List of Cytheruridae ostracode species from Gulf of Panama

Station	4	6	7	8	9	13	14	15	17
Eucytherura complexa (Brady, 1867)	-	1	-	-	-	-	-	-	-
Eucytherura guaymasensis (Swain, 1967)	-	4	13	9	4	-	-	3	-
Eucytherura pinasensis, n. sp.	-	-	-	16	-	-	-	-	2
Eucytherura sanjoensis, n. sp.	-	-	-	13	1	-	-	-	5
juveniles of eucytheruras	4	2	6	-	1	4	-	-	-
Cytherura bajacala Benson, 1959	-	-	-	-	-	1	-	-	1
Cytherura nodosa, n. sp.	-	-	-	-	-	-	1	-	-
Cytherura purii, n. sp.	-	-	-	-	-	-	-	-	-
Serrocytherura panamaensis, n. sp.	-	-	-	2	-	-	-	2	-
Semicytherura sandbergi (Morales, 1966)	-	1	3	-	-	2	-	7	-
Semicytherura johnsonoides (Swain, 1967)	-	-	-	-	-	-	-	-	-
Semicytherura reticuliforma, n. sp.	-	-	-	-	-	-	-	1	-
Semicytherura sp. A	-	-	-	-	-	-	-	-	-
Nearocytherura bananaformis (Coryell and Fields, 1937)	-	-	-	-	-	1	-	-	-
Nearocytherura? raadshooveni (van den Bold, 1946)	-	-	2	-	-	-	-	-	-
Kangarina complicata, n. sp.	-	-	-	-	-	-	-	-	-
Kangarina delicata, n. sp.	-	4	-	3	-	-	-	2	4
Kangarina pervadera, n. sp.	-	14	1	-	-	-	-	-	-
Kangarina quellita Coryell and Fields, 1937	-	3	-	3	-	-	-	2	-
Kangarina sp. B	-	-	-	-	-	-	-	-	-
"Kangarina" sp. A	-	-	-	-	-	-	-	-	-
juveniles of cytheruras	-	-	-	-	-	-	-	-	-
Paracytheridea clara Coryell and Fields, 1937	-	-	-	-	-	-	4	6	-
Paracytheridea tschoppi van den Bold, 1946	-	-	-	-	-	4	12	25	-
Paracytheridea washingtonensis Puri, 1954	-	-	-	-	-	-	2	-	-
Cytheropteron assimiloides Swain, 1967	-	32	1	32	1	-	-	10	1
Lobosocytheropteron altatensis (Swain, 1967)	-	3	1	-	-	-	-	3	2
Lobosocytheropteron bartolomensis, n. sp.	-	-	-	4	1	-	-	-	-
Lobosocytheropteron perlasensis, n. sp.	-	-	-	-	-	-	-	-	-
Lobosocytheropteron pinasensis, n. sp.	-	-	-	3	-	-	-	-	-
Lobosocytheropteron? sp. A	-	-	-	-	-	-	-	-	-
Lobosocytheropteron? sp. B	1	-	-	3	-	-	-	-	-
Lobosocytheropteron? sp. C	-	-	-	-	-	-	-	-	-

18	19	23	26	28	30	31	32	33	34	35	36	38	39	58	59	61	69	70	73
-	-	-	-	-	-	2	-	-	4	-	-	-	-	1	1	-	-	-	-
1	-	-	-	3	-	1	-	-	7	1	7	-	-	7	-	-	-	6	-
-	1	-	-	2	1	-	-	-	2	1	3	-	-	-	-	-	-	3	-
8	11	-	-	1	52	2	7	-	-	2	38	2	-	-	-	-	-	-	-
-	-	-	-	2	9	1	-	-	1	-	4	-	-	4	-	-	-	-	-
-	-	-	-	-	-	2	1	-	6	5	-	-	-	-	2	-	-	-	-
-	-	-	-	-	-	-	-	-	9	-	-	-	-	1	1	-	-	-	-
-	-	-	-	-	-	9	-	1	-	9	-	-	-	-	-	-	-	-	-
-	-	-	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
1	-	7	-	2	4	48	2	2	-	65	2	1	10	2	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	1	-	-	2	-	2	-	1	1	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
-	-	-	-	1	-	-	-	-	-	4	-	-	-	1	-	4	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	4	-	-	1	2	1	1	-	-	1	-	-	-	1	-
3	3	-	-	3	3	-	1	-	6	1	4	-	-	20	-	-	-	-	-
-	-	-	-	-	-	2	-	-	7	3	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	-	-	-
-	-	-	-	-	-	-	-	-	18	-	-	-	-	9	3	-	-	-	-
-	-	-	-	-	-	1	-	-	24	5	-	-	-	17	6	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
-	-	-	-	-	2	-	1	-	-	-	1	-	-	-	-	-	-	-	-
-	1	-	-	6	6	-	-	-	2	-	8	1	-	4	-	-	-	5	1
6	-	1	-	-	6	-	-	-	-	-	-	-	1	-	-	-	-	3	-
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2 (continued)

75	80	84	85	86	87	88	89	90	96	98	100	102	103	104	105	106	110	112
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
4	–	–	–	–	–	–	–	9	2	3	–	2	132	–	–	2	–	–
–	–	–	–	2	2	–	2	8	–	–	–	–	–	–	–	2	–	–
–	–	–	–	–	1	2	8	62	–	–	5	–	–	–	23	63	–	–
1	–	–	1	–	–	–	–	7	–	2	–	19	2	–	3	5	–	–
–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
–	2	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	3	–	–	–	–	2	–	1	2	–	–
5	–	–	–	6	2	–	–	4	–	–	1	11	3	–	1	1	–	21
–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	1	6	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	4	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	6	–	–	–	1	10	1	3	12	–	–
3	–	4	–	2	–	–	2	16	–	–	6	2	33	–	4	9	–	–
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	1	–	6	2	–	4	12	–	–	–	–	4	–	7	13	1	2
–	–	–	–	–	–	–	–	4	–	–	2	10	13	–	9	2	–	–
–	–	–	–	–	–	–	–	13	–	–	–	–	–	3	–	1	–	–
11	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	2	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

116	121	122	125	126	128	131	143	151	181	183	184	185	189	190	191	192	193	194	195
–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	2	–	–	–	–
3	–	–	–	–	–	5	–	–	–	–	–	–	–	–	1	–	–	1	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
1	–	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–
–	–	–	–	–	–	–	4	1	–	–	–	1	–	–	–	–	–	–	–
–	1	–	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
–	–	–	1	1	–	8	54	57	3	–	4	4	–	3	16	2	9	10	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	3	–	–	–	–	–	4	–	–	14	–	1	3	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–
–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	1	51	1	–	–	–	–	1	2	–	0	1	3	3	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	4	22	–	–	1	–	6	–	–	4	3	10	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	2	1	4	7	–	1	–	–	–	–	–	–	1	–	1	5	–
1	–	–	–	–	2	1	–	–	–	–	–	–	–	–	–	–	–	1	–
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Table 2 (continued)

196	197	198	199	200	201	202	205	206	208	209	210	211	220	221	231	233	234	236
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–
–	2	15	–	–	7	–	–	–	1	–	–	–	–	–	–	–	–	–
–	–	–	69	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	1	–	–	–	4	–	–	–	–	–	–	–	–	–
–	–	4	–	15	6	–	–	–	1	–	–	–	–	–	–	–	3	–
–	2	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	1	–	3	–	–	–	–	–	–	–	–	–
32	24	30	18	13	8	1	–	2	3	1	–	–	–	–	–	–	7	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	5	6	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
23	6	24	1	5	4	–	–	–	9	–	1	2	–	–	–	–	–	–
–	2	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–
19	10	11	2	1	9	–	–	–	3	–	–	–	–	–	–	–	2	1
3	–	–	–	–	3	–	–	–	2	–	–	–	–	–	–	–	2	–
–	4	–	2	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6	–
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–	–	–	–	–	2	–	–	–	1	1	–	–	–	–	–	–	–	–
1	–	1	1	–	–	–	–	–	1	–	–	–	–	–	–	–	23	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–
91	24	26	18	11	14	–	–	–	12	–	2	–	–	–	–	–	–	–
3	5	–	–	2	4	–	–	–	–	–	–	–	–	–	–	–	–	–
22	104	98	92	26	56	–	–	–	3	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	17	37	20	41	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–
–	–	–	–	1	8	–	–	–	–	–	–	–	2	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–

237	246	248	250
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1	–	–	–
1	–	–	–
–	–	1	–
2	–	–	–
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–	1	–	–
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–	5	–	–
–	2	–	–
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SYSTEMATIC DESCRIPTION

Subclass Ostracoda Latreille, 1806
Order Podocopida Müller, 1894
Suborder Podocopina Sars, 1866
Superfamily Cytheracea Baird, 1850
Family Cytheruridae G.W. Müller, 1894
Genus *Cytherura* Sars, 1866
Cytherura bajacala Benson

Pl. 5, figs. 10–12; Pl. 7, fig. 4; Fig. 6

Cytherura bajacala Benson, 1959, p. 52, pl. 4, figs. 7a-c, pl. 9, figs. 1, 11, 14; Swain, 1967, p. 64, pl. 9, fig. 7; Swain and Gilby, 1967, p. 324, pl. 32, figs. 13 a-c, fig. 13c; Swain, 1969, p. 463, pl. 4, fig. 8; Swain and Gilby, 1974, p. 301, 302, pl. 3, fig. 9, text-fig. 23a-h.

Additional description: – Some features of valve ornamentation and details of hingement were shown by Swain and Gilby (1974). Each solum surrounded by reticulating longitudinal and transverse ridges, and filled with second-order reticulation, except for median area. External openings of simple normal pore canals, in general, on longitudinal and crossing ridges.

In internal view, hingement lophodont; anterior tooth incised and separated from postjacent median groove by narrow and deep furrow, posterior tooth smooth in right valve.

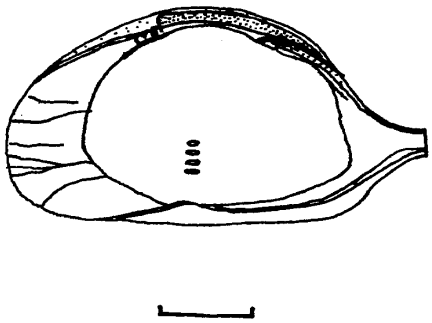

Fig. 6. *Cytherura bajacala* Benson. Internal view, adult right valve; details of hinge structure, marginal zone, and pattern of central scars indicated. UMPC 12270. Horizontal line indicates 0.10 mm.

Marginal pore canals narrow, long, sinuous, very few, sometimes polyfurcated. Internal openings of normal pore canals simple, small in diameter and few.

Dimension: – Right valve, Pl. 7, fig. 4, Fig. 6, UMPC 12270, 0.449 mm long and 0.221 mm high; left valve, Pl. 5, figs. 10, 12, UMPC 12271, 0.430 mm long and 0.234 mm high; right valve, Pl. 5, fig. 11, UMPC 12272, 0.428 mm long and 0.204 mm high.

Materials: – More than ten specimens were examined, including both sexes.

Occurrence: – This species was first described from Baja California. It is also known from the Gulf of California, the Pacific coast of San Diego and La Jolla, California, and Corinto Bay, Nicaragua.

In the Gulf of Panama, the species rarely occurs in eastern half of the shelf area.

Cytherura nodosa Ishizaki and Gunther, n. sp.

Pl. 5, figs. 8, 9; Pl. 6, fig. 10; Fig. 7

Description: – Carapace somewhat small for genus, ovoid in lateral view with narrower posterior end. Caudal process short, but distinct. Greatest length at mid-height, greatest height at mid-length. Dorsal margin arching broadly, ventral margin nearly straight, but contact margin sinuous; narrowly concave at anterior third or anterior end of ventral margin. Anterior margin broadly rounded, merges into dorsal and ventral margins. Posterior margin narrowly protruded posteriorly; upper margin concave in its lower half and nearly straight in upper half, and merges into dorsal margin; lower margin nearly straight, merges into ventral margin. Surface ornamented with distinct coarse reticulation consisting of rather distinct longitudinal ridges nearly parallel to valve length, and of subordinate crossing ridges. Each solum nearly square in shape and ornamented with second-order reticulation with +–shaped weaker muri. Large prominent knob-like swelling distinct in posteromedian area. Lateral openings of simple normal pore canals small, nearly flush, and on ridges (in many case, on subordinate ridges), and sola free from ridges.

In internal view, hingement lophodont; anterior tooth short, thick, bifid, postjacent

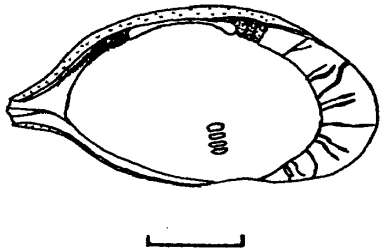

Fig. 7. *Cytherura nodosa* Ishizaki and Gunther, n. sp. Internal view, adult to later stage, left valve; details of hinge structure, marginal zone, and pattern of central scars indicated, UMPC 12275. Horizontal line indicates 0.10 mm.

groove broadly arching, smooth, considerably thickened at both extremities, posterior tooth rounded, smooth. Inner lamella wide in anterior margin, and very narrow in posterior margin. Marginal pore canals moderate in number, sinuous, thickened and/or bifurcated in the anterior margin in some cases. Y-shaped marginal pore canals in posterior margin from posteroventral area to posterior end of caudal process. Selvage not distinct. Internal openings of normal pore canals simple, very small, widely spaced. Adductor muscle scars in vertical rows of four. Several dorsal scars above, in front of rows of adductor muscle scars, and one large mandibular scar in front of the bottom row.

Dimension: – Right valve, Pl. 5, fig. 8, UMPC 12273, 0.364 mm long and 0.202 mm high; left valve (holotype), Pl. 5, fig. 9, Pl. 6, fig. 10, UMPC 12274, 0.354 mm long and 0.197 mm high; left valve, Fig. 7, UMPC 12275, 0.383 mm long and 0.189 mm high.

Comparisons: – This species is more or less similar to *Cytherura johnsonoides* Swain in lateral view, but differs from the latter in having distinct knob-like swelling in posteromedian area and lobate anterior tooth in right valve.

Derivation of name: – This species is named after the characteristic of having posteromedian knob-like swelling.

Material: – More than ten specimens, undiscriminated sexes, were examined.

Occurrence: – This species prevails sparsely on the eastern half of the shelf area; rather common at station 34, depth 38 m and bottom of sandy clay.

Cytherura purii Ishizaki and Gunther, n. sp.

Pl. 6, figs. 6–9; Fig. 8

?*Cytherura forulata* Puri, 1960, p. 115, Pl. 4, figs. 16, 17.
Not *Cytherura forulata* Edwards, 1944, p. 526, Pl. 88, figs. 17–20.

Description: – Sexual dimorphism distinct; male oblong, and female ovoid with greatest height at posterior end of dorsal margin. Surface ornamented with irregular ridges forming a coarse reticulation on entire surface; two kinds of ridges (longitudinal and crossing) nearly the same in thickness. Very small simple lateral openings of normal pore canals usually on crossing ridges. In internal view, hingement lophodont; in right valve, anterior tooth short, thick, smooth, prejacent deepened anterior end of median groove; median groove smooth, narrow, but distinctly wider at anterior extremity; posterior tooth rounded, high, slightly incised ventrally. Inner lamella rather narrow in anterior and posterior margins; line of concrescence coincides with inner margin. Marginal pore canals moderate in number, sinuous, sometimes bifurcated in the anterior margin, few in ventral margin. Selvage not distinct. Internal openings of normal pore canals simple, moderate to large, widely spaced. Caudal process not observed in male, but distinct in female. Adductor muscle scars in vertical rows of four, frontal scar elongated, inclined anteriorly, rather far in front of top scar of rows. No other scars observed.

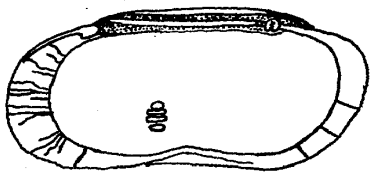

Fig. 8. *Cytherura purii* Ishizaki and Gunther, n. sp. Internal view, adult right valve; details of hinge structure, marginal zone, and patterns of central scars indicated, UMPC 12279. Horizontal line indicates 0.10 mm.

Dimension: – Complete carapace, male, fig. 6, UMPC 12276, 0.392 mm long and 0.202 mm high; complete carapace (holotype), female, figs. 7, 9, UMPC 12277, 0.410 mm long and 0.262 mm high; right valve, female, fig. 8, UMPC 12278, 0.394 mm long and 0.234 mm high; right valve, Fig. 8, UMPC 12279, 0.370 mm long and 0.176 mm high.

Material: – Only six specimens, including both sexes, were examined.

Derivation of name: – Named in honor of Dr. H.S. Puri of the Florida Geological Survey, who reported a similar form under the name of *Cytherura forulata* from shore sand of Florida.

Remarks: – This species resembles *Cytherura forulata* Puri (1960) from Florida and is possibly conspecific with the latter, judging from the illustrations given by him. Comparative studies of type specimens deposited in U. S. National Museum have proved the original specimens are somewhat different from the present form in having more distinct caudal process and longitudinal ridges of the former.

Occurrence: – In Gulf of Panama, this form rarely occurs in west of Archipielago de las Perlas and Bahia San Miguel; relatively common at stations 31 and 35, depth 88 to 91 m, bottom of sandy clay, temperature 17.08°C, and salinity 34.787 ‰.

Genus *Semicytherura* Wagner, 1957

Semicytherura sandbergi (Morales)

Pl. 1, fig. 14; Pl. 6, figs. 1–5; Fig. 9

Cytherura sandbergi Morales, 1966, p. 50–52, Pl. 4, figs. 4a-d.
Cytherura johnsoni Swain, 1955, p. 627, Pl. 64, figs. 8a-c, text-figs. 35b, 38, 8a-b, 39, 1a-c; Benson and Coleman, 1963, p. 31, Pl. 6, figs. 1–5, text-figs. 18a-b; Benson and Kaesler, 1963, p. 22, Pl. 3, figs. 7, 9, text-figs. 11a-c.
Cytherura johnsoni? van den Bold, 1963, p. 395, Pl. 9, fig. 3.

Additional description: – On lateral surface, simple normal pore canals rimmed narrowly, scattered mainly on even surface free from ridges, and rarely on ridges. Openings of false marginal pore canals not observed. No detailed ornamentation observed aside from longitudinal narrow ridges and feeble ridges crossing between them.

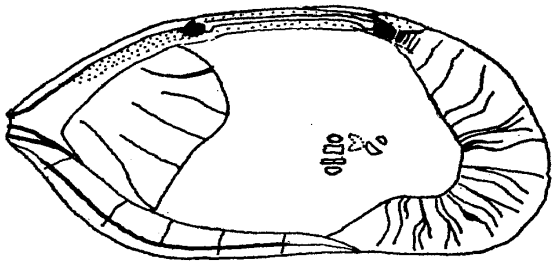

Fig. 9. *Semicytherura sandbergi* (Morales). Internal view of adult left valve; details of hinge structure, marginal zone, and pattern of central scars indicated, UMPC 12287. Horizontal line indicates 0.10 mm.

In internal view, hingement lophodont; in right valve both thickened ends of median ridge smooth, and anterior socket complementary to incised tooth in left valve; anterodorsal marginal area in front of anterior socket feebly crenulated. Inner lamella extremely wide in anterior and posterior margins; posterior inner lamella distinctly invades

anteriorly near half length; vestibule not developed. Marginal pore canals numerous, narrow, sinuous, bifurcated in many cases in anterior margin, but simple, few, wavy in posterior marginal zone; distinct Y-shaped marginal pore canals from posteroventral area to end of narrowly protruded posterior terminal. Internal openings of normal pore canals medium in diameter, simple, widely scattered. Adductor muscle scars in vertical rows of four, two extremities semicircular, and remaining ones oblong; frontal scars inclined anteriorly in front of second row of adductor muscle scars; upper one smaller, lenticular and lower one larger, oblong with both extremities thickened; mandibular fulcral point between frontal scars and rows of adductor muscle scars.

Dimension: – Left valve, longer form, Pl. 1, fig. 14, Pl. 6, fig. 5, UMPC 12284, 0.520 mm long and 0.250 mm high; right valve, short form, Pl. 6, figs. 1, 3, UMPC 12285, 0.500 mm long and 0.300 mm high; left valve, Pl. 6, fig. 2, UMPC 12286, 0.589 mm long and 0.300 mm high; left valve, Pl. 6, fig. 4, Fig. 9, UMPC 12287, 0.534 mm long and 0.279 mm high.

Material: – At least, 30 specimens, including both sexes, were examined.

Remarks: – The present form appears similar to *Cytherura ostiicola* Hartmann (1957) proposed mainly on soft parts; soft parts have not been found in our material to allow comparison. The carapace of the Gulf material differs from the descriptions of *C. ostiicola* in the possession of longitudinal ridges that converge strongly anteroventrally and of reticulations over the entire surface rather than the posterior half. Examination of specimens at the Smithsonian Institution (by K.I.) indicates that the forms from the Gulf are closely allied to the form described by Morales (1966). Many forms included by previous authors under the name of *Cytherura johnsoni* should also be referred here.

Occurrence: – The present form has been reported from the eastern and western Gulf of Mexico (Swain, 1955; Benson and Coleman, 1963; and Benson and Kaesler, 1963) and the Cenozoic strata of Trinidad (Bold, van den, 1963).

In the Gulf of Panama, the species is distributed widely on the shelf area and extends to restricted areas like Bahia San Miguel; common to abundant in areas west of the Archipielago de las Perlas, Bahia San Miguel, and off Bahia Piñas; at stations 31, 35, 112, 143, 151, 196, and 198, depth 8 to 101 m, bottom clay to sandy clay and fine grained sand, temperature 15.83 to 17.57°C (or possibly higher for upper limit because there are no data for area of Bahia San Miguel), and salinity 25.499 to 34.918 ‰.

Semicytherura johnsonoides (Swain)

Pl. 5, fig. 7; Pl. 6, figs. 11, 12; Fig. 10

Cytherura johnsonoides Swain, 1967, p. 62, 63, Pl. 2, figs. 2a, b, Pl. 3, figs. 10, 12, text-fig. 44a; Swain and Gilby, 1967, p. 323, 324, Pl. 32, figs. 12a, b, text-figs. 13a, b; Swain and Gilby, 1974, p. 299, 301, Pl. 3, figs. 3-5, Pl. 7, fig. 9.

Cytherura johnsonoides? Swain, 1967, p. 463, Pl. 4, fig. 9.

Additional description: – Most additional features of valve ornamentation were shown by Swain and Gilby (1974) through the scanning electron microscope photographs. Specimens from the Gulf of Panama ornamented with second-order reticulation except for median area: area free from second-order reticulation ornamented with small puncta or pits regularly arranged along longitudinal and crossing ridges; these are seemingly not true normal pore canals. Lateral openings of normal pore canals smaller, few, and flush or narrowly rimmed, free from or on ridge.

In internal view, feeble vestige of inner lamella widely invaded anteriorly from posterior end as in case of *Semicytherura*, although it is not calcified distinctly. Anterior

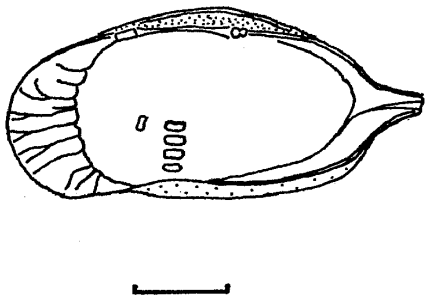

Fig. 10. *Semicytherura johnsonoides* (Swain). Internal view, adult right valve; details of hinge structure, marginal zone, and pattern of central scars indicated, UMPC 12289. Horizontal line indicates 0.10 mm.

marginal pore canals moderate in number, sinuous, bifurcated in many cases. Posterior marginal pore canals Y-shaped, from posteroventral area to posterior end narrowly protruded posteriorly. Internal openings of normal pore canals very small, simple, and few.

Dimension: – Left valve, Pl. 5, fig. 7, Pl. 6, fig. 11, UMPC 12288, 0.453 mm long and 0.216 mm high; right valve, Pl. 6, fig. 12, Fig. 10, UMPC 12289, 0.434 mm long and 0.217 mm high.

Material: – Only three specimens, undiscriminated sexes, were examined.

Occurrence: – The species has been reported from Gulf of California, Corinto Bay and San Juan del Sur, Nicaragua.

In Gulf of Panama, this species is found only at stations 35 and 84 on the shelf at depths ranging from 50 to 100 m.

Semicytherura reticuliforma Ishizaki and Gunther, n. sp.

Pl. 4, figs. 15–18; Fig. 11

Description: – Carapace moderate in size for genus, oblong with distinct caudal process. Dorsal margin nearly straight, ventral margin nearly straight, overreached by posteroventral alar process, but contact margin of ventral margin sinuous, concave before mid-length. Anterior margin symmetrical, broadly rounded, merges into dorsal and ventral margins. Posterior margin ends above mid-height, narrowly protruded posteriorly; upper margin slightly sinuous, meets dorsal margin smoothly, and lower margin nearly straight in upper half and concave in lower half, meets ventral margin with angular posterior terminal of ventral margin. Posteromedian swelling broad, moderate in thickness. Narrow, but thick alar process from mid-length to posterior end of ventral margin. Surface ornamented with two kinds of reticulations: coarse one consisting of thicker longitudinal ridge nearly parallel to valve length and slightly weaker crossing ridges for nearly entire surface; finer reticulation in posterior half. Very shallow, but rather broad sulcus from anterior third of dorsal margin to just above mid-length of ventral margin.

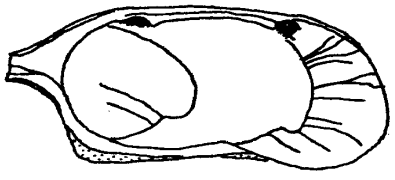

Fig. 11. *Semicytherura reticuliforma* Ishizaki and Gunther, n. sp. Internal view of left valve; details of hinge structure, marginal zone and invasion of inner lamella in posterior part indicated, UMPC 12292. Horizontal line indicates 0.10 mm.

Eye tubercle rather large, low, elongated along valve length at just below anterior end of dorsal margin. Lateral openings of normal pore canals small, simple, on mound in solum free from ridge, rimmed, or flush.

In internal view, hingement lophodont; anterior tooth rounded, smooth, postjacent groove smooth, widened at both ends and posterior tooth somewhat elongated, bifid. Inner lamella broad in anterior margin, and especially so in posterior margin where it invades anteriorly beyond mid-length, and retires postward just below posterior tooth for upper boundary and near posterior end of ventral margin for lower. Line of concrescence entirely coincides with inner margin. Marginal pore canals moderate in number, sinuous, sometimes clustered, and bifurcated in anterior margin; two linear pores from lower third of anterior boundary of posterior inner lamella to mid-height obliquely; in area of caudal process, Y-shaped ones distinct. Selvage not distinct. Internal openings of normal pore canals simple, very small, widely spaced. Adductor muscle scars in vertical rows of four, of which top scar inclined posteriorly; frontal scar oblong, in front of top scar of rows. Other scars not observable.

Dimension: – Right valve,Pl. 4, fig. 15, UMPC 12290, 0.395 mm long and 0.183 mm high; left valve (holotype), Pl. 4, figs. 16, 17, 18, UMPC 12291, 0.420 mm long and 0.203 mm high; left valve, Fig. 11, UMPC 12292, 0.392 mm long and 0.187 mm high.

Comparisons: – This species resembles *Semicytherura johnsonoides* (Swain) in lateral shape, but differs in having narrow but distinct posteroventral alar process, and more finely reticulated ornamentation without pits arranged along ridges (or muri).

The present species is also very close to *Cytherura bajacala* Benson in many lateral features, but differs from the latter in having more complicated ornamentation, more distinctly overreaching posteroventral alar process, non-lobate anterior tooth in right valve, and much wider inner lamella especially in posterior one.

Derivation of name: – After the characteristics of the lateral surface which is ornamented with very delicate reticulation on entire surface.

Material: – Only five specimens, undiscriminated sexes, were examined.

Occurrence: – In Gulf of Panama, this form rarely occurs in west of Archipielago de las Perlas and mouth area of Bahia San Miguel.

Semicytherura sp. A

Pl. 4, fig. 19; Pl. 5, figs. 1–3; Fig. 12

Description: – Carapace moderate in size for genus, oblong to ovoid, more or less tapering posteriorly in right lateral outline. Greatest length near mid-height, greatest height at anterior end of dorsal margin. Dorsal margin relatively short, straight, ventral margin slightly sinuous, concave just before mid-length. Anterior margin ended below mid-height, broadly rounded, meets dorsal margin with rather distinct anterior cardinal angle, and merges into ventral margin. Posterior end narrowly protruded posteriorly for short distance, where short caudal process developed, upper margin straight, merges into dorsal margin, lower margin concave, and meets ventral margin smoothly. Surface ornamented with subdued ridges, which make up irregular and hexagonal reticulations in anterior and posterior halves, respectively. No longitudinal ridges distinct. Lateral openings of normal pore canals simple, free from muri, flush to low rimmed.

In internal view, hingement lophodont, in right valve, anterior tooth small, rounded, smooth, postjacent anterior end of median groove considerably wide and deep, but entirely smooth, posterior tooth small, rounded, smooth. Inner lamella moderate in width in anterior margin, and widely invades anteriorly in posterior marginal area.

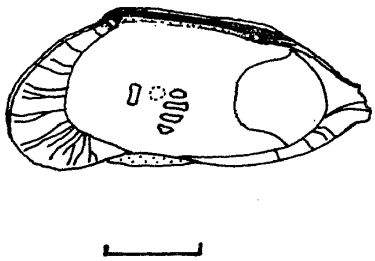

Fig. 12. *Semicytherura* sp. A. Internal view of right valve, adult; details of hinge structure, marginal zone, central scars, and invasion of inner lamella in posterior part indicated, UMPC 12293. Horizontal line indicates 0.10 mm.

Marginal pore canals moderate in number, sinuous, clustered anteroventrally, often bifurcated. Line of concrescence coincides with inner margin. Selvage not distinct. Internal openings of normal pore canals simple, moderate in diameter, widely spaced. Adductor muscle scars in slightly inclined rows of four, lower one crescent, rest oblong. Frontal scar steeply inclined anteriorly, oblong. Fulcral point just in front of top row of scars.

Dimension: – Right valve, Pl. 4, fig. 19, Pl. 5, figs. 1–3, Fig. 12, UMPC 12293, 0.357 mm long and 0.174 mm high.

Comparisons: – This form resembles more or less *Cytherura forulata* described by Malkin (1953) from the Miocene Yorktown Formation of Virginia and Maryland, but differs in subdued ridges, and lacks stronger longitudinal ridges.

Material: – Only one right valve was examined.

Occurrence: – This form was found only at one station on the shelf, west of Isla de San Jose, station 35, depth 88 m, bottom of sandy clay, temperature 17.05°C, and salinity 34.787 ‰.

Genus *Nearocytherura* Ishizaki and Gunther, n. gen.

Diagnosis: — Carapace narrow, oblong, with distinct narrow caudal process. Dorsal margin nearly straight to broadly arching. Ventral margin sinuous, distinctly concave at mid-length. Anterior margin broader, merges into ventral and dorsal margins. Ornamentation with longitudinal ridges and others nearly parallel to outline. Shallow sulcus from anterior third of dorsal margin to median area. Between ridges, surface ornamented with numerous rather large puncta throughout. Eye tubercle not so distinct. Adductor muscle scar pattern clear laterally. Lateral openings of normal pore canals simple, rimmed, free from puncta.

Hingement lophodont; both extremities of median bar in left valve thickened, smooth; anterior socket of left valve complementary of rounded, incised anterior tooth of right valve; posterior socket narrow, long, smooth. Inner lamella moderate in anterior and posterior margins. Selvage distinct ventrally. Internal openings of normal pore canals simple, small, widely spaced. Adductor muscle scars in vertical rows of four, of which upper two subdivided into two.

Comparisons: – This genus agrees well with *Cytherura* Sars, 1866, in many important characters, but differs in having adductor muscle scars, of which upper two are subdivided into two, and more narrow and sinuous lateral outline.

Derivation of name: – Prefix "Nearo"- is old English for narrow, for the lateral shape of the carapace.

Type species: – *Cytherura bananaformis* Coryell and Fields.

Nearocytherura bananaformis (Coryell and Fields)

Pl. 1, fig. 13; Pl. 2, fig. 5; Pl. 5, fig. 6; Fig. 13

Cytherura bananaformis Coryell and Fields, 1937, p. 12, 14, figs. 14a-d; van den Bold, 1967, p. 312, Pl. 1, fig. 18.

Additional description: – On lateral surface, longitudinal ridges and others more or less parallel to outline are very distinct. Between ridges, ornamented with numerous puncta. Lateral openings of normal pore canals simple, small, rimmed, free from puncta. Laterally central muscle scar pattern observable; scars in vertical rows of four, of which upper two scars subdivided into two. Eye tubercle not distinct.

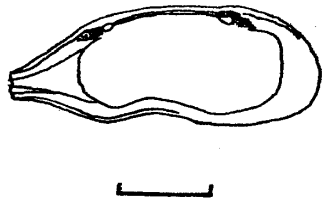

Fig. 13. *Nearocytherura bananaformis* (Coryell and Fields). Internal view of left valve, adult; UMPC 12294. Horizontal line indicates 0.10 mm.

In internal view, hingement lophodont; anterior socket of left valve complementary of feebly incised anterior tooth in right valve; median bar of left valve smooth, both extremities distinctly thickened as independent rounded high, smooth tooth; posterior tooth of right valve not distinctly thickened and appears as an extension of selvage. Inner lamella moderate in width in anterior and posterior margins; line of concrescence coincides with inner margin. Selvage rather distinct in ventral margin, upper margins of anterior and posterior margins. Internal openings of normal pore canals simple, small, few. No scar pattern, except for adductor muscle scars, clear.

Dimension: – Left valve, Pl. 2, fig. 5, Pl. 5, fig. 6, UMPC 12294, 0.333 mm long and 0.140 mm high; right valve, Pl. 1, fig. 13, UMPC 12295, 0.337 mm long and 0.128 mm high; left valve, Fig. 13, UMPC 12296, 0.329 mm long and 0.150 mm high.

Material: — Only six specimens, undiscriminated sexes, were examined.

Occurrence: — This species was first described by Coryell and Fields (1937) from the Miocene Gatun Formation of Cativa, Colon, Panama, and also reported from there by van den Bold (1967).

In Gulf of Panama, this species is rather rare, but widely distributed on entire shelf area; common at a station 191 in mouth area of Bahia San Miguel, depth 33 m, bottom of clay, and salinity 29.362‰.

Nearocytherura? *raadshooveni* (van den Bold)

Pl. 5, figs. 4, 5

Cytherura raadshooveni van den Bold, 1946, p. 118, Pl. 14, figs. 17a-b.

Dimension: – Left valve, Pl. 5, figs. 4, 5, UMPC 12297, 0.300 mm long and 0.250 mm high.

Remarks: – The specimens from Gulf of Panama agree with the type specimen illustrated by van den Bold (1946) in general features of ridge pattern on lateral surface, although so far as being known to the writers, it has never been reported subsequently. Insufficient number of adult specimens available make the observation of internal features difficult. The similarities of outline in lateral view, ornamentation with bold ridges and

numerous pits between them, and small simple openings of normal pore canals lead us to assign the form to *Nearocytherura* n. gen.

Material: – Only three adult valves, undiscriminated sexes, were examined.

Occurrence: – This species was first reported by van den Bold (1946) from the Miocene Nipe Series of eastern Cuba.

In Gulf of Panama, the species occurs very rarely in a part of shelf area, at two stations of western part of the Gulf, depth between 50 to 100 m.

Genus *Kangarina* Coryell and Fields, 1937

Kangarina quellita Coryell and Fields

Pl. 2, figs. 6–8; Fig. 14

Kangarina quellita Coryell and Fields, 1937, p. 13, figs. 15a-c; Puri, 1953, p. 248, Pl. 4, fig. 9; van den Bold, 1958, p. 416, Pl. 4, fig. 8; van den Bold, 1963, p. 396, Pl. 10, fig. 2; Swain and Gilby, 1967, p. 325, Pl. 31, figs. 10a-c, Pl. 34, fig. 16.

Kangarina cf. *quellita* Swain, 1967, p. 68–70, Pl. 3, figs. 8a, b, text-fig. 46; McKenzie and Swain, 1967, p. 291, Pl. 29, fig. 6.

Additional description: – In internal view, hingement lophodont, in left valve anterior thickened end of median bar bifid, posterior end longer, polylobate (into three to four), connected with smooth more narrow bar. Inner lamella wide in anterior and posterior half of ventral margin; line of concrescence coincides with inner margin in anterior margin but separated from the latter as to make wide vestibule in posteroventral margin. Marginal pore canals moderate in number, more or less sinuous; crowded in lower half of anterior margin. In protruded posterior end a characteristic Y-shaped marginal pore canal running from posteroventral corner, terminated. Selvage distinct in anterior margin. Internal openings of normal pore canals simple, few, rather large in diameter.

Surface ornamented with bold ridges, one running from anterior end to posteroventral area and second from median area to posterodorsal area with one branch turning up and the other posterior. In addition, most surface ornamented with closely spaced, regular,

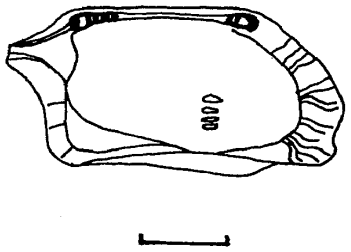

Fig. 14. *Kangarina quellita* Coryell and Fields. Internal view of adult left valve; details of hinge structure, marginal zone, central scars, and wide internal lamella in posterior half of ventral margin indicated, UMPC 12313. Horizontal line indicates 0.10 mm.

weak reticulation (illegible reticulation)* except for areas of narrow ridges and lateral openings of normal pore canals. Each fossa of illegible reticulation is, in general, polygonal rather than rounded. Narrow ridges very narrow and more irregular on bold ridges, but relatively thick, regular, and diverge at many points in other areas. Lateral openings of normal pore canals simple, elevated on a mound so as to form a rimmed funnel-pore (Sylvester-Bradley and Benson, 1971), and with apophysis in scale of illegible ornamenta-

* A term "illegible reticulation" is proposed for the weak reticulation that is clear in the image of scanning electron microscope, but in general, very difficult to observe under an optical microscope.

tion in most cases.

Dimension: – Right valve, Pl. 2, figs. 6, 8, UMPC 12311, 0.287 mm long and 0.172 mm high; left valve, Pl. 2, fig. 7, UMPC 12312, 0.362 mm long and 0.196 mm high; left valve, Fig. 14, UMPC 12313, 0.367 mm long and 0.205 mm high.

Material: – At least 10 specimens, undiscriminated sexes, were examined.

Occurrence: – This species was first described by Coryell and Fields (1937) from the middle Miocene Gatun Formation of Cativa, Panama, and reported from the Miocene strata of Florida (Puri, 1953), and Trinidad (van den Bold, 1958, 1963). On the other hand, the species has also been reported from the Recent sediments from the Gulf of California (Swain, 1967), Scammon Lagoon, Baja California (McKenzie and Swain, 1967), Corinto Bay, western Nicaragua (Swain and Gilby, 1967), and San Juan del Sur, Nicaragua (Swain, 1969).

In the Gulf of Panama, this species is widely but sparsely distributed in outer shelf area; common at station 131, off the mouth of Bahia San Miguel, 104? m deep, and sandy gravel bottom.

Kangarina pervadera Ishizaki and Gunther, n. sp.

Pl. 1, fig. 6; Pl. 2, figs. 9–12; Fig. 15

Description: – In lateral view, carapace oblong to subovate, moderate in size for genus. Surface ornamented with complicated ridges with two distinct longitudinal and one transversal ridges. Greatest length near mid-height, and greatest height at anterior end of dorsal margin. Anterior margin depressed posteroventrally, ends below mid-height; upper margin more broadly rounded, merges into dorsal margin, and lower one more narrowly rounded, merges into ventral margin. Posterior end more or less protruded narrowly postward above mid-height. Dorsal margin broadly convex or nearly straight. Ventral margin somewhat sinuous; slightly overreached by ventral marginal ridge, and concave at anterior third.

Surface ornamented with complicated and bold linear ridges; dorsal marginal ridge rather narrow, from mid-height of anterior margin to just above posterior end of dorsal margin, where more delicate ridges develope in a complicated manner; ventral marginal ridge more distinct, from lower point of anterior margin to end of ventral margin, somewhat overreaching ventral margin for posterior half; two longitudinal bold ridges distinct — upper one somewhat oblique, from anteromedian area to just below posterior end of dorsal margin and crossed by two subordinate transversal ridges near posterior part of dorsomedian area; lower one distinctly oblique, turning downward at its posterior quarter, from mid-height of anterior margin to mid-length of ventral margin —; in area between bold ridges, many delicate ridges developed in a complicated manner. No eye tubercle is discernible.

Illegible reticulation and openings of normal pore canals are just the same as that of type species. Narrow complicated ridges much thicker than illegible ridges of type

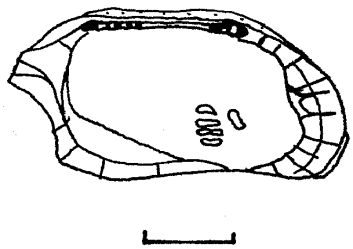

Fig. 15. *Kangarina pervadera* Ishizaki and Gunther, n. sp. Internal view of adult left valve; details of hinge structure, marginal zone, and central scars indicated, UMPC 12310. Horizontal line indicates 0.10 mm.

species.

In internal view, hingement lophodont, in left valve, anterior thickened end of median bar trilobated, posterior end longer, polylobate (into five or more), connected with rounded, and rounded, incised teeth anteriorly and posteriorly. Inner lamella wide in anterior and posterior half of ventral margins; line of concrescence coincides with inner margin in anterior margin but separated from the latter and making wide vestibule in posteroventral margin. Marginal pore canals few, not so sinuous, and sometimes bifurcated in mid-length. In protruded posterior end a characteristic Y-shaped marginal pore canal running from posteroventral corner, terminated. Selvage distinct along near anterior margin and at mid-length of ventral margin in right valve. Internal openings of normal pore canals simple, few, large. Adductor muscle scars in vertical rows of four; scars at both ends semi-circular, and rest of them oblong; frontal scars declined anteriorly in front of scars next to top. Two elongate mandibular scars below between frontal and adductor scars, in line declined posteriorly. Four or more dorsal scars above frontal and adductor muscle scars.

Dimension: – Complete carapace (holotype), Pl. 2, figs. 10, 12, UMPC 12306, 0.370 mm long and 0.204 mm high; complete carapace, Pl. 2, fig. 9, UMPC 12307, 0.350 mm long and 0.171 mm high; left valve, Pl. 1, fig. 6, UMPC 12308, 0.372 mm long and 0.186 mm high; right valve, Pl. 2, fig. 11, UMPC 12309, 0.374 mm long and 0.199 mm high; left valve, Fig. 15, UMPC 12310, 0.370 mm long and 0.190 mm high.

Comparisons: – This species resembles *Kangarina delicata* n. sp. in many important features of surface ornamentation, but differs from the latter in having no distinct loop consisted of bold ridges in median area, and the hinge structure in right valve (longer thickened posterior end of median bar which is lobated more numerously).

Derivation of name: – This species is named after its pervasive distribution in the Gulf of Panama.

Material: – More than 30 specimens, undiscriminated sexes, were examined.

Occurrence: – This species pervades nearly the entire Gulf of Panama, except for areas of great depth off the continental slope; common at stations 58, 103, and 196, depth 38 to 88 m, bottom fine to medium grained sands, and known temperature and salinity 17.57°C and 34.836‰, respectively.

Kangarina delicata Ishizaki and Gunther, n. sp.

Pl. 2, figs. 16–18; Pl. 3, figs. 1, 4; Fig. 16

Description: – In lateral view, carapace oblong to ovoid, moderate in size for genus. Surface ornamented with complicated ridges with loop near median area. Greatest length near mid-height, greatest height at anterior end of dorsal margin. Anterior margin depressed posteroventrally, ends below mid-height; upper margin broadly rounded, merges into dorsal margin, and lower one more narrowly rounded, merges into ventral margin. Posterior end protruded narrowly postward above mid-height. Dorsal margin nearly straight. Ventral margin slightly sinuous, more or less overreached by ventral marginal ridge. Surface ornamented with complicated ridges: dorsal marginal ridges very narrow, from mid-height of anterior margin to posterior end of dorsal margin along just inside margin; two longitudinal ridges distinct — upper one from just before posterior end to median area where it turns downward to form upper counterpart of loop in median area; lower one from mid-height of anterior margin to mid-ventral area at where it diverges post- and down-wards to form lower counterpart of loop —; three transversal ridges distinct in posterior half — the most prominent one from just before posterior end of dorsal

margin to mid-ventral area, and forms posterior counterpart of loop in median area; posterior one not so distinct, from end of dorsal margin to posteroventral corner; much less distinct, short one just before and in parallel to ones composing posterior counterpart of loop, trespassing upon loop from posterior half of mid-dorsal area —. No eye tubercle is discernible.

Illegible reticulation and openings of normal pore canals are just the same as that of type species. Among narrow ridges, two types observed: one is typically illegible just as that of type species, and other is much thicker, common in portions free from thick ridges.

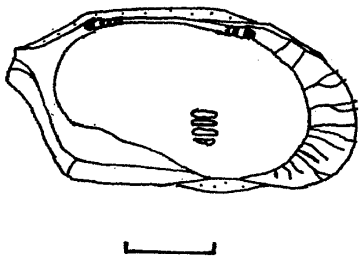

Fig. 16. *Kangarina delicata* Ishizaki and Gunther, n. sp. Internal view of adult left valve; details of hinge structure, marginal zone, and central scars indicated, UMPC 12305. Horizontal line indicates 0.10 mm.

In internal view, hingement lophodont, in left valve anterior thickened end of median bar bifid, posterior one longer, polylobate (into four), connected with smooth, rounded bar. Inner lamella wide in anterior and posterior half of ventral margin; line of concrescence coincides with inner margin in anterior margin but separated from the latter and making wide vestibule posteroventrally. Marginal pore canals not so sinuous, moderate in number, and some ones bifurcated. In protruded posterior end a characteristic Y-shaped marginal pore canal running from posteroventral corner, terminated. Selvage distinct in anterior margin. Internal openings of normal pore canals simple, few, large in diameter. Adductor muscle scars in vertical rows of four; each scar elongated horizontally.

Dimension: – Right valve (holotype), Pl. 2, fig. 16, Pl. 3, fig. 4, UMPC 12301, 0.367 mm long and 0.202 mm high; left valve, Pl. 2, fig. 17, UMPC 12302, 0.355 mm long and 0.200 mm high; right valve, Pl. 2, fig. 18, UMPC 12303, 0.400 mm long and 0.190 mm high; left valve, Pl. 3, fig. 1, UMPC 12304, 0.377 mm long and 0.205 mm high; left valve, Fig. 16, UMPC 12305, 0.369 mm long and 0.222 mm high.

Comparisons: – This species is similar to *Kangarina pervadera* n. sp. in many characteristic features, but differs in having ridges composing a distinct loop in median area.

Derivation of name: – After the characteristic ridge patterns delicate and complicated.

Material: – More than 30 specimens, undiscriminated sexes, are examined.

Occurrence: – This species occurs widely but sparsely on the shelf area deeper than 50 m, east to Archipielago de las Perlas; relatively common at stations 103 and 106, depth 66 and 102 m, bottom medium grained sand, temperature 15.80°C, and salinity 34.896‰.

Kangarina complicata Ishizaki and Gunther, n. sp.

Pl. 2, figs. 13–15; Fig. 17

Description: – In lateral view, carapace oblong to subovate, large for genus. Sexual dimorphism distinct; male longer and ridges more slender. Greatest length near mid-

height, greatest height at posterior end of dorsal margin. Dorsal margin nearly straight. Ventral margin sinuous; concave at anterior third, where ventral marginal ridge overreaches. Anterior margin depressed slightly posteroventrally, ends slightly below mid-height; upper margin broadly rounded, merges into dorsal margin, and lower margin more narrowly rounded, merges into ventral margin. Posterior margin more or less protruded posteriorly, ends above mid-height. Surface ornamented with complicated, slender ridges with no distinct bold ridges: in anterior half longitudinal ridges relatively distinct, connected by feebler crossing ridges at irregular intervals; in posterior half no longitudinal ridge distinct except for ventral marginal ridge, and ridges nearly same in thickness compose rough reticulation except for ventral third. Dorsal marginal ridge not so distinct, from mid-height of anterior margin to just before posterior end, sinuous along dorsal margin; distinctly convex in anterior half. Ventral marginal ridge not so distinct in anterior half but becomes more thick postwards. No eye tubercle distinct.

Illegible reticulation and openings of normal pore canals are just the same as that of type species. Illegible ridges transversing some fossae bounded by narrow prime ridges which stand for muri of rough reticulation.

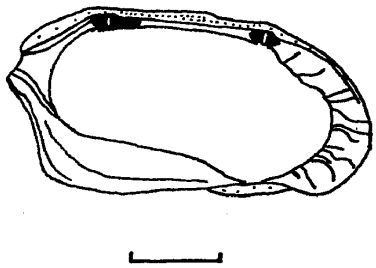

Fig. 17. *Kangarina complicata* Ishizaki and Gunther, n. sp. Internal view of adult left valve; details of hinge structure and marginal zone indicated, UMPC 12300. Horizontal line indicates 0.10 mm.

In internal view, hingement lophodont, in left valve, anterior thickened end of median bar short, bifid, posterior one somewhat longer, polylobate (into four), anterior and posterior teeth shorten and rounded, smooth. Inner lamella wide in anterior and posterior half of ventral margins; line of concrescence coincides with inner margin in anterior margin but separated from the latter and making wide vestibule in posteroventral margin. Marginal pore canals moderate in number, sinuous, more in lower half in anterior margin. In protruded posterior margin two marginal pore canals extend from posteroventral corner, and do not merge into each other (other species of this genus have a Y-shaped posterior marginal pore canal resulted from two marginal pore canals merged into each other). Internal openings of normal pore canals simple, moderate in number, rather large in diameter. Adductor muscle scars in vertical rows of four; each scar rather large, elongated horizontally. Frontal scar oblong, inclined anteriorly.

Dimension: – Complete carapace (holotype), Pl. 2, figs. 13, 15, UMPC 12298, 0.417 mm long and 0.203 mm high; left valve, Pl. 2, fig. 14, UMPC 12299, 0.397 mm long and 0.210 mm high; left valve, Fig. 17, UMPC 12300, 0.413 mm long and 0.220 mm high.

Comparisons: – This species resembles somewhat *Kangarina delicata* n. sp. but differs in surface ornamentation with much more slender and complicated ridges, and with marginal pore canals in anterior margin fewer, more widely spaced, and sinuous, and in posterior margin not merged.

Derivation of name: – After the characteristic complicated ridge pattern.

Material: – More than 30 specimens, including both sexes, were examined.

Occurrence: – This species occurred in a rather restricted area at depths of 57 to 128 m off Punta Garachiné-Bahia Piñas, along the southeastern border of the Gulf; common

at stations 196 to 198, depth 88 m, bottom fine grained sand to sandy clay, temperature 17.57 and 16.84°C, and salinity 34.836 and 34.917‰.

Kangarina sp. B

Pl. 3, figs 5–7; Fig. 18

Description: – Carapace moderate in size for genus, subrhomboidal in lateral view. Dorsal and ventral margins nearly parallel. Dorsal margin nearly straight, gently convex at both terminals. Ventral margin slightly sinuous, overreached by ventral marginal ridge, but contact margin concave at anterior third. Anterior margin ended slightly below mid-height, merges into dorsal and ventral margins. Posterior margin ended above mid-height, protruded posteriorly where caudal process distinct. Surface ornamented with narrow ridges composing irregular coarse reticulation; longitudinal and marginal ridges relatively strong. Lateral openings of normal pore canals numerous, simple, low rimmed, intramural, or on dune-shaped tubercle, bounded by ridges or free from ridges, and sometimes with apophysis. Between ridges illegible reticulation developed.

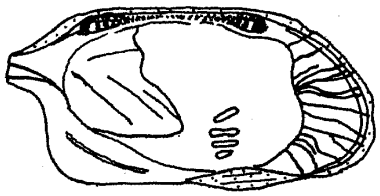

Fig. 18. *Kangarina* sp. B. Internal view of adult left valve; details of hinge structure, marginal zone, invasion of inner lamella in posterior part, and central scars indicated, UMPC 12314. Horizontal line indicates 0.10 mm.

In internal view, hingement lophodont; in left valve anterior socket complementary to small rounded smooth tooth in right valve; median bar strongly thickened at both terminals, anterior terminal bifid, and posterior terminal lobated into four, median part narrow, smooth entirely; posterior socket small, complementary to small, rounded, smooth posterior tooth in right valve. Inner lamella wide in anterior and posterior half of ventral margins; especially posterior one invading anteriorly more than posterior quarter of valve length. In posteroventral margin inner lamella considerably wide as in typical form of *Kangarina*. Line of concrescence coincides with inner margin except for posteroventral area. Marginal pore canals moderate in number, sinuous, sometimes bifurcated. Two marginal pore canals Y-shaped, open along caudal process. Selvage distinct along inside dorsal and anterior margins. Internal openings simple, few, large in diameter. Adductor muscle scars in anteriorly inclined rows of four, lower one smallest, and upper one inclined posteriorly, and remaining two oblong. Frontal scars not distinct.

Dimension: – Left valve, Pl. 3, figs. 5–7, Fig. 18, UMPC 12314, 0.362 mm long and 0.197 mm high.

Remarks: – The present species resembles *Kangarina complicata* in general lateral characters except for its outline, but differs in having more distinct ventral ridge which overreaches ventral margin, and characteristics of widely invading posterior inner lamella.

Material: – Only two specimens, undiscriminated sexes, were examined.

Occurrence: – In Gulf of Panama, this form rarely occurs at the edge of the shelf, only at one station 231, depth 562 m, bottom clay, temperature 7.60°C, salinity 34.639‰, and oxygen 0.21 ml/l.

"*Kangarina*" sp. A

Pl. 1, fig. 7; Pl. 3, figs. 2, 8–11

Description: – Carapace moderate in size for genus, subrhomboidal in lateral view. Dorsal margin slightly arching. Ventral margin nearly straight. Anterior margin ended below mid-height, broadly rounded, merges into dorsal margin, but meets ventral margin with more or less distinct angularity. Posterior margin ended at upper third, protruded posteriorly for short distance, where wide and short caudal process developed. Two dorsal and ventral marginal ridges discernible for entire length of margins. Anterior marginal ridge not distinct but narrow and sinuous. Posterior marginal ridge runs along posterior margin which grades into inner dorsal and ventral marginal ridges. Surface ornamented with several less distinct longitudinal ridges and irregular, intermittent transversal ridges. Both kinds of ridges compose prime polygonal reticulation. Each prime fossa filled with, in general, three finer fossa composed of finer muri. Caperation in each finer fossa vertically and regularly fluting. Lateral openings of normal pore canals only observed on muri, rather large, simple, most of them conjunctive.

In internal view, hingement lophodont; in left valve anterior socket rounded, complementary to bifid to incised tooth of right valve; median bar distinctly thick at both terminals, polylobate (bifid anteriorly and polylobate (into five to six) posteriorly), narrow median part of median element smooth; posterior socket complementary to bifid or ventrally incised rounded tooth in right valve. Inner lamella wide in anterior and posterior half of ventral margins. Vestibule distinct at posteroventral area. Selvage distinct dorsally, but not so in remaining margins. Marginal pore canals moderate in number, sinuous, clustered anteroventrally. Internal openings of normal pore canals numerous, sometimes four to five of them clustered proving presence of celate sieve plate laterally. Adductor muscle scars in vertical rows of four, lower one smallest. Frontal scar oblong, in front of upper two rows of adductor muscle scars.

Dimension: – Left valve, Pl. 1, fig. 7, Pl. 3, figs. 2, 8–11, UMPC 12315, 0.370 mm long and 0.214 mm high.

Remarks: – This species is peculiar for its rhomboidal outline and fine reticulation. The form may be characteristic of deeper area, and is not fully known to date.

In comparison with allied forms, the proposal of a new generic taxon for this form may be needed. Because of insufficient materials available at present, in this report, this form is tentatively referred to *Kangarina* Coryell and Fields, 1937, on the basis of having relatively wide inner lamella along posteroventral margin and of having a similar outline. The generic assignment is open to further study

Material: – Only one adult and five immature forms were examined.

Occurrence: – This form occurs at outer shelf edge of the Gulf, only at station 234, depth 262 m, bottom sandy clay, temperature 12.96°C, salinity 34.882‰, and oxygen 0.55 ml/l.

Genus *Serrocytherura* Ishizaki and Gunther, n. gen.

Diagnosis: – Carapace moderate in size for cytherurids, oblong to ovoid with narrowly protruded posterior end near mid-height in lateral view. Right valve overreaches left valve dorsally. Caudal process moderate in length, but wide. Surface ornamented with puncta which are bounded by low but wide muri. In each punctum a few to several perforations observed, probably a sort of sieve plate. Several irregular ridges, in anterior, posterior, and ventral marginal areas. Narrow and low wing-shaped process posterovent-

rally. Small lateral openings of normal pore canals few, simple, intramural, low to moderate rimmed.

Hingement lophodont; in right valve anterior tooth small, rounded, incised; median groove more or less wide at both terminals, complementary to rather thick coarsely denticulate bar in left valve; posterior tooth slightly elongated, bifid. Inner lamella narrow to moderate in width anteriorly. Line of concrescence coincides with inner margin. Marginal pore canals rather few, sinuous, simple; along caudal process two marginal pore canals Y-shaped. Some specimens show invasion of posterior inner lamella, which extends forwards to near mid-length. Internal openings of normal pore canals simple, moderate in dimension, few. Adductor muscle scars in vertical rows of four, with two mandibular fulcral scars in line inclined posteriorly. Frontal scar V-shaped, opening anteriorly.

Comparisons: – This genus is similar to *Cytherura-Semicytherura* in many respects, but differs in having no distinct reticulation, but punctate lateral surface, in each punctum a few to several perforations open, as a sort of sieve plate, and different hingement of thick and coarsely denticulated median bar in left valve of this genus.

So far as hingement is considered, this genus resembles more or less *Paracytheridea* G.W. Müller, 1894, but is quite different in having no distinct subcentral tubercle, and no characteristic coarse scars extending from dorsal ones to adductor muscle field in serial.

Pseudocytherura Dobowsky, 1939, is also different from this genus in lateral ornamentation pattern, and hingement in left valve of polylobate both teeth and narrow median groove instead of shorter bifid teeth and thick groove of this genus.

Derivation of name: – Prefix "serro-" is after Latin *serra* means serrate which stands for serrate median hinge elements of this genus.

Type species: – *Serrocytherura panamaensis* n. sp.

Serrocytherura panamaensis Ishizaki and Gunther, n. sp.

Pl. 1, fig. 12; Pl. 4, figs. 11–14; Pl. 5, figs. 13, 14; Figs. 19, 20

Description: – Carapace moderate in size, oblong to ovoid in lateral view. Right valve overreaches left valve dorsally. Greatest length near mid-height. Dorsal and ventral margins nearly in parallel. Dorsal margin broadly arching to nearly straight. Ventral margin sinuous, overreached in its posterior half by ventral ridge, and its contact margin broadly concave anteriorly. Anterior margin ended below mid-height, broadly rounded, merges into ventral margin, but meets dorsal margin with more or less distinct anterior cardinal angle. Posterior margin narrowly protruded posteriorly, ended near mid-height, where wide caudal process developed; upper margin concave, meets dorsal margin with obtuse cardinal angle, lower margin straight to broadly concave, meets ventral margin smoothly. Entire surface ornamented with puncta which are bounded by low but wide muri (Several irregular ridges in anterior, posterior, and ventral marginal areas. Narrow and low wing-shaped process posteroventrally). In each punctum a few to several perforations observed, probably a sort of sieve plate (small lateral openings of normal pore canals few, simple, intramural, low to moderate rimmed).

In internal view, hingement lophodont; in right valve anterior tooth small, rounded, incised; median groove wide and more or less wide at both terminals, coarsely denticulated; posterior tooth slightly elongated, bifid. Inner lamella moderate to rather narrow anteriorly. Line of concrescence coincides with inner margin. Marginal pore canals rather few, sinuous, simple; along caudal process two marginal pore canals Y-shaped. Some specimens show invasion of posterior inner lamella, which extends forward to near mid-length. Selvage not distinct except for anterodorsal margin. Internal openings of normal

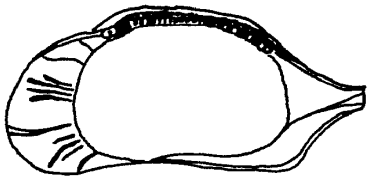

Fig. 19

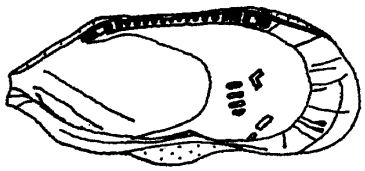

Fig. 20

Figs. 19, 20. *Serrocytherura panamaensis* Ishizaki and Gunther, n. gen., n. sp. 19. Internal view of adult right valve, without invasion of inner lamella in posterior part; 20. Internal view of adult left valve with invasion of inner lamella in posterior part; details of hinge structure, marginal zone, central scars, and invasion of inner lamella in posterior part indicated, UMPC 12280 and 12283. Indicated line shows 0.10 mm.

pore canals simple, moderate, few. Adductor muscle scars in vertical rows of four, with two mandibular fulcral scars in line inclined posteriorly. Frontal scar V-shaped, opening anteriorly.

Dimension: – Right valve, Pl. 4, figs. 11, 13, 14, Fig. 19, UMPC 12280, 0.396 mm long and 0.214 mm high; complete carapace (holotype), Pl. 5, figs. 13, 14, UMPC 12281, 0.397 mm long and 0.203 mm high; complete carapace, Pl. 4, fig. 12, UMPC 12282, 0.377 mm long and 0.167 mm high; left valve, Pl. 1, fig. 12, Fig. 20, UMPC 12283, 0.367 mm long and 0.184 mm high.

Comparisons: – This species resembles *Cytherura elongata* Edwards reported by Swain (1955) from San Antonio Bay, Texas, in general lateral characters, but differs from the latter in having no distinct subparallel longitudinal ridges of this form.

Derivation of name: – After geographic name of Gulf of Panama, in which this species prevails scarcely, but widely.

Material: – More than ten specimens, indiscriminated sexes, were examined.

Occurrence: – In Gulf of Panama, this species prevails scarcely but rather widely on the shelf area deeper than 42 m.

Genus *Paracytheridea* G.W. Müller, 1894

Paracytheridea tschoppi van den Bold

Pl. 1, fig. 10; Pl. 4, fig. 10; Pl. 8, figs. 3–9

Paracytheridea tschoppi van den Bold, 1946, p. 85, Pl. 16, figs. 6, 7; Keij, 1954, p. 220, Pl. 4, fig. 4; van den Bold, 1957, p. 245, Pl. 4, fig. 7; Benson and Coleman, 1963, p. 33, 34, Pl. 6, figs. 7, 9, 10, text-figs. 20a, b; van den Bold, 1967, p. 313; van den Bold, 1968, p. 76, Pl. 4, figs. 8a-d.

Paracytheridea vanwessemi van den Bold, 1946, p. 86, Pl. 16, fig. 13.

Additional description: – Surface ornamented with narrow ridges composing coarse irregular reticulation entirely. Small circular (porous and dense) papillae, rings (relatively large circles consisting of illegible ridges), and sieve plates and simple lateral openings of normal pore canals circumscribed with coarser papillae are on sola. Another openings with circumscribing papillae are porous conulus. Dense conulus prevails.

In internal view, anterior tooth in right valve elongated, as being posterior extension of selvage, coarsely crenulate; postjacent groove widened anteriorly, coarsely denti-

culate; posterior tooth elongated, thickened distinctly as like true tooth, rather finely crenulate in its anterior side, remaining posterior half nearly smooth. Inner lamella moderate in width in anterior and posterior margins. Caudal process narrow, just above mid-height. Selvage rather distinct just inside of anterior and ventral margins. Internal openings of normal pore canals simple, moderate in size, widely spaced. Adductor muscle scars difficult to define as being in serial from dorsal scars; probably upper four scars in vertical line may be dorsal scars; then adductor muscle scars seem to be in vertical rows of three along posterior boundary of subcentral depression; of which bottom one is much smaller, and two scars in each row of upper two in right valve; on the contrary, two scars only in middle row in left valve although dorsal scars just same as that of right valve. Frontal scars not distinct.

Dimension: – Left valve, Pl. 1, fig. 10, Pl. 8, fig. 3, UMPC 12319, 0.550 mm long and 0.267 mm high; right valve, Pl. 4, fig. 10, Pl. 8, fig. 8, UMPC 12320, 0.526 mm long and 0.247 mm high; left valve, Pl. 8, figs. 5, 9, UMPC 12321, 0.522 mm long and 0.281 mm high; right valve, Pl. 8, figs. 4, 7, UMPC 12322, 0.533 mm long and 0.233 mm high; left valve, Pl. 8, fig. 6, UMPC 12323, 0.513 mm long and 0.269 mm high.

Material: – More than 30 specimens, undiscriminated sexes, were examined.

Occurrence: – This species has been widely reported from the Miocene strata of Caribbean region (van den Bold, 1946–1968), and modern sediments of around Trinidad (Keij, 1954) and Gulf Coast regions (Benson and Coleman, 1963).

In Gulf of Panama, this species occurs widely on the shelf area, in eastern half of the Gulf. Abundant at stations 15, 34, 143, and 234; depth 8 to 262 m, bottom of clay to sandy clay and calcarenite, temperature 12.96 to 19.30°C, and salinity 26.602 to 34.882‰.

Paracytheridea clara Coryell and Fields

Pl. 1, fig. 9; Pl. 4, fig. 7; Pl. 8, figs. 12–14

Paracytheridea clara Coryell and Fields, 1937, p. 6, 7, figs. 6a-c; van den Bold, 1967, p. 313.

Additional description: – Entire surface ornamented with narrow ridges composing irregular coarse reticulation, in addition to subcentral tubercle and ventral alar process. On some sola flush sieve plate of normal pore canals found, free from ridge or with very narrow apophysis; distinct setose pore not observable. Papillae observed on some sola.

In internal view, anterior tooth of hinge, in right valve, long, as like posterior extension of selvage, strongly denticulate; postjacent median groove narrowest at mid-length, increases in width towards both terminals; postjacent tooth elongated, thickened as like typical tooth, denticulate. Inner lamella moderate to narrow in anterior and posterior margins. Selvage rather distinct just inside anterior margin. Internal openings of normal pore canals small, few, widely spaced. Adductor muscle scars are difficult to define, as being in a series with dorsal scars; probably in vertical rows of three in right valve, two scars in each row of upper two; three frontal scars in front of top row, rounded. Four dorsal scars above adductor muscle scars. Caudal process narrow, slightly above mid-length.

Dimension: – Left valve, Pl. 4, fig. 7, Pl. 8, fig. 13, UMPC 12316, 0.64 mm long and 0.295 mm high; right valve, Pl. 1, fig. 9, Pl. 8, fig. 12, UMPC 12317, 0.640 mm long and 0.292 mm high; right valve, Pl. 8, fig. 14, UMPC 12318, 0.716 mm long and 0.333 mm high.

Material: – More than ten specimens, undiscriminated sexes, were examined.

Occurrence: – This species was described from the Middle Miocene Gatun Formation, Cativa, Colon, Panama (Coryell and Fields, 1937; van den Bold, 1967).

In Gulf of Panama, the species occurs rarely around Archipielago de las Perlas, and mouth area of the Gulf. Rather common west of Archipielago, at stations 34 and 58, depth 38 m, bottom sandy clay to fine grained sand.

Paracytheridea washingtonensis Puri

Pl. 4, figs. 8, 9; Pl. 8, fig. 10

Paracytheridea washingtonensis Puri, 1954, p. 240, Pl. 3, figs. 10, 11, text-figs. 5d-f; Puri, 1960, p. 110, 111, Pl. 1, figs. 11, 12, text-figs. 6, 7.

Additional description: – Surface ornamented with narrow ridges composing coarse reticulation. Sola filled with small papillae entirely, and larger sieve-plate pore or smaller lateral opening of normal pore canals, both of which circumscribed with coarse papillae; buttressed tube and papillae observable in center and remaining part of sieve plate pore, respectively.

Dimension: – Left valve, Pl. 4, figs. 8, 9, Pl. 8, fig. 10, UMPC 12324, 0.613 mm long and 0.250 mm high.

Remarks: – When the buttressed tube is exposing laterally, its sieve plate has often been considered to have been broken off and buttressed tube has become exposed laterally (Sandberg and Plusquellec, 1969). But the complete preservation of papillae and details of buttressed tube in sieve plate pore observed in this study suggests that it exists in this form prior to destruction.

Material: – Only four adult specimens, undiscriminated sexes, were examined.

Occurrence: – This species was first described by Puri (1954) from the Miocene *Ecphora* Faunizone of the Florida Panhandle; he also reported its common occurrence in Recent shore sand of Franklin County, Florida.

In Gulf of Panama, the species occurs very rarely on shelf area, near and west of Archipielago de las Perlas.

Genus *Cytheropteron* Sars, 1866

Cytheropteron assimiloides Swain

Pl. 4, figs. 2, 3; Pl. 7, figs. 5, 8; Fig. 21

Cytheropteron assimiloides Swain, 1967, p. 67, 68, Pl. 9, figs. 8a-c.

Additional description: – General features were given in Swain (1967). On muri small, flush, simple pore open. In dorsal area where no distinct reticulation developed, small flush and narrow rimmed simple pores open. In each solum and irregular punctum, a sort of sieve plate opens.

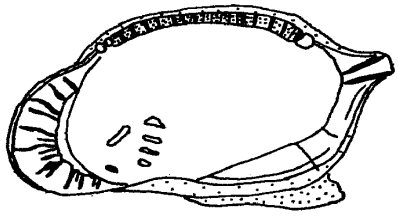

Fig. 21. *Cytheropteron assimiloides* Swain. Internal view of adult right valve; details of hinge structure, marginal zone, and central scars indicated, UMPC 12328. Horizontal line indicates 0.10 mm.

In internal view, hingement lophodont; in right valve anterior tooth elongated, bifid, postjacent median groove slightly arching, denticulated more coarsely toward both terminals, and posterior tooth large, thick, bifid. Caudal process narrow slightly above mid-height. Selvage more or less distinct in upper half of anterior margin and posteroventral margin. Internal openings of normal pore canals simple, small, moderate in number. Inner lamella wide to moderate in anterior and posteroventral margins. Vestibule rather narrow, nearly a quarter width of anterior inner lamella. Marginal pore canals moderate in number, thick, sinuous, sometimes bifurcated in anterior margin. Along caudal process, two pores open posteriorly. Adductor muscle scars in slightly anteriorly inclined rows of four, each scar widely spaced, and upper two ones inclined posteriorly. Frontal scar oblong, in front of second scar of rows, inclined anteriorly.

Dimension: – Right valve, Pl. 4, fig. 2, UMPC 12325, 0.450 mm long and 0.299 mm high; right valve, Pl. 7, fig. 8, UMPC 12326, 0.504 mm long and 0.317 mm high; left valve, Pl. 4, fig. 3, Pl. 7, fig. 5, UMPC 12327, 0.442 mm long and 0.247 mm high; right valve, Fig. 21, UMPC 12328, 0.437 mm long and 0.286 mm high.

Material: – More than 30 specimens, undiscriminated sexes, were examined.

Occurrence: – This species was first described by Swain (1967) from the Gulf of California. In Gulf of Panama, the species prevails widely on shelf area; abundant in near shore of the mouth area, such as off Punta Mala and Bahia Piñas, at stations 6, 8, 196, 197, and 198, depth 82 to 110 m, bottom fine grained sand and sandy clay, temperature 16.58 to 17.64°C, and salinity 34.783 to 34.917‰.

Genus *Lobosocytheropteron* Ishizaki and Gunther, n. gen.

Diagnosis: – For general character of type species, refer to Swain (1967).

Surface smooth or ornamented with numerous fine pits. Alar process prominent, ended in narrowly pointed terminal. Postjacent fringe distinct but not so high. In right valve, rather large, more or less horizontally elongated pit at posterior third of dorsal margin. Lateral openings of normal pore canals simple, few, and generally of funnel pore and/or very narrow rimmed simple pores. No sieve plate observed.

Hingement lophodont, in right valve, anterior tooth rounded, bifid; posterior half of median element much thickened, a combination of tooth-socket-tooth-socket; and posterior tooth trilobate like a series of three toothlets. Inner lamella rather narrow to moderate in anterior and posteroventral margins. Vestibule broad, nearly half width of anterior inner lamella. Marginal pore canals few to moderate, clustered anteroventrally, thickened partially along anterior margin; two simple canals opening along caudal process; internal openings of normal pore canals simple, small, few. Adductor muscle scars oblong, in slightly anteriorly inclined rows of four; upper two scars inclined posteriorly; frontal scar in front of second scar, oblong, inclined anteriorly. Several dorsal scars small, above rows of adductor scars.

Comparisons: – This genus is distinct from *Cytheropteron* Sars, 1866, in having posterior half of median hinge element in right valve, which is much thickened and combined with tooth-socket-tooth-socket, posterior trilobate tooth like a series of three small toothlets, and wider vestibule in anterior margin.

This genus is rather allied to *Kobayashiina* Hanai, 1957, in general characters, but differs from it in having clearly subdivided posterior half of median hinge element in right valve, and caudal process upturned.

Derivation of name: – "Loboso-" is prefixed after the Latin word for lobe, standing for the characteristic hingement of this genus.

Type species: – *Cytheropteron altatensis* Swain, 1967.

Lobosocytheropteron altatensis (Swain)

Pl. 1, fig. 11; Pl. 7, figs. 1–3; Fig. 22

Cytheropteron altatensis Swain, 1967, p. 64, 65, Pl. 9, fig. 10.

Additional description: – Important characters were described by Swain (1967). Surface entirely smooth, except for alar process, postjacent fringe, and some pits arranged in two or three lines along posterior half of ventral margin. In right valve, rather large, deep, more or less horizontally elongated pit at posterior third of dorsal margin. Lateral openings of normal pore canals few, and generally of funnel pore, and/or very narrow rimmed simple pores. No sieve plate observed.

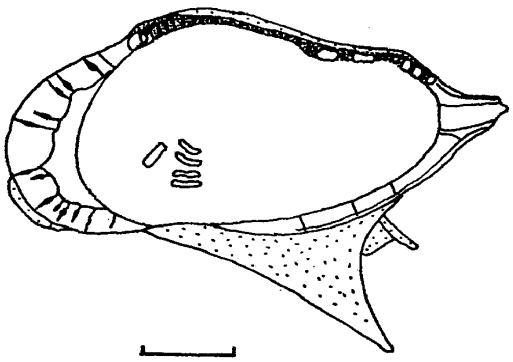

Fig. 22. *Lobosocytheropteron altatensis* (Swain). Internal view of adult right valve; details of hinge structure, marginal zone, and central scars indicated, UMPC 12332. Horizontal line indicates 0.10 mm.

In internal view, hingement lophodont; in right valve anterior tooth short, bifid: postjacent element consisted of two units; anterior unit coarsely denticulate groove, and posterior unit much thickened, combined with tooth-socket-tooth-socket (each tooth rounded or somewhat elongated and smooth, and socket finely denticulated), posterior tooth trilobate like a series of three toothlets. Inner lamella rather narrow in anterior and posteroventral and posterior margins. Vestibule broad, nearly half width of anterior inner lamella. Marginal pore canals moderate in number, clustered anteroventrally, thickened partially along anterior margin; two simple canals opening along caudal process; four short, simple canals in posterior half of ventral margin. Selvage not distinct in posterior half of ventral margin. Internal openings of normal pore canals simple, small, few. Adductor muscle scars oblong, in slightly anteriorly inclined rows of four; upper two scars inclined posteriorly; frontal scar oblong, inclined anteriorly, in front of second scar. Several small dorsal scars above rows of adductor scars. Mandibular scars and fulcral point not observed.

Dimension: – Left valve, Pl. 1, fig. 11, UMPC 12329, 0.537 mm long and 0.250 mm high; left valve, Pl. 7, figs. 1, 3, UMPC 12330, 0.550 mm long and 0.325 mm high; right valve, Pl. 7, fig. 2, UMPC 12331, 0.575 mm long and 0.345 mm high; right valve, Fig. 22, UMPC 12332, 0.534 mm long and 0.253 mm high.

Comparisons: – This species is allied to *Cytheropteron bartolomensis* Ishizaki and Gunther, n. sp., but is distinguishable in lateral surface ornamentation with small numerous pits and without short spine in posterior terminal of fringe of the latter.

Material: – More than 15 specimens, undiscriminated sexes, were examined.

Occurrence: – This species was first described by Swain (1967) from the Gulf of California. In Gulf of Panama, the species occurs widely but not so prolific; relatively

common at stations 102 and 103, depth 51 to 66 m and bottom of clay and medium-grained sand.

Lobosocytheropteron bartolomensis Ishizaki and Gunther, n. sp.

Pl. 1, fig. 8; Pl. 4, fig. 4; Pl. 7, fig. 7; Fig. 23

Cytheropteron sp. Swain, 1969, p. 464, Pl. 4, fig. 11a, b.

Additional description: – Surface ornamented with small pits except for narrow alar process. Distinct deep pit near posterior third of dorsal margin in right valve. Small, elongate pits in line along inside posterior half of ventral margin. Narrow rimmed simple pore of normal pore canals few, nearly flush. No sieve plate observed.

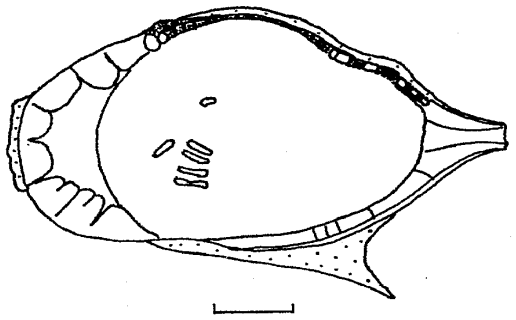

Fig. 23. *Lobosocytheropteron bartolomensis* Ishizaki and Gunther, n. sp.). Internal view of adult right valve; details of hinge structure, marginal zone, and central scars indicated, UMPC 12336. Horizontal line indicates 0.10 mm.

In internal view major features just like *Lobosocytheropteron altatensis* (Swain), except for fewer and simpler marginal pore canals in anterior margin of this species.

Dimension: – Left valve, Pl. 1, fig. 8, UMPC 12333, 0.606 mm long and 0.279 mm high; right valve, Pl. 4, fig. 4, UMPC 12334, 0.530 mm long and 0.347 mm high; left valve, Pl. 7, fig. 7, UMPC 12335, 0.584 mm long and 0.333 mm high; right valve, Fig. 23, UMPC 12336, 0.516 mm long and 0.287 mm high.

Comparisons: – This species is allied to *Cytheropteron altatensis* Swain from the Gulf of California, but is distinguishable in lateral surface ornamented with small numerous pits and without short spine in posterior terminal of fringe, and much fewer and simpler marginal pore canals in anterior margin in this species.

Material: – More than 30 specimens, undiscriminated sexes, were examined.

Occurrence: – In the Gulf of Panama, the form prevails widely on the shelf area; abundant off Bahia Piñas at stations 197, 198, 199, 200, and 201, depth 77 to 157 m, bottom of fine grained sand, sandy clay, and sand, temperature 16.84 to 17.41°C, and salinity 34.852 to 34.917‰.

Lobosocytheropteron perlasensis Ishizaki and Gunther, n. sp.

Pl. 7, fig. 6; Fig. 24

Description: – Carapace moderate in size for genus, ovoid in lateral view. Dorsal margin broadly arching, although somewhat sinuous in its posterior half in right valve. Ventral margin overreached by ala and spine, but contact margin sinuous, concave at anterior third. Anterior margin ended below mid-height, broadly rounded, merges into dorsal and ventral margins. Posterior margin ended in narrow caudal process at upper

third; upper margin short, narrowly concave, meets dorsal margin smoothly, lower margin longer, more gently concave, merges into ventral margin. Surface ornamented with narrow, but sharply pointed ala ventrally, its posterior end nearly vertical and grades into narrow and low sinuous transversal ridge upward, which disappears at posteromedian area. Narrow spine distinct at posterior third of ventral margin and grades into narrow sinuous ridge upward which runs vertically to posterior end of dorsal margin then turns forward and disappears at mid-length of dorsal margin. Narrow dorsal marginal ridge from mid-height of anterior margin to posterior end of dorsal margin. Small pits in a line along posterior ventral margin. Small, but deep circular pit near posterior end of dorsal margin. Aside from characters mentioned above, surface nearly smooth. Lateral openings of normal pore canals small, few, simple, low rimmed, or flush.

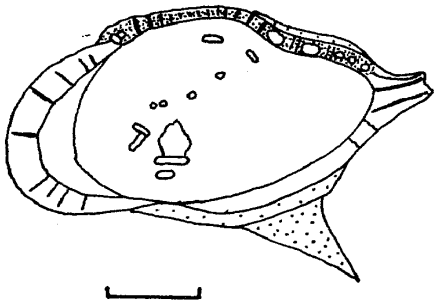

Fig. 24. *Lobosocytheropteron perlasensis* Ishizaki and Gunther, n. sp. Internal view of right valve; details of hinge structure, marginal zone, and scar pattern indicated, UMPC 12338. Horizontal line indicates 0.10 mm.

In internal view, hingement lophodont, typical for genus. Inner lamella wide anteriorly, vestibule wide, nearly a half width of inner lamella, marginal pore canals few, simple, straight. Inner lamella of posteroventral margin moderate in width, line of concrescence coincides with it; two rather thick marginal pore canals open along caudal process, and two more posteroventrally. Internal openings simple, small, widely spaced. Adductor muscle scars not distinct owing to broken upper part; only lower two ones observed. Frontal scar clearly V-shaped, as a fusion of two oblong scars. Dorsal scar rather clear, small, three, and a small and large two scars above, and behind above adductor muscle scars rows, respectively.

Dimension: – Right valve (holotype), Pl. 7, fig. 6, UMPC 12337, 0.492 mm long and 0.300 mm high; right valve, Fig. 24, UMPC 12338, 0.497 mm long and 0.271 mm high.

Comparisons: – This species resembles somewhat *Lobosocytheropteron bartolomensis* Ishizaki and Gunther, n. sp., but differs in smooth surface, narrower ala, distinct posteroventral spine, and distinct narrow three ridges.

Derivation of name: – After place name Archipielago de las Perlas, near which this species is found.

Material: – Six specimens, undiscriminated sexes, are examined.

Occurrence: – This species was found near Archipielago de las Perlas, shallower than 50 m, at only two stations; relatively common at station 75 (depth 42 m, bottom of clay, temperature 25.84°C, and salinity 32.943‰).

Lobosocytheropteron pinasensis Ishizaki and Gunther, n. sp.

Pl. 4, fig. 6; Pl. 7, figs. 11, 12; Fig. 25

Description: – Carapace moderate in size, subrhomboidal in lateral view, swings anteroventrally. Caudal process turned upward. Dorsal margin broadly arching in right valve, and more linear or sinuous in left valve. Ventral margin slightly overreached by

ala, but contact margin sinuous; concave at anterior third of ventral margin. Anterior margin broadly rounded, ended below mid-height, merges into dorsal and ventral margins. Posterior margin narrow, ended in narrowly protruded caudal process at upper third; upper margin short, concave, and lower margin nearly straight, merges into ventral margin. Surface ornamented with fine pits entirely. Narrowly pointed ala ventrally prominent, extends vertically, and ends in sharp spine, and broadly depressed anterodorsally. Narrow fringe behind ala. Narrow, sinuous transversal ridge from posterior end of ala upward to posterior end of dorsal margin, then turned anteriorly. In some specimens, flange distinct along anterior margin. Very narrow ridge on dorsal side of ala from posterior end of ala to mid-length of ventral margin. Horizontally elongated deep pit at posterior third of dorsal margin of right valve. Lateral openings of normal pore canals small, low-rimmed, simple. A few perforations observed in each punctum, may be a sort of sieve plate.

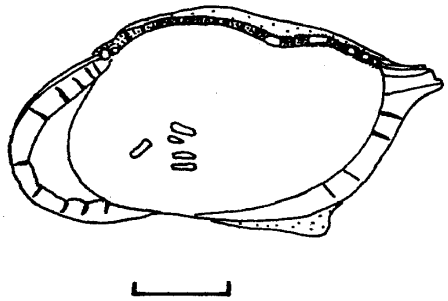

Fig. 25. *Lobosocytheropteron pinasensis* Ishizaki and Gunther, n. sp. Internal view of right valve; details of hinge structure, marginal zone, and central scars indicated, UMPC 12341. Horizontal line indicates 0.10 mm.

In internal view, hingement lohodont, typical for this genus. Inner lamella wide anteriorly, and moderate in posteroventral margins. Marginal pore canals few, simple, widely spaced. Along caudal process two simple marginal pores opening posteriorly. Vestibule wide, nearly two thirds width of inner lamella in maximum anteriorly. Internal openings of normal pore canals simple, small, widely spaced. Adductor muscle scars in nearly vertical rows of four, upper two scars inclined postward. Frontal scar oblong, inclined anteriorly.

Dimension: – Right valve, Pl. 4, fig. 6, Pl. 7, fig. 11, UMPC 12339, 0.538 mm long and 0.277 mm high; left valve (holotype), Pl. 7, fig. 12, UMPC 12340, 0.487 mm long and 0.250 mm high; right valve, Fig. 25, UMPC 12341, 0.446 mm long and 0.252 mm high.

Comparisons: – This species resembles *Cytheropteron hamatum* reported by Sars (1928) from Lofoten Islands, Norway, in shape of alar process, but differs in less arching dorsum and presence of sinuous transversal narrow ridge.

Derivation of name: – After place name of Bahia Piñas, where this species was found abundantly.

Material: – More than 20 specimens, undiscriminated sexes, were examined.

Occurrence: – This species occurs on the outer shelf area, in a central part of the Gulf and off Bahia Piñas; abundant at stations 199, 200, and 201, depth 77 to 157 m, bottom clay, temperature 17.28°C, and salinity 34.909‰.

Lobosocytheropteron? sp. A

Pl. 7, figs. 9, 10

Description: – Carapace moderate in size for genus, ovoid in lateral view. In right valve, dorsal margin broadly arching. Ventral margin overreached by ala, but contact

margin broadly arching. Anterior margin ended below mid-height, broadly rounded, merges into dorsal and ventral margins. Posterior margin ended at mid-height, narrowly protruded posteriorly where narrow caudal process observed; upper margin broadly concave, meets dorsal margin smoothly, lower margin shorter, narrowly concave, merges into ventral margin. Surface smooth. Ala rather narrow, but sharply pointed at its terminal; narrow depression along anterior margin of ala, small spines along posterior margin of it. Lateral openings of normal pore canals moderate to small in diameter, few, simple, and flush.

Dimension: – Right valve, Pl. 7, fig. 9, UMPC 12342, 0.494 mm long and 0.322 mm high; right valve, Pl. 7, fig. 10, UMPC 12343, 0.455 mm long and 0.295 mm high.

Comparisons: – This species resembles somewhat *Cytheropteron alatum* described by Sars (1926) from off Christiania, Norway, but differs in different shape of ala.

Material: – Only three, partly broken adult specimens, undiscriminated sexes, were examined.

Occurrence: – This species rarely occurs in the deeper part of the shelf, at only two stations.

Lobosocytheropteron? sp. B

Pl. 4, fig. 5; Pl. 8, fig. 1

Description: – Carapace large for genus, ovoid in lateral view. Dorsal margin broadly arching. Ventral margin sinuous, concave at anterior third. Anterior margin ended below mid-height, broadly rounded, merges into dorsal and ventral margin. Posterior margin ended at upper third, rather broadly protruded postward, where narrow caudal process developed; upper margin broadly concave, meets dorsal margin smoothly, lower margin nearly straight, merges into ventral margin. Surface smooth except for sporadically distributing lateral openings of normal pore canals. Alar process not so prominent; along its anterior terminal narrow ridge runs from summit to just above anterior end of ventral margin, and long and relatively high fringe developed along posterior ventral margin, grades into intermittent narrow ridge which traceable to mid-length of dorsal margin. Short, but distinct ridge from just behind summit of ala upward, and meets short horizontal ridges. Moderate pit observed at posterior third of dorsal margin in right valve. Lateral openings of normal pore canals simple, low rimmed, flush, but sometimes, celate. At posterior end of dorsal margin two porous tubercles observed.

Dimension: – Right valve, Pl. 4, fig. 5, UMPC 12344, 0.372 mm high; right valve, Pl. 8, fig. 1, UMPC 12345, 0.646 mm long and 0.371 mm high.

Remarks: – Only few, partly broken adult specimens, were examined. Nevertheless, this form is clearly distinct from other species in having characteristically diminished alar process and prominent fringe along posterior ventral margin.

Material: – Only three, partly broken adult specimens, and a few more complete larval specimens, undiscriminated sexes, were examined.

Occurrence: – In Gulf of Panama, this form occurs rarely at four stations, all of those are on deeper shelf area than 100 m; relatively common immature specimens at station 201, depth 148 m, and bottom of clay.

Lobosocytheropteron? sp. C

Pl. 8, figs. 2, 11

Description: – Carapace moderate in size for genus, ovoid in lateral view. In left

valve dorsal margin sinuous, concave at posterior third. Ventral margin broadly arching. Posterior margin ended at upper third, narrowly protruded posteriorly, where caudal process developed; upper margin short, slightly concave, merges into dorsal margin, lower margin longer, nearly straight, meets ventral margin smoothly. Lateral surface ornamented with large puncta for its anterior two thirds, but with reticulation composed of rather distinct muri transversal and parallel to posterior ventral margin, and subdued longitudinal muri. Ala thick, rather blunt for genus, slightly overreaches ventral margin; small pits in six lines on dorsal side of ala. Small spine just behind posterior terminal of ala. Lateral openings of normal pore canals simple, few, intramural, and several ones along margin of alar process.

Dimension: – Left valve, Pl. 8, figs. 2, 11, UMPC 12346, 0.269 mm high.

Comparisons: – This form is characterized by its coarse puncta and reticulation on entire surface. Such a form has never been reported, except for ones from the Cretaceous *Metoicoceras whitei* Hyatt zone of Texas (*Cytheropteron eximium* Alexander), which is different in posterior margin ended at upper position of this species.

Material: – Only one left valve is examined.

Occurrence: – Only one valve was found in the deepest part of the Gulf, at station 221, depth 3276 m, and bottom of clay.

Genus *Eucytherura* G.W. Müller, 1894

Eucytherura complexa (Brady)

Pl. 1, figs. 1–3; Pl. 2, figs. 1–2; Fig. 26

Cythere complexa Brady, 1867, p. 210; Brady and Norman, 1889, p. 145, Pl. 19, figs. 31–32.
Cythere limicola Brady, 1868, p. 405, Pl. 31, figs. 38–41 (part).
Eucytherura dilatata Müller, 1894, p. 306, Pl. 20, figs. 13, 17, Pl. 21, fig. 3.
Eucytherura complexa Müller, 1912, p. 280; Weingeist, 1949, Pl. 73, fig. 15; van den Bold, 1957, p. 245, Pl. 4, fig. 14; van den Bold, 1963, p. 398, Pl. 9, figs. 2a-b.
Eucytherura aff. *complexa* Key, 1954, p. 228, Pl. 5, figs. 13–14.
Not *Eucytherura complexa* Méhes, 1941, p. 61, Pl. 2, figs. 1, 2, text-figs. 1(14), 2(46), 3(83).

Additional description: – Each solum surrounded by rather bold ridges (muri) occupied by several openings of normal pores. Number of perforations, in general, four, at maximum six. Warty tubercles porous, conjunctive. Small intramural simple pore canals generally conjunctive. In instar forms, trefoil pattern of tegmen, consisted of four short, small extensions. In internal view, hingement lophodont, median bar denticulated, both ends somewhat thickened; anterior and posterior sockets rather large, short, smooth,

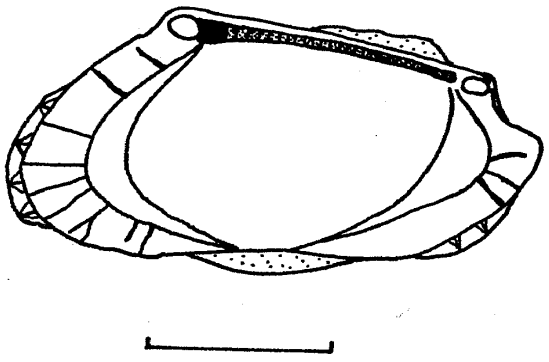

Fig. 26. *Eucytherura complexa* (Brady). Internal view of adult right valve; details of hinge structure and marginal zone indicated, UMPC 12257. Horizontal line indicates 0.10 mm.

opening ventrally in left valve. Hinge ear discernible in antero- and postero-dorsal margins; line of concrescence clearly separated from inner margin of inner lamella; vestibule nearly half width of inner lamella in anterior margin and less wide in posterior margin. Marginal pore canals simple, few, widely spaced, only anteroventral one bifurcated. Along anterior margin short flange developed. Along this five short, narrow marginal denticles found; in each paramarginal pore canals penetrating, which do not connect directly with marginal pore canals. Internal openings correspond to perforation in each solum found laterally. Adductor muscle scar pattern not observable.

Dimension: – Complete carapace, Pl. 1, fig. 1, Pl. 2, fig. 1, UMPC 12255, 0.297 mm long and 0.163 mm high; right valve, immature, Pl. 1, fig. 2, Pl. 2, fig. 2, UMPC 12256, 0.267 mm long and 0.147 mm high; right valve, Pl. 1, fig. 3, Fig. 26, UMPC 12257, 0.259 mm long and 0.108 mm high.

Material: – Only five specimens are examined, undiscriminated sexes.

Occurrence: – Since the first description by Brady (1866) from Hebridges, Great Britain, this species has been reported from many regions of the Atlantic Ocean and Caribbean regions. In the latter region, it has been reported also from strata such as Morne Diablo Quarry, Forest, Talparo, Springsvale, Tamana Formations, and Point d'Ore beds (van den Bold, 1957, 1963).

In the Gulf of Panama, this species is distributed only sparsely on the shelf.

Eucytherura guaymasensis (Swain)

Pl. 1, figs. 4, 5; Pl. 2, figs. 3, 4; Fig. 27

Pteroloxa guaymasensis Swain, 1967, p. 95, 96, Pl. 8, fig. 3.

Additional description: – General characteristics of lateral surface was given previously (Swain, 1967). Each solum surrounded by bold ridges (muri) occupied by a several openings of normal pore canals as if being a celate sieve-plate pore; maximum number of perforations up to 12 or 13. Intramural (in many cases conjunctive) simple pores scattered throughout. Warty tubercles porous, intramural.

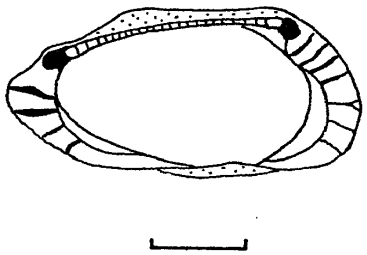

Fig. 27. *Eucytherura guaymasensis* (Swain). Internal view of adult left valve; details of hinge structure and marginal zone indicated, UMPC 12260. Horizontal line indicates 0.10 mm.

In internal view, hingement lophodont; in left valve median bar denticulate, both ends somewhat thickened; anterior and posterior sockets rather large, elongated, smooth, opening ventrally. Hinge ear distinct in posteroventral corner. Inner lamella moderate in width in anterior and posterior margins; line of concrescence clearly separated from inner margin of inner lamella; vestibule nearly a half width of inner lamella in lower two thirds of anterior margin, and narrow in posteroventral area. Marginal pore canals few, widely spaced, nearly straight, only one of them bifurcated. Internal openings correspond to perforation in each solum found laterally. Adductor muscle scar not observed.

Dimension: – Complete carapace, Pl. 1, fig. 4, Pl. 2, fig. 3, UMPC 12258, 0.345 mm

long and 0.197 mm high; right valve, Pl. 1, fig. 5, Pl. 2, fig. 4, UMPC 12259, 0.360 mm long and 0.212 mm high; left valve, Fig. 27, UMPC 12260, 0.348 mm long and 0.202 mm high.

Remarks: – This species was originally referred to the *Pteroloxa* Swain, 1963, because of the several allied characteristics. Recent use of the scanning electron microscope made definite many more fine structures such as details of hingement — lophodont, and ornamentation of lateral and internal surfaces — intramural simple normal pore canals, small porous spine, and a several perforations in each solum and their corresponding internal openings. Some of these characters found in the present work lead this generic identification to the *Eucytherura* G.W. Müller, 1894.

Material: – More than 30 specimens, undiscriminated sexes, were examined.

Occurrence: – This species was first described from Gulf of California by Swain (1967), depth 32 and 62 fathoms, and mud and sandy mud bottom. In the Gulf of Panama, this species is distributed widely on the shelf area of the Gulf, except for deeply embayed areas as Bahia San Miguel; predominant at station 103, depth 66 m, bottom medium-grained sand.

Eucytherura pinasensis Ishizaki and Gunther, n. sp.

Pl. 3, figs. 12–15; Fig. 28

Description: – In lateral view, carapace subtrapezoidal, swings anteroventrally, moderate in size for genus. Greatest length above mid-height, greatest height at anterior end of dorsal margin. Anterior margin ends below mid-height, broadly rounded, merges into dorsal and ventral margins. Posterior margin narrowly protruded posteriorly, ends above mid-height; upper margin short, meets dorsal margin with rather distinct obtuse cardinal angle; lower margin nearly straight, longer, merges into ventral margin. Dorsal margin broadly convex, overreached by ridges at mid-length of dorsal margin. Ventral margin broadly convex, overreached by ventral marginal ridge for most length.

Surface ornamented with coarse reticulation bounded by bold, irregular ridges. Continuous circumferential ridges consist of dorsal, posterior, and ventral marginal ridges; dorsal marginal ridge from mid-length where it is convex to overreach dorsal margin, to posterior end of dorsal margin; posterior marginal ridge from posterior terminal of dorsal marginal ridge to posteroventral area; ventral marginal ridge from lower part of anterior margin to posterior end of ventral margin. More or less distinct longitudinal ridge from just below mid-height of anterior margin to posterior third of ventral margin where it merges into ventral marginal ridge. Isolated bold, short ridge from anterior end of dorsal margin to mid-height of anterior margin. Posteroventral swelling blunt, just above marginal ridge. Median sulcus shallow but broad, opening dorsally. Eye tubercle not so distinct, on ridge near anterior end of dorsal margin. Every solum of reticulation occupied by sieve-plate-like coarse perforations of normal pore canals; these perforations eight in general and 12 in maximum. Small simple normal pore canals are intramural, in many case conjunctive. Warty tubercle porous, on ridges (muri).

In internal view, hingement lophodont; median bar denticulated, more or less thickened at both terminals, anterior and posterior sockets large, smooth, opening ventrally. Inner lamella moderate in width in anterior and posterior to posteroventral margins; vestibule very narrow in anterior and posteroventral margins. Marginal pore canals few, widely spaced, simple, straight. Internal openings corresponding to sieve-plate pores found on lateral surface. Adductor muscle scars rounded, in slightly inclined vertical row of four: the scars on top and next to bottom smaller; frontal scars in vertical rows of two in front of upper two adductor muscle scars. Two dorsal scars just above the rows of

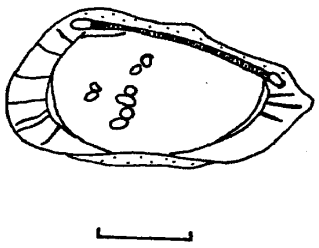

Fig. 28. *Eucytherura pinasensis* Ishizaki and Gunther, n. sp. Internal view of right valve; details of hingement, marginal zone, and scar pattern indicated, UMPC 12263. Horizontal line indicates 0.10 mm.

adductor muscle scars.

Dimension: – Complete carapace (holotype), Pl. 3, fig. 13, UMPC 12261, 0.330 mm long and 0.202 mm high; left valve, Pl. 3, figs. 12, 14, UMPC 12262, 0.339 mm long and 0.173 mm high; right valve, Fig. 28, UMPC 12263, 0.333 mm long and 0.171 mm high; complete carapace, Pl. 3, fig. 15, UMPC 12264, 0.350 mm long and 0.205 mm high.

Comparisons: – This species resembles somewhat *Eucytherura guaymasensis* (Swain), but differs from the latter in having distinct posteroventral swelling, no distinct median longitudinal ridge, and less distinct sulcus.

Derivation of name: – After the geographic name of Bahia Piñas, off which the species is predominant.

Material: – More than 20, undiscriminated sexes, were examined.

Occurrence: – The species, in general, prevails widely, but sparsely on the shelf area of the Gulf, and is predominant only at station 199, depth 77 m, bottom clay, temperature 17.28°C, and salinity 34.909‰.

Eucytherura sanjoensis Ishizaki and Gunther, n. sp.

Pl. 3, figs. 3, 16, 17; Pl. 4, fig. 1; Fig. 29

Description: – In lateral view, carapace subtrapezoidal, swings anteroventrally, rather large for genus. Greatest length near mid-height, greatest height at mid-length. Anterior margin ends below mid-height, broadly rounded, merges into dorsal and ventral margin. Posterior margin narrowly protruded for short distance posteriorly, ends above mid-height; upper margin short, concave, meets dorsal margin with rather distinct posterior cardinal angle; lower margin longer, broadly convex, merges into ventral margin. Dorsal margin convex due to overreach of dorsal marginal ridge. Ventral margin convex, overreached by ventral marginal ridge for nearly entire length, although contact margin sinuous, concave at anterior third.

Surface ornamented with irregular reticulation entirely. Dorsal marginal ridge narrow, broadly arching, from anterior end of dorsal margin to posterodorsal area where it turned downward to meets posterior marginal ridge. Ventral marginal ridge from lower part of anterior margin to posteroventral area. Two longitudinal ridges distinct; upper one linear, from anteromedian area to posterodorsal area; lower one from lower third of anterior margin to posteroventral area where it overreaches ventral marginal ridge, and terminated in blunt spine-like swelling at junction with posterior marginal ridge. Eye tubercle not so distinct, on ridge near anterior end of dorsal margin. Every solum of reticulation occupied by sieve-plate-like perforations of normal pore canals; these perforations 12 to 13 in general, seven in minimum, and 17 in maximum. Small simple normal pore canals are intramural, in many case conjunctive. Warty tubercle porous, scattered on ridges.

In internal view, hingement lophodont; median bar denticulated, more or less

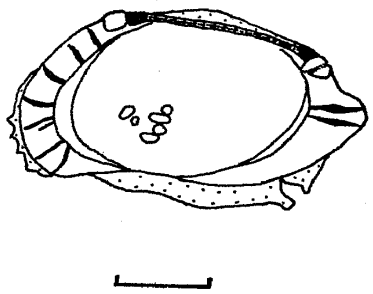

Fig. 29. *Eucytherura sanjoensis* Ishizaki and Gunther, n. sp. Internal view of adult right valve; details of hinge structure, marginal zone, and central scars indicated, UMPC 12269. Horizontal line indicates 0.10 mm.

thickened at both terminals, anterior and posterior sockets large, smooth, opening ventrally. Inner lamella moderate in width in anterior and posterior to posteroventral margins; vestibule one-third the width of inner lamella at maximum in anterior and posteroventral margins. Marginal pore canals few, widely spaced, simple, but thickened in some length, and nearly straight. Internal openings correspond to perforations in each solum found on lateral surface. Adductor muscle scars rounded, in slightly inclined irregular vertical rows of four, the scars on top and next to bottom smaller; frontal scars in front of second row, elongated one inclined anterior and the other rounded, small. Dorsal scars above rows of adductor muscle scars.

Dimension: – Right valve, Pl. 3, fig. 3, UMPC 12265, 0.364 mm long and 0.225 mm high; left valve, Pl. 3, fig. 17, UMPC 12266, 0.379 mm long and 0.239 mm high; right valve (holotype), Pl. 3, fig. 16, UMPC 12267, 0.344 mm long and 0.197 mm high; left valve, Pl. 4, fig. 1, UMPC 12268, 0.364 mm long and 0.186 mm high; right valve, Fig. 29, UMPC 12269, 0.352 mm long and 0.185 mm high.

Comparisons: – This species differs from the all other species referred to this genus from the Gulf in having a distinct wing-like swelling of ventral marginal ridge, and larger valve size.

Derivation of name: – After the geographic name of Isla San Jose, off which the species is more common.

Occurrence: – The species, in general, prevails widely but sparsely on the shelf area of the Gulf, and is common at several stations in eastern half of the Gulf as stations 30, 36, 90, 105, and 106; depth 88 to 102 m, bottom fine to medium grained sand, temperature 17.22 to 15.80°C, and salinity 34.751 to 34.896‰.

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Plates 1 — 8

Plate 1

Figs. 1–3. *Eucytherura complexa* (Brady) ..... p. 44
1-right side view of complete carapace, adult, UMPC 12255, ×190. 2-lateral view of immature right valve, UMPC, 12256, ×200. 3-internal view of right valve, UMPC 12257, showing details of hinge structure and marginal zone, ×190.

Figs. 4, 5. *Eucytherura guaymasensis* (Swain) ..... p. 45
4-right side view of complete carapace, UMPC 12258, ×157. 5-internal view of right valve, showing details of hinge structure and marginal zone, UMPC 12259, ×178.

Fig. 6. *Kangarina pervadera* Ishizaki and Gunther, n. sp. ..... p. 28
Internal view of left valve, showing details of hinge structure and a part of marginal zone, UMPC 12308, ×194.

Fig. 7. "*Kangarina*" sp. A ..... p. 33
A part of lateral view of left valve, showing reticulation and simple pore canals intramural, UMPC 12315, ×750.

Fig. 8. *Lobosocytheropteron bartolomensis* Ishizaki and Gunther, n. sp. ..... p. 40
A part of internal view of left valve, showing details of hinge structure, UMPC 12333, ×167.

Fig. 9. *Paracytheridea clara* Coryell and Fields ..... p. 36
Internal view of right valve, showing details of hinge structure, and marginal zone, UMPC 12317, ×100.

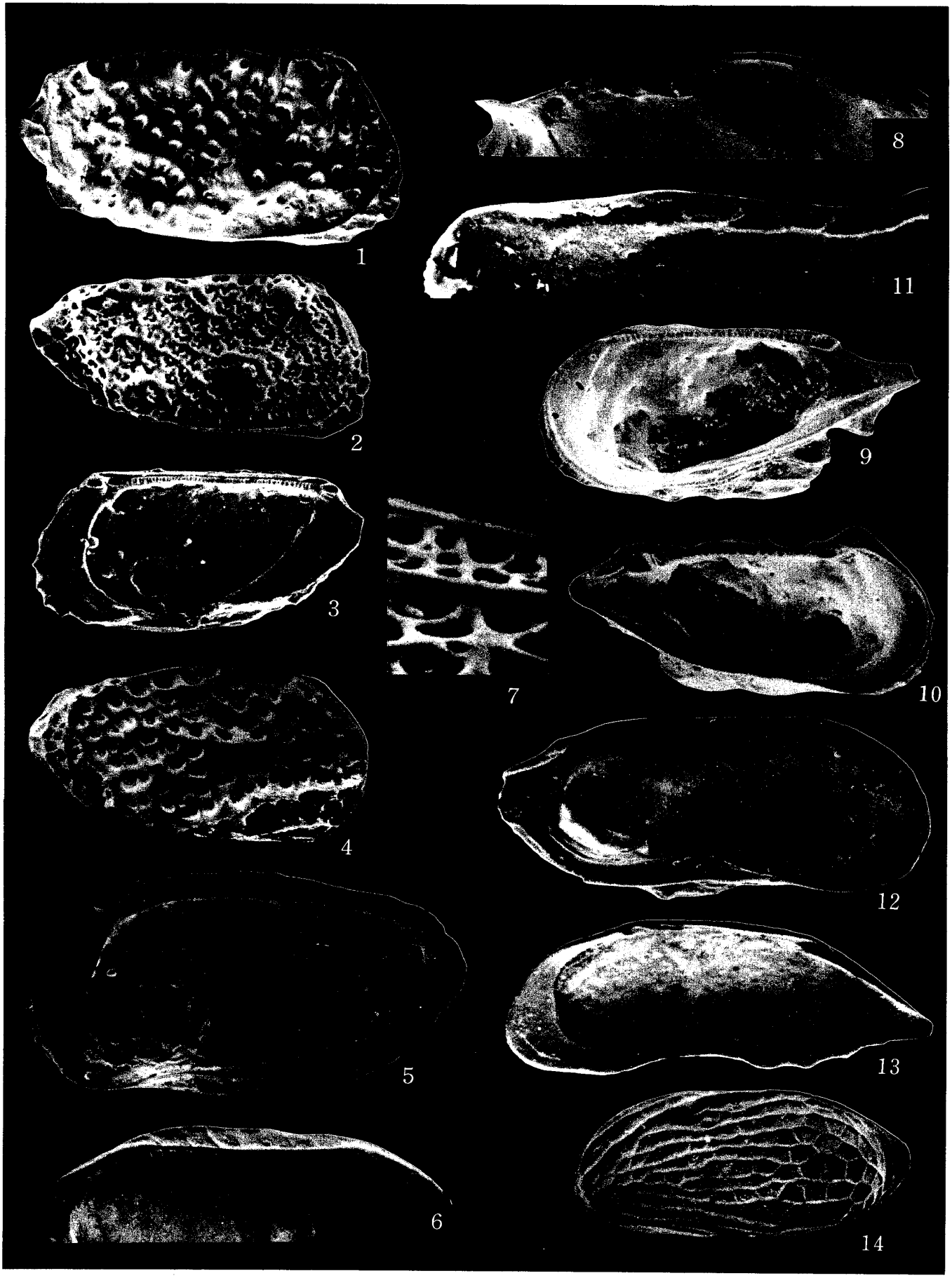
Fig. 10. *Paracytheridea tschoppi* van den Bold ..... p. 35
Internal view of left valve, showing details of hinge structure, marginal zone, and internal openings of normal pore canals, UMPC 12319, ×190.

Fig. 11. *Lobosocytheropteron altatensis* (Swain) ..... p. 39
A part of internal view, showing details of posterior half of hinge structure, UMPC 12329, ×300.

Fig. 12. *Serrocytherura panamaensis* Ishizaki and Gunther, n. gen., n. sp. ..... p. 34
Internal view of left valve, showing details of hinge structure, marginal zone, and invasion of inner lamella in posterior part, UMPC 12283, ×200.

Fig. 13. *Nearocytherura bananaformis* (Coryell and Fields) ..... p. 26
Internal view of right valve, showing details of hinge structure and marginal zone, UMPC 12295, ×188.

Fig. 14. *Semicytherura sandbergi* (Morales) ..... p. 21
Lateral view of left valve, elongate form (male?), UMPC 12284, ×100.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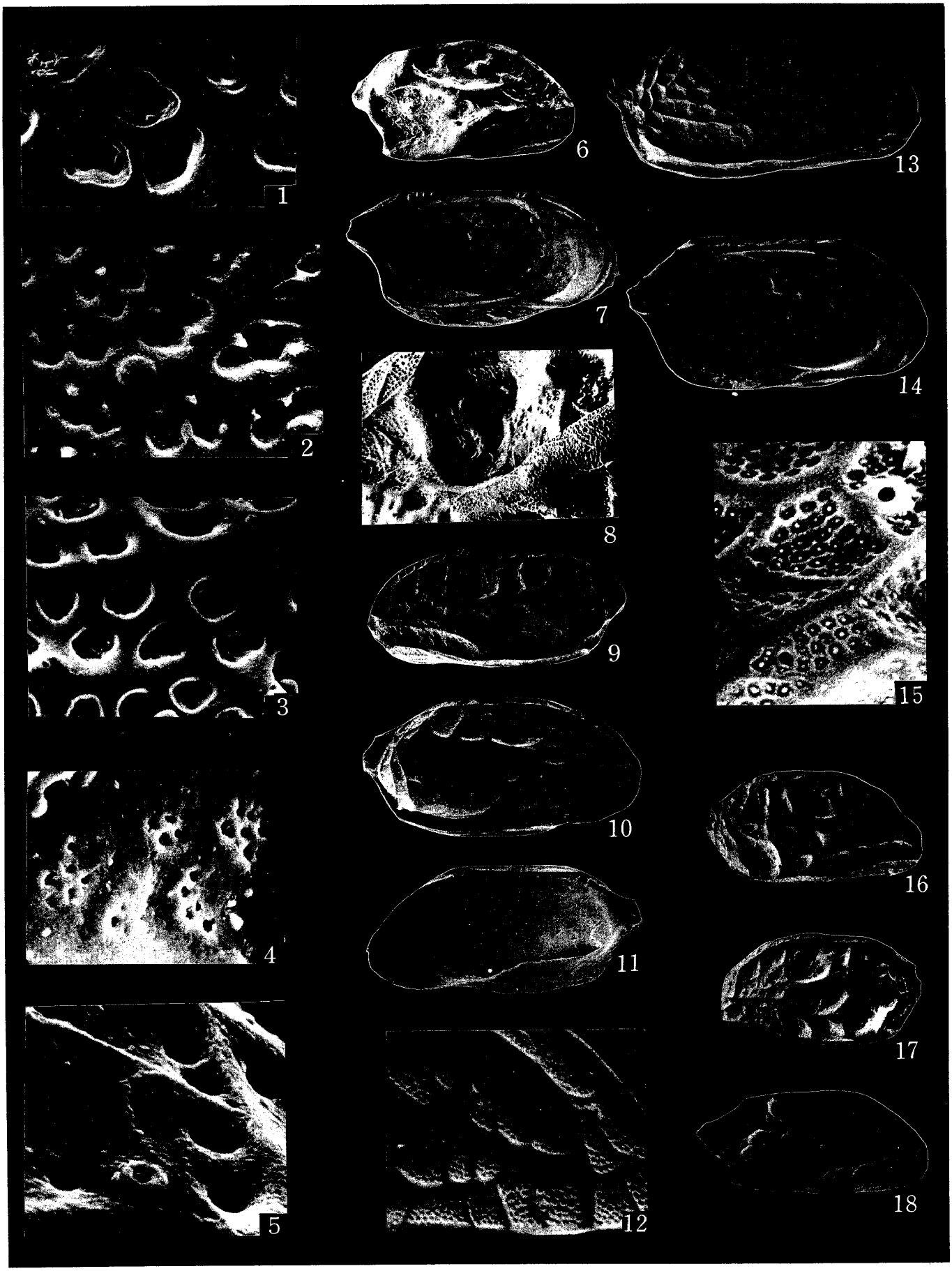
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Plate 2

Figs. 1, 2. *Eucytherura complexa* (Brady) ..... p. 44
1-a part of lateral surface of UMPC 12255, showing small simple pore intramural, and sieve-plate-like coarse perforations in a solum, ×900. 2-a part of lateral surface, showing trefoil celation consisted of small spine-like extension, and porous warty tubercle, UMPC 12256, ×900.

Figs. 3, 4. *Eucytherura guaymasensis* (Swain) ..... p. 45
3-a part of lateral surface, showing small simple pore intramural, sieve-plate-like coarse perforations in each solum, and warty tubercle, UMPC 12258, ×450. 4-a part of internal view, showing bunches of internal openings of normal pore canals corresponding to each lateral perforation free from muri, UMPC 12259, ×870.

Fig. 5. *Nearocytherura bananaformis* (Coryell and Fields) ..... p. 26
A part of lateral surface of left valve, showing rimmed simple pore canal, puncta, and narrow ridge, UMPC 12294, ×1800.

Figs. 6–8. *Kangarina quellita* Coryell and Fields ..... p. 27
6-lateral view of right valve, UMPC 12311, ×123. 7-internal view of left valve, showing details of hinge structure and marginal zone, UMPC 12312, ×107. 8-a part of lateral surface of fig. 6, showing illegible reticulation, dune-shaped porous tubercle, and ridge pattern, ×315.

Figs. 9–12. *Kangarina pervadera* Ishizaki and Gunther, n. sp. ..... p. 28
9-left side lateral view of complete carapace, UMPC 12307, ×108. 10-right side view of complete carapace (holotype), UMPC 12306, ×110. 11-internal view of right valve, showing details of hinge structure, marginal zone, and central scars, UMPC 12309, ×120. 12-a part of right side view of complete carapace in fig. 10, showing illegible reticulation, ridge pattern, and apophysis simple pore canals, ×428.

Figs. 13–15. *Kangarina complicata* Ishizaki and Gunther, n. sp. ..... p. 30
13-right side lateral view of complete carapace (holotype), UMPC 12298, ×108. 14-internal view of left valve, showing details of hinge structure and marginal zone, UMPC 12299, ×109. 15-a part of right side view of fig. 13, showing illegible reticulation, ridge pattern, and simple pore canals apophysis and free from ridge, ×900.

Figs. 16–18. *Kangarina delicata* Ishizaki and Gunther, n. sp. ..... p. 29
16-lateral view of right valve (holotype), UMPC 12301, ×92. 17-lateral view of left valve, UMPC 12302, ×92. 18-lateral view of right valve, elongate form (male?), UMPC 12303, ×92.

Plate 3

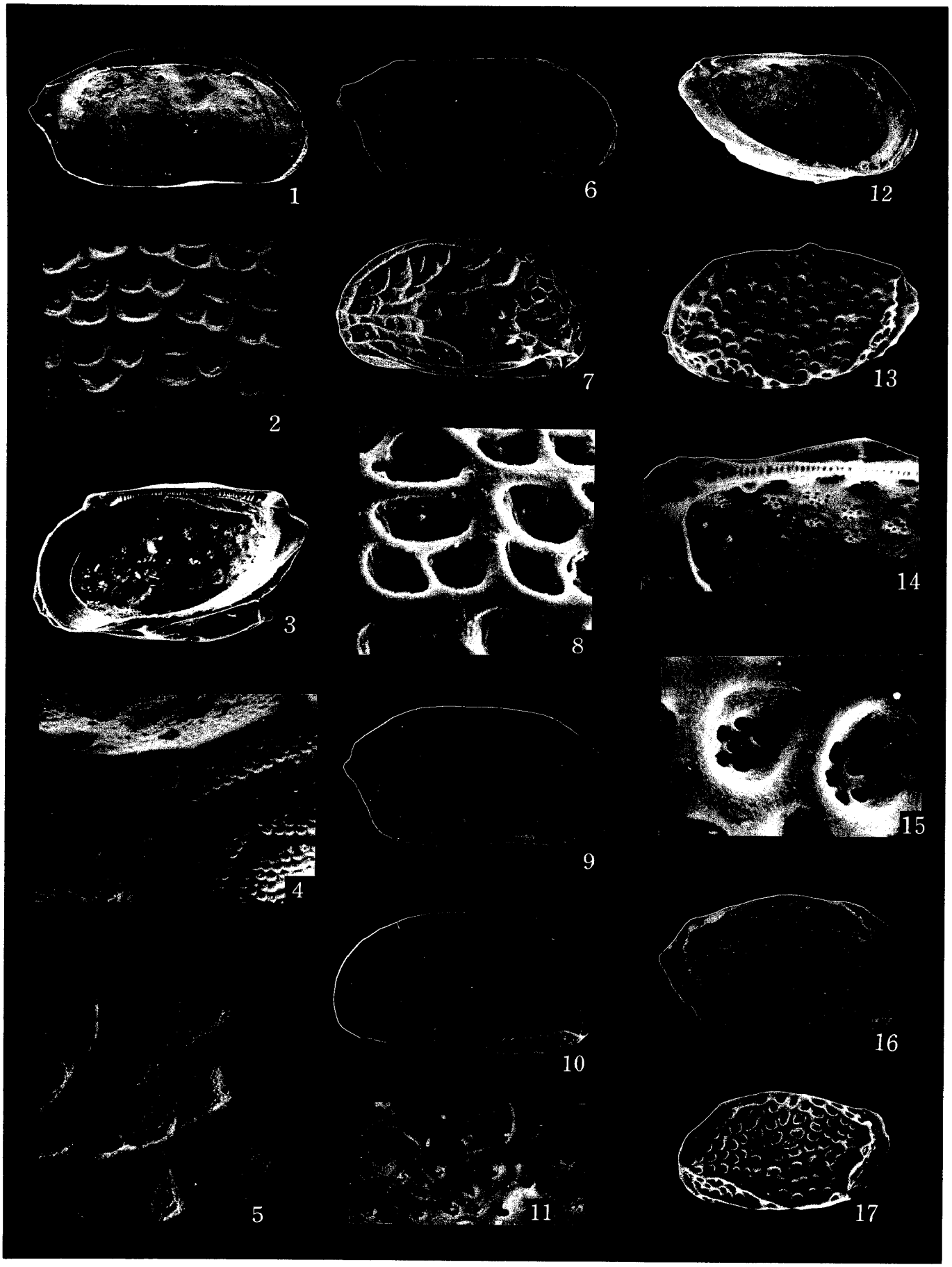
Figs. 1, 4. *Kangarina delicata* Ishizaki and Gunther, n. sp. ..... p. 29
1-internal view of left valve, showing details of hinge structure and marginal zone, UMPC 12304, ×108. 4-a part of lateral view of right valve (holotype), showing illegible reticulation, ridge pattern, and simple normal pore canal, UMPC 12301, ×630.

Figs. 2, 8–11. "*Kangarina*" sp. A ..... p. 33
2-a part of lateral view of left valve, showing reticulation and simple pore canals intramural, UMPC 12315, ×450. 8-a part of lateral view of left valve, showing flute type caperation on slope of muri, UMPC 12315, ×1170. 9-internal view of the same valve, showing details of hinge structure, marginal zone, numerous internal openings of normal pore canals, and central scars, ×114. 10-lateral view of the same specimen, ×120. 11-a part of internal view, the same valve, showing a sort of celate sieve plate in internal openings of normal pore canals, ×427.

Figs. 3, 16, 17. *Eucytherura sanjoensis* Ishizaki and Gunther, n. sp. ..... p. 47
3-internal view of right valve, showing details of hinge structure, marginal zone, and numerous internal openings of normal pore canals arranged in bunches corresponding to sola laterally observed, UMPC 12265, ×126. 16-lateral view of right valve (holotype), UMPC 12267, ×120. 17-lateral view of left valve, UMPC 12266, ×94.

Figs. 5–7. *Kangarina* sp. B ..... p. 32
5-a part of lateral view of left valve, showing illegible reticulation, ridge pattern, and simple normal pore canals, UMPC 12314, ×387. 6-internal view of left valve, showing details of hinge structure, marginal zone, and internal openings of normal pore canals, UMPC 12314, ×117. 7-lateral view of left valve of figs. 5 and 6, ×115.

Figs. 12–15. *Eucytherura pinasensis* Ishizaki and Gunther, n. sp. ..... p. 46
12-internal view of left valve, showing details of hinge structure, marginal zone, and numerous internal openings of normal pore canals arranged in bunches corresponding to sola laterally observed, UMPC 12262, ×120. 13-left side lateral view of complete carapace (holotype), UMPC 12261, ×120. 14-a part of internal view of fig. 12, showing details of numerous internal openings of normal pore canals arranged in bunches corresponding to sola laterally observed, ×318. 15-a part of right side lateral view of complete carapace, showing sieve-plate-like coarse perforations in each solum, which correspond to internal openings in fig. 14, UMPC 12264, ×1260.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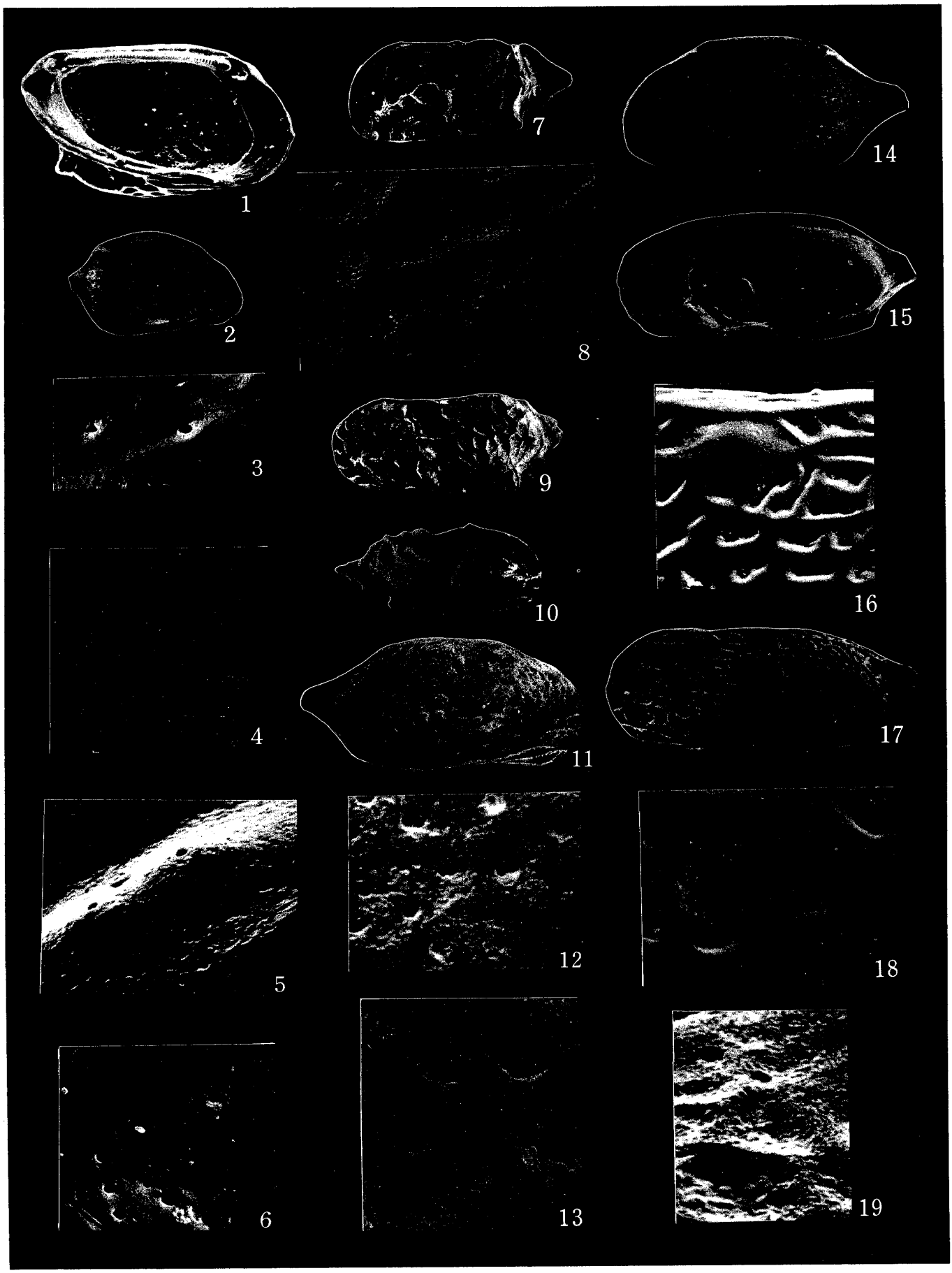
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Plate 4

Fig. 1. *Eucytherura sanjoensis* Ishizaki and Gunther, n. sp. ..... p. 47
Internal view of left valve, showing details of hinge structure, marginal zone, central scars, and numerous internal openings of normal pore canals arranged in bunches corresponding to sola laterally observed, UMPC 12268, ×123.

Figs. 2, 3. *Cytheropteron assimiloides* Swain ..... p. 37
2-lateral view of right valve, UMPC 12325, ×62. 3-a part of lateral view of left valve, showing narrowly rimmed simple normal pore canal, UMPC 12327, ×900.

Fig. 4. *Lobosocytheropteron bartolomensis* (Swain and Gilby) ..... p. 40
A part of lateral view of right valve, showing simple normal pore canals and puncta, UMPC 12334, ×900.

Fig. 5. *Lobosocytheropteron*? sp. B ..... p. 43
A part of lateral view of right valve, showing small simple pore canals amidst broad tubercle-like swellings, UMPC 12344, ×900.

Fig. 6. *Lobosocytheropteron pinasensis* Ishizaki and Gunther, n. sp. ..... p. 41
A part of lateral view of right valve, showing small simple normal pore canals and puncta, UMPC 12339, ×900.

Fig. 7. *Paracytheridea clara* Coryell and Fields ..... p. 36
Lateral view of left valve, UMPC 12316, ×60.

Figs. 8, 9. *Paracytheridea washingtonensis* Puri ..... p. 37
8-a part of lateral view of left valve, showing normal pore canals armored with coarse papillae, fine papillae on remaining lateral area, and ridge pattern, UMPC 12324, ×450. 9-lateral view of the same specimen, ×57.

Fig. 10. *Paracytheridea tschoppi* van den Bold ..... p. 35
Lateral view of right valve, UMPC 12320, ×62.

Figs. 11–14. *Serrocytherura panamaensis* Ishizaki and Gunther, n. sp. ..... p. 34
11-lateral view of right valve, UMPC 12280, ×114. 12- a part of lateral view of right side of complete carapace, showing celate sieve plate in normal pore canals laterally observed, UMPC 12282, ×850. 13-a part of lateral view of fig. 11, showing a sort of celate sieve plate in normal pore canals laterally observed, ×850. 14-internal view of right valve, same as fig. 11, showing details of hinge structure, marginal zone, and internal openings of normal pore canals, ×120.

Figs. 15–18. *Semicytherura reticuliforma* Ishizaki and Gunther, n. sp. ..... p. 23
15-internal view of right valve, showing details of hinge structure, marginal zone, and invasion of inner lamella in posterior part, UMPC 12290, ×118. 16-a part of lateral view of left valve (holotype), showing small simple pore canal, papillae on sola, ridge pattern, and eye tubercle, UMPC 12291, ×450. 17-lateral view of fig. 16, ×120. 18-a part of lateral view of left valve (holotype) showing small simple normal pore canals, ridge pattern, and papillae on area free from ridges, UMPC 12291, ×900.

Fig. 19. *Semicytherura* sp. A ..... p. 24
A part of lateral view of right valve, showing simple normal pore canals, UMPC 12293, ×700.

Plate 5

Figs. 1–3. *Semicytherura* sp. A ..... p. 24
1-lateral view of right valve, UMPC 12293, ×118. 2-internal view of the same specimen, showing details of hinge structure, marginal zone, central scars, and invasion of inner lamella in posterior part, ×115. 3-a part of lateral view of the same valve, showing details of reticulation and small normal pore canals, ×430.

Figs. 4, 5. *Nearocytherura*? *raadshooveni* (van den Bold) ..... p. 26
4-lateral view of left valve, UMPC 12297, ×140. 5-a part of lateral view of the same specimen, showing small normal pore canals and celate perforations in each punctum, ×2000.

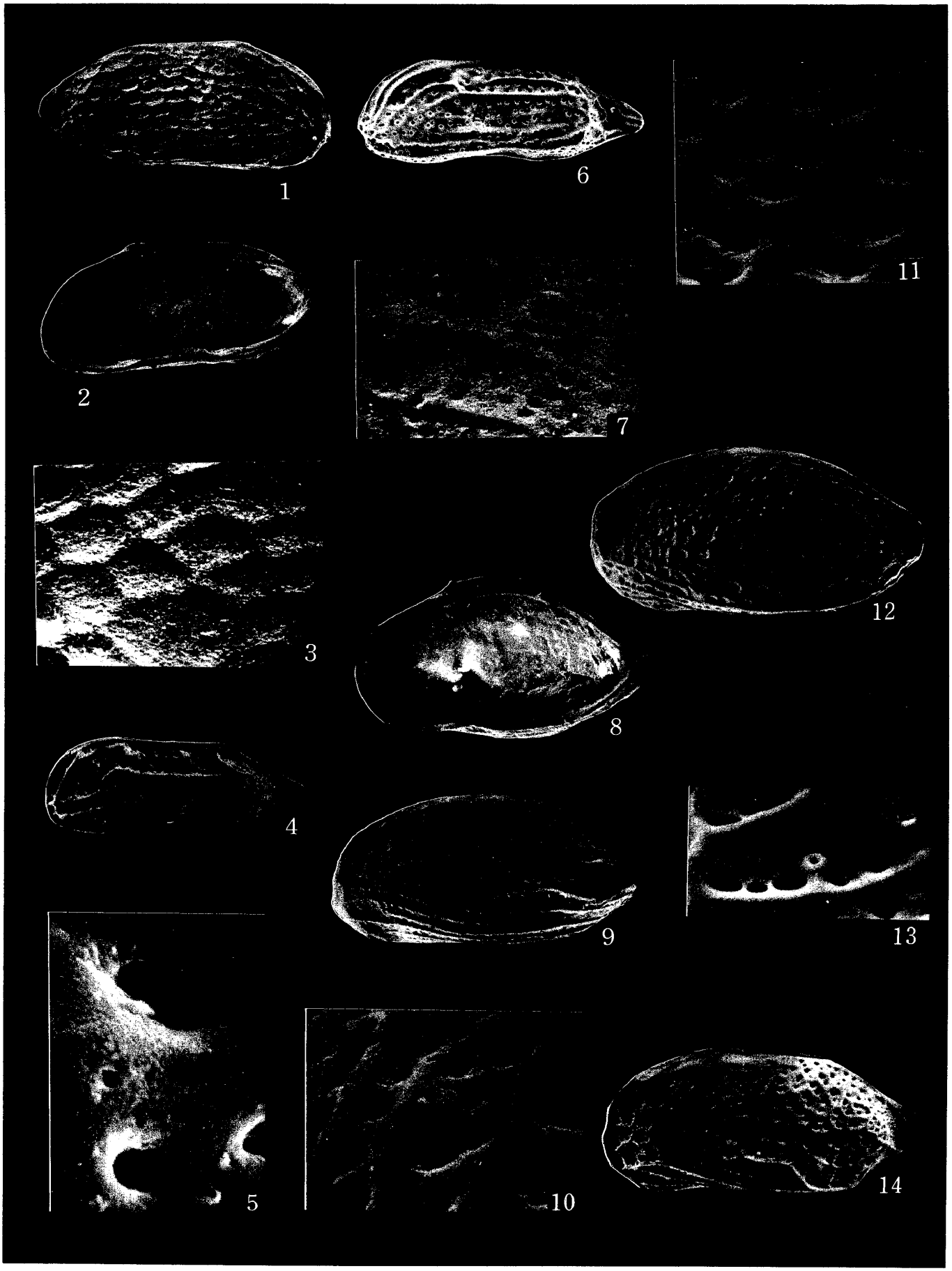
Fig. 6. *Nearocytherura bananaformis* (Coryell and Fields) ..... p. 26
Lateral view of left valve, UMPC 12294, ×137.

Fig. 7. *Semicytherura johnsonoides* (Swain) ..... p. 22
A part of lateral view of left valve, showing details of reticulate ornamentation, and small simple normal pore canals, UMPC 12288, ×500.

Figs. 8, 9. *Cytherura nodosa* Ishizaki and Gunther, n. sp. ..... p. 19
8-internal view of right valve, showing details of hinge structure and marginal zone, UMPC 12273, ×120. 9-lateral view of left valve (holotype), UMPC 12274, ×133.

Figs. 10–12. *Cytherura bajacala* Benson ..... p. 18
10-a part of lateral view of left valve, showing ridge pattern and simple normal pore canals intramural, UMPC 12271, ×1000. 11-a part of lateral view of right valve, showing reticulate ornamentation, UMPC 12272, ×1000. 12-lateral view of left valve, same as fig. 10, ×133.

Figs. 13, 14. *Serrocytherura panamaensis* Ishizaki and Gunther, n. gen., n. sp. ..... p. 34
13-a part of lateral view of left side of complete carapace (holotype), showing ridge pattern, puncta, and rimmed normal pore canals, UMPC 12281, ×1000. 14-left side lateral view of the same specimen, ×137.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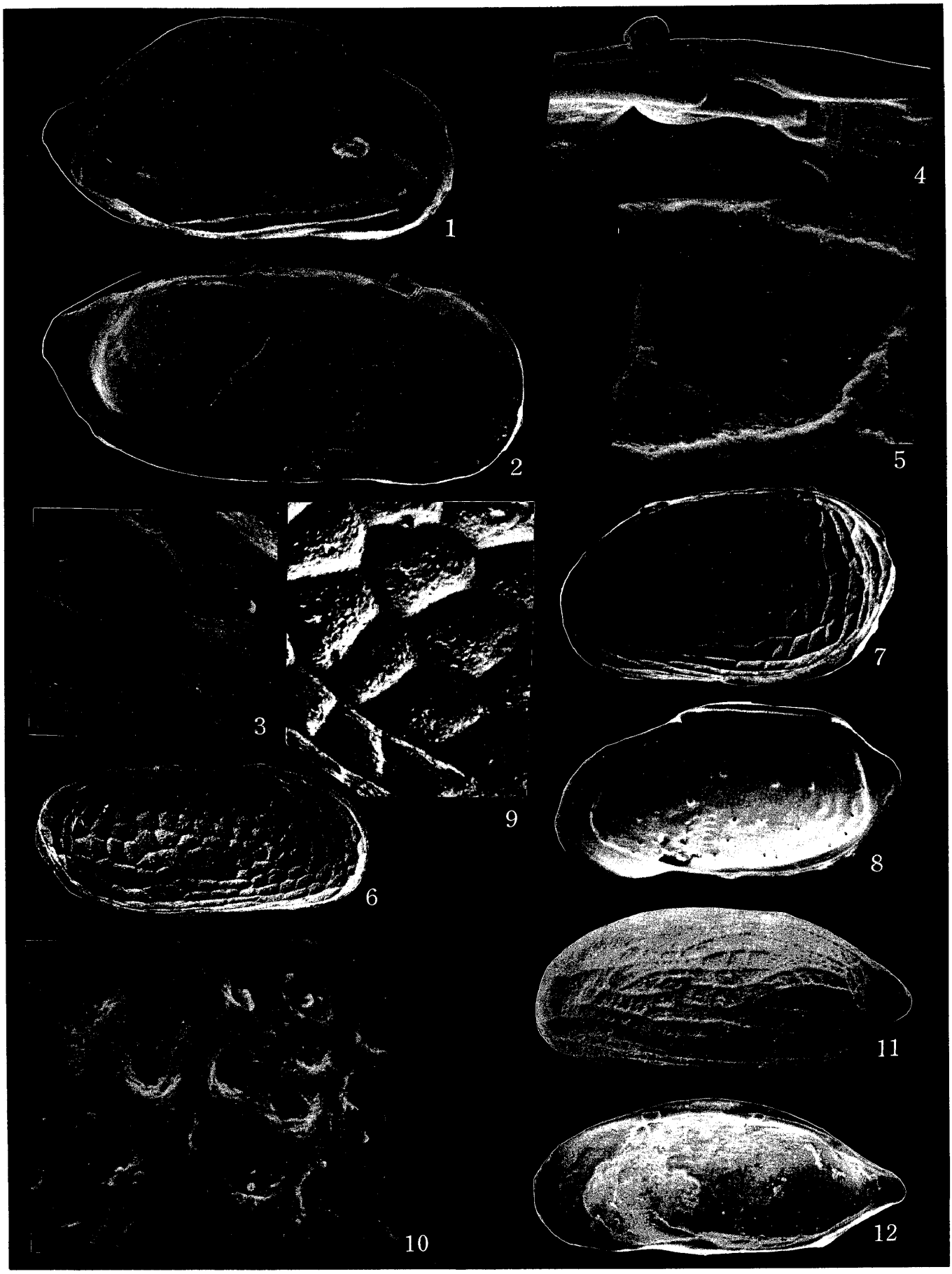
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Plate 6

Figs. 1–5. *Semicytherura sandbergi* (Morales) ..... p. 21
1-lateral view of right valve, short form, UMPC 12285, ×133. 2-internal view of left valve, showing details of hinge structure, marginal zone, central scars, and invasion of inner lamella in posterior part, UMPC 12286, ×119. 3-a part of lateral view of fig. 1, showing ridge pattern and openings of normal pore canals, ×500. 4-a part of internal view of left valve, showing details of anterior terminal of hingement, UMPC 12287, ×500. 5-a part of lateral view of left valve, showing ridge pattern and openings of normal pore canal, UMPC 12284, ×1000.

Figs. 6–9. *Cytherura purii* Ishizaki and Gunther, n. sp. ..... p. 20
6-right side lateral view of complete carapace, male, UMPC 12276, ×121. 7-left side lateral view of complete carapace (holotype), female, UMPC 12277, ×121. 8-internal view of right valve, showing details of hinge structure, marginal zone, adductor muscle scar, and internal openings of normal pore canals, UMPC 12278, ×121. 9-a part of lateral view of fig. 7, showing ridge pattern and small simple normal pore canals intramural, ×500.

Fig. 10. *Cytherura nodosa* Ishizaki and Gunther, n. sp. ..... p. 19
A part of lateral view of left valve (holotype), showing ridge pattern and small simple normal pore canals, UMPC 12274, ×1000.

Figs. 11, 12. *Semicytherura johnsonoides* (Swain) ..... p. 22
11-lateral view of left valve, UMPC 12288, ×133. 12-internal view of right valve, showing details of hinge structure and marginal zone, UMPC 12289, ×130.

Plate 7

Figs. 1–3. *Lobosocytheropteron altatensis* (Swain) ..... p. 39
1-lateral view of left valve, UMPC 12330, ×1311. 2-internal view of right valve, showing details of hinge structure and marginal zone, UMPC 12331, ×127. 3-a part of lateral view of fig. 1, showing small simple normal pore canal, ×1000.

Fig. 4. *Cytherura bajacala* Benson ..... p. 18
Internal view of right valve, showing details of hinge structure and marginal zone, UMPC 12270 ×127.

Figs. 5, 8. *Cytheropteron assimiloides* Swain ..... p. 37
5-lateral view of left valve, UMPC 12327, ×133. 8-internal view of right valve, showing details of hinge structure, marginal zone, and central scars, UMPC 12326, ×120.

Fig. 6. *Lobosocytheropteron perlasensis* Ishizaki and Gunther, n. sp. ..... p. 40
Lateral view of right valve (holotype), UMPC 12337, ×127.

Fig. 7. *Lobosocytheropteron bartolomensis* Ishizaki and Gunther, n. sp. ..... p. 40
Lateral view of left valve, UMPC, 12335, ×133.

Figs. 9, 10. *Lobosocytheropteron*? sp. A ..... p. 42
9-lateral view of right valve, UMPC 12342, ×133. 10-a part of lateral view of right valve, showing small normal pore canal, UMPC 12343, ×2000.

Figs. 11, 12. *Lobosocytheropteron pinasensis* Ishizaki and Gunther, n. sp. ..... p. 41
11-lateral view of right valve, UMPC 12339, ×133. 12-lateral view of left valve (holotype), UMPC 12340, ×133.

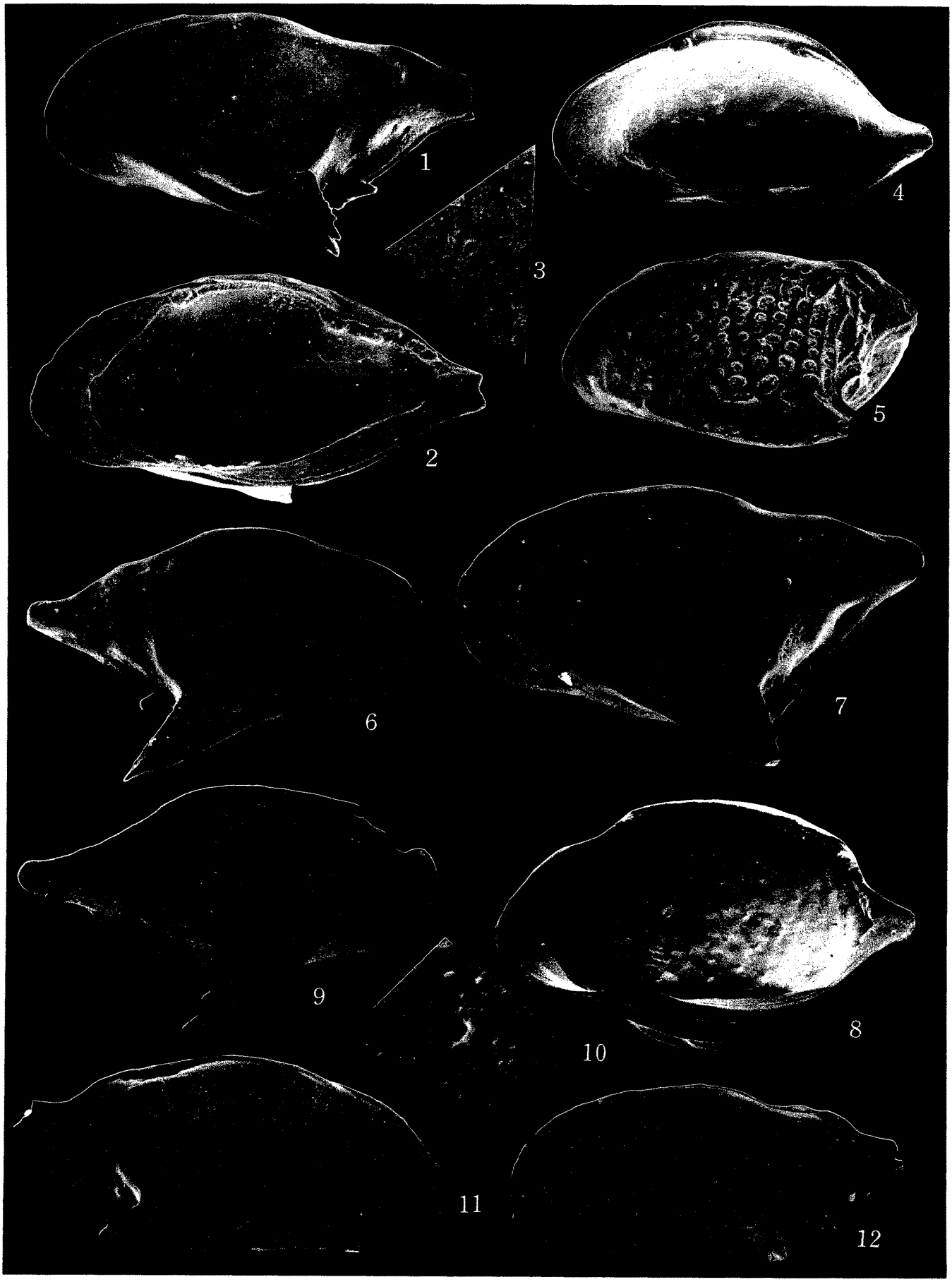
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Plate 8

Fig. 1. *Lobosocytheropteron*? sp. B ..... p. 43
Lateral view of fragmental right valve, UMPC 12345, ×133.

Figs. 2, 11. *Lobosocytheropteron*? sp. C ..... p. 43
2-lateral view of fragmental left valve, UMPC 12346, ×133. 11-a part of lateral view of left valve, showing details of reticulate ornamentation and small simple pore on muri, same as fig. 2, ×2000.

Figs. 3–9. *Paracytheridea tschoppi* van den Bold ..... p. 35
3-a part of internal view of left valve, showing scar pattern, UMPC 12319, ×216. 4-a part of internal view of right valve, showing details of scar pattern, UMPC 12322, ×350. 5-lateral view of left valve, UMPC 12321, ×137. 6-a part of lateral view of left valve, showing celate sieve plate pores and armored coarse papillae around pore, UMPC 12323, ×968. 7-a part of internal view of right valve, showing details of hinge structure, same as fig. 4, ×133. 8-a part of lateral view of right valve, showing details of lateral ornamentation consisted of pores armored with coarse papillae, fine papillae free from around pore, ridge, and ring, UMPC 12320, ×500. 9-a part of lateral view of fig. 5, showing numerous circular papillae, ridges, and pores, ×500.

Fig. 10. *Paracytheridea washingtonensis* Puri ..... p. 37
A part of lateral view of left valve, showing pore armored with coarse papillae, and fine papillae free from around pore, UMPC 12324, ×2000.

Figs. 12–14. *Paracytheridea clara* Coryell and Fields ..... p. 36
12-a part of internal view of right valve, showing details of anterior part of hingement and scar pattern, UMPC 12317, ×200. 13-a part of lateral view of left valve, showing details of ridge pattern and sieve plate pores, UMPC 12316, ×500. 14-a part of lateral view of right valve, showing sieve-plate pores and papillae, UMPC 12318, ×500.