Ostracoda (Myodocopina) of Cape Cod Bay, Massachusetts

LOUIS S. KORNICKER

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ABSTRACT

Kornicker, Louis S. Ostracoda (Myodocopina) of Cape Cod Bay, Massachusetts. *Smithsonian Contributions to Zoology*, number 173, 20 pages, 11 figures, 1974.—Cape Code Bay contains two species of Ostracoda in the suborder Myodocopina: *Sarsiella zostericola* Cushman, 1906, a carnivore, which occupies the southwestern part of the bay and Provincetown Harbor at depths mainly shallower than 25 m; and *Synasterope cushmani*, new species, a filter feeder, which occupies the deeper parts of the bay mainly between depths of 26-36 m. Only 8 percent of about 500 samples collected with a 0.1 m^2 Smith-McIntyre grab contained myodocopids. The new species is described herein, and a supplementary description is given of the related *Synasterope psitticina* (Darby, 1965), which lives off Sapelo Island, Georgia. The distribution and abundance of the Myodocopina of Cape Cod Bay are compared with that in Discovery Bay and English Strait, Antarctica.

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Louis S. Kornicker

Introduction

The Systematics-Ecology Program, Marine Biological Laboratory, Woods Hole, Massachusetts, from September 1965 to the fall of 1969, conducted a sampling program with the objective of making a biotic census of Cape Cod Bay. At the time of sampling, the Project Director was, first, Dr. David C. Grant and, later, Dr. David K. Young. Dr. Allan D. Michael, the Project Director since 1970, is responsible for sorting, identification, and the analysis of the resultant data. The Assistant Project Director was Margaret A. Mills.

Cape Cod Bay, which is about 41 km in diameter and 56 m deep at its mouth, was divided into one-mile squares from which quadrats were selected for quantitative and qualitative sampling using various sampling gear; each quadrat corner and the center were given the numbers 1 to 5 (Figure 1). The center and four corners of each quadrat were sampled with a Smith-McIntyre Grab (0.10 m^2). An epibenthic sled was used to collect a qualitative sample at one corner, a modified clam dredge at a second corner, and a naturalist dredge at a third corner. Surface temperatures and a profile of temperature vs. depth (bathythermograph) were taken at the center of each quadrat. Salinity samples were taken with van Dorn bottles from the surface, at the thermocline, and just above the bottom. Sediment cores for analysis of organic carbon and particle size were taken from each Smith-McIntyre Grab sample and frozen until analyzed. Collected specimens were sorted by the staff of the program, and taxa were sent to specialists for identification and study. When the identifications are completed, the staff of the Marine Biological Program plans to perform multivariate analysis on the data to see if there are correlations between the observed distribution and abundance of taxa and various environmental factors.

I received for identification Ostracoda of the suborder Myodocopina. The bay contained only two species: *Sarsiella zostericola* Cushman, 1906, and *Synasterope cushmani*, new species. Station data made available to me for use and the number of specimens of each species collected at each station are given in Table 1. In addition to the program's samples, I collected, on 19 June 1972, three specimens of *Sarsiella zostericola* from two intertidal localities in Plymouth Bay, which is north of the quadrat area.

Sarsiella zostericola was described originally from the "Gate of Canso," a small channel in the northwestern coast of Great Harbor; the harbor opens into Vineyard Sound to the south, and to Buzzards Bay to the west. The maximum water depth in the Gate of Canso is about 6 m. Buzzards Bay is connected to Cape Cod Bay by a narrow man-made canal (Cape Cod Canal). Other localities from which the species has been reported are Vineyard Sound (Cushman, 1906); Narragansett Bay, Rhode Island (Williams, 1907); Great Harbor (Fish, 1925); off the coast of Maine (Blake, 1933); Point Richmond area, California (Jones, 1954, 1958a, 1958b, 1961); coastal lagoons and bays in Texas (Kornicker and Wise, 1962); Hadley Harbor, a small bay in the

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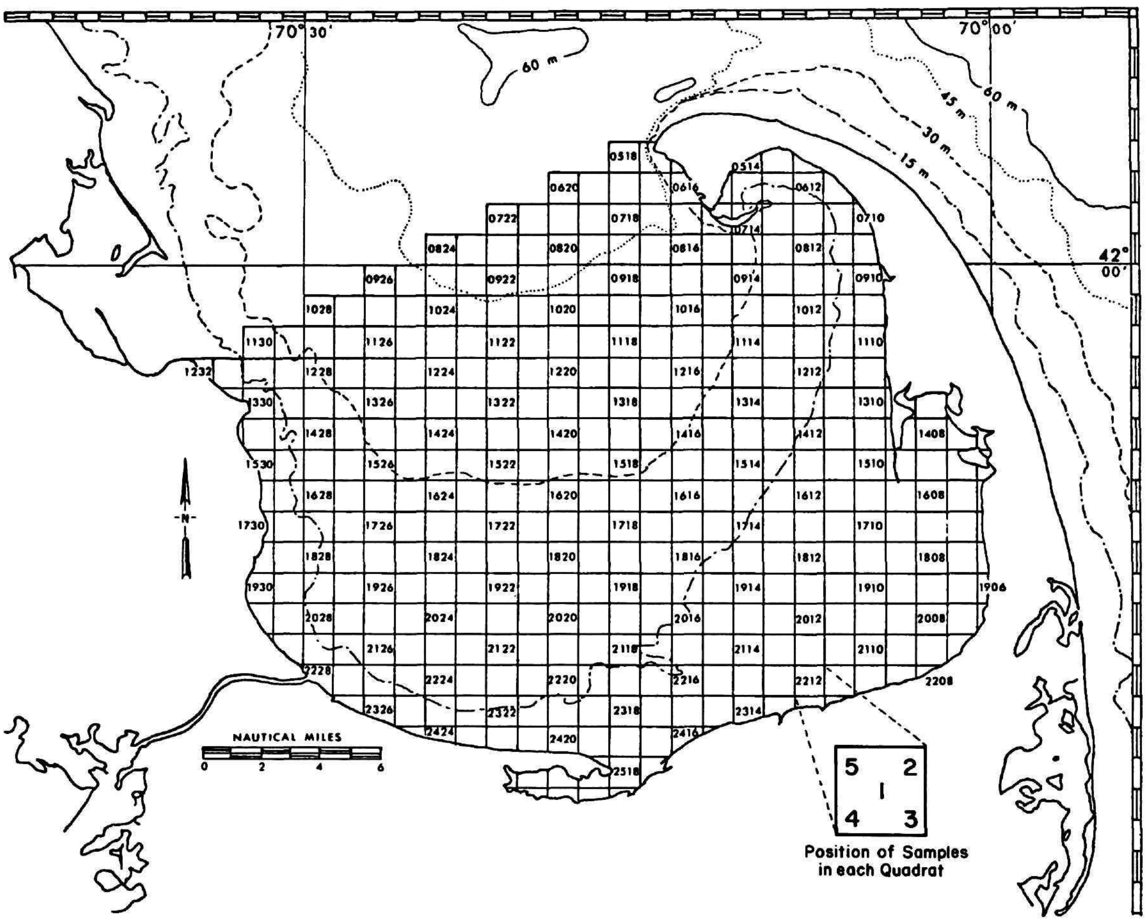

FIGURE 1.—Map of Cape Cod Bay showing quadrat area, station numbers, and positions of samples in each quadrat.

southern part of Buzzards Bay (Kornicker, 1967); Chesapeake Bay area, Delaware, and estuaries in England (Kornicker, 1974). Kornicker (1974) suggested that the species might have been carried to California and England on oysters transplanted from the east coast of North America. The species previously had been collected from various substrates including mud, sand, and shell, at temperatures from 16.2°–25°C, salinities of 20–30‰, and depths of 1–22 m. Kornicker and Wise (1960) showed experimentally that individuals burrow into sediment and that they burrow more rapidly into silty sand than into oolite. Members of the species are carnivorous (Kornicker, 1967).

The collections containing *S. zostericola* from Cape Cod Bay permit extension of the known lower limit of its temperature range to 1.0°C based on temperatures measured at time of sampling. At stations in Cape Cod Bay where this species was collected the temperature range was 1.0°–17°C. The salinity range of the species in Cape Cod Bay was 31.2–32.6‰, which is within the previously known range. The lower limit of the depth range of the species is extended by the samples from

TABLE 1.—*Data within each quadrat* (SM = Smith-McIntyre grab (0.10 m²), Ep = Epibenthic sled, N = Naturalist dredge)

Data	0514	0612	0812		1028	1126	1216	1322	1326
Date	16 Oct 69	24 Apr 68	10 Mar 69		21 Apr 69	12 May 69	19 Dec 67	24 Jul 67	22 Jul 66
Surface salinity (‰)	31.632	31.097	32.582		31.883	30.772	31.811	31.002	31.577
Bottom salinity (‰)	31.629	31.846	32.550		32.398	32.079	31.672	31.776	31.929
Surface temperature (C)	16.0	5.2	1.6		6.2	10.0	6.0	15.9	16.0
Bottom temperature (C)	15.7	5.2	1.6		4.2	4.8	6.5	4.8	6.0
Locality in quadrat	3	2	1	3	4	3	3	3	3
Sampling method	SM	Ep	SM	SM	Ep	SM	Ep	Ep	Ep
Depth below mean low water (m)	6.4	0.6	22	17.7	34.2	44.5	32.0	35.7	34.8
Sediment analysis									
Percent gravel	2.00	0.16	0	0	0.05	0.51	0	0	sample lost
Percent sand	96.70	100.33	10.50	90.21	71.15	47.57	13.97	10.23	
Percent silt	1.30	0.01	64.32	4.74	18.96	34.63	63.79	64.63	
Percent clay	0	0	25.14	5.04	9.83	17.27	22.23	25.07	
Sediment class	sand	sand	clayey silt	sand	silty sand	silty sand	clayey silt	clayey silt	
Major mode									
Phi unit	0.50	1.20	5.70	1.50	3.50	3.50	6.10	4.60	
Percent	66.0	5.46	22.2	58.0	48.9	34.3	22.2	24.1	
Median (phi)	0.47	1.06	6.15	1.61	3.56	4.12	6.15	5.96	
Mean (phi)	0.52	1.05	7.13	2.19	4.26	5.29	6.51	6.52	
Standard deviation (phi units)	0.85	0.65	3.38	2.18	2.16	3.06	2.67	2.48	
Skewness	0.74	−0.07	0.72	1.35	0.83	0.63	0.29	0.38	
Kurtosis	5.87	−0.48	1.50	6.93	1.96	0.98	0.49	0.10	
Myodocopina									
Sarsiella zostericola	6	1	5	7	1	1	0	0	0
Synasterope cushmani	0	0	0	0	0	0	1	2	2

Data	1412	1416		1424	1428	1518	1620
Date	11 Jun 68	1 Oct 68		19 Nov 68	13 May 69	23 Jan 68	19 Dec 67
Surface salinity (‰)	30.954	31.764		31.995	30.737	31.544	31.661
Bottom salinity (‰)	31.529	31.901		32.228	32.035	31.694	31.663
Surface temperature (C)	14.0	16.5		9.5	9.9	0.0	6.0
Bottom temperature (C)	7.0	9.5		9.5	4.8	0.9	6.0
Locality in quadrat	2	2	5	5	4	4	4
Sampling method	SM	SM	Ep	SM	SM	SM–Ep	Ep
Depth below mean low water (m)	10.7	30.5	32.0	35.9	24.7	31.7	29.6
Sediment analysis							
Percent gravel	14.25	0	0	0	0.04	0	2.32
Percent sand	85.70	27.86	19.51	36.76	79.09	24.03	39.40
Percent silt	0.01	54.27	59.32	46.75	13.74	54.41	39.94
Percent clay	0	17.86	21.15	16.47	7.10	21.36	18.34
Sediment class	–	sandy silt	clayey silt	sandy silt	sand	sandy silty clay	silty sand
Major mode							
Phi unit	−0.50	3.80	6.40	3.60	3.10	3.80	−0.50
Percent	60.1	19.4	22.0	33.5	43.5	20.3	18.3
Median (phi)	−0.40	5.47	6.02	4.61	3.22	5.56	4.74
Mean (phi)	−0.41	5.86	6.32	5.58	3.78	6.12	4.59
Standard deviation (phi units)	0.79	2.69	2.69	2.66	1.98	2.69	4.03
Skewness	−0.23	0.33	0.36	0.66	1.01	0.43	0.18
Kurtosis	1.23	0.32	0.49	1.18	3.79	0.48	−0.64
Myodocopina							
Sarsiella zostericola	0	0	0	0	4	0	0
Synasterope cushmani	1	1	1	1	0	1–3	2

TABLE 1.—*Data within each quadrat* (SM = Smith-McIntyre grab (0.10 m²), Ep = Epibenthic sled, N = Naturalist dredge)—continued

Data	1628				1718		1918		1918
Date	26 Mar 68				29 Oct 68		11 Feb 69		4 Aug 66
Surface salinity (‰)	32.108				31.966		32.275		31.714
Bottom salinity (‰)	32.154				31.991		32.276		31.924
Surface temperature (C)	2.0				13.4		1.0		18.0
Bottom temperature (C)	1.8				13.1		1.5		6.8
Locality in quadrat	1	3	4	5	2	3	1	2	5
Sampling method	SM	SM–Ep	SM	SM	SM	Ep	SM	SM	SM
Depth below mean low water (m)	22.9	25.0	19.8	19.5	27.5	25.6	19.8	22.6	23.2
Sediment analysis									
Percent gravel	0.09	0	0	0.01	0	0	0	0	0
Percent sand	76.92	61.07	41.15	85.54	43.30	61.91	46.19	29.79	62.34
Percent silt	15.33	29.08	39.58	11.19	40.78	27.06	37.53	51.21	25.53
Percent clay	7.68	9.83	19.27	3.24	15.92	11.02	6.24	18.98	12.09
Sediment class	sand	silty sand	silty sand	sand	silty sand	silty sand	silty sand	sandy silt	silty sand
Major mode									
Phi unit	3.50	3.50	3.60	3.40	3.60	3.50	3.50	3.90	3.40
Percent	66.9	46.7	31.4	4.36	28.0	44.4	35.1	23.5	40.5
Median (phi)	3.59	3.78	4.44	3.15	4.31	3.74	4.22	4.98	3.69
Mean (phi)	4.03	4.51	5.51	3.29	5.35	4.61	5.20	5.77	4.66
Standard deviation (phi units)	2.05	2.14	2.80	1.69	2.98	2.29	2.54	2.71	2.49
Skewness	0.80	0.73	0.53	0.99	0.69	0.62	0.50	0.44	0.67
Kurtosis	3.31	1.52	0.22	6.25	1.22	0.65	0.13	0.36	0.95
Myodocopina									
Sarsiella zostericola	3	4–28	1	11	0	3	2	0	2
Synasterope cushmani	0	0	0	0	1	0	0	1	0

Data	1926		2024		2028		2114	2118
Date	19 Nov 68		27 Mar 68		21 Mar 66		25 Oct 67	15 Oct 68
Surface salinity (‰)	31.871		31.710		32.342		31.557	31.879
Bottom salinity (‰)	31.948		32.201		32.493		31.532	31.899
Surface temperature (C)	9.5		2.4		3.5		11.8	14.8
Bottom temperature (C)	9.5		1.8		3.0		11.5	13.6
Locality in quadrat	1	4	2	3	1	5	4	1
Sampling method	SM	SM–Ep	SM	N	SM	SM	Ep	SM
Depth below mean low water (m)	23.1	21.4	22.0	22.0	15.6	16.2	10.4	17.1
Sediment analysis								
Percent gravel	0	0.03	0	0	0	0.04	7.77	0.14
Percent sand	38.08	42.39	73.86	58.65	60.51	98.22	90.06	78.95
Percent silt	47.21	42.74	14.38	30.04	28.36	0.22	0.67	12.00
Percent clay	14.68	14.84	11.74	11.30	11.10	1.02	1.50	8.90
Sediment class	sandy silt	sandy silt	silty sand	silty sand	silty sand	sand	sand	sand
Major mode								
Phi unit	3.70	3.80	2.40	3.50	3.5	1.40	2.00	3.00
Percent	36.6	23.6	36.7	44.4	54.8	60.5	47.2	29.8
Median (phi)	4.41	4.34	2.61	3.82	3.83	1.30	1.90	2.93
Mean (phi)	5.30	5.10	3.68	4.65	4.83	1.40	1.84	3.35
Standard deviation (phi units)	2.35	2.80	2.85	2.25	2.33	1.23	1.60	2.63
Skewness	0.64	0.53	0.81	0.60	0.76	2.32	0.86	0.62
Kurtosis	0.69	0.66	1.82	0.80	1.48	30.83	11.88	1.25
Myodocopina								
Sarsiella zostericola	1	6–23	1	2	3	1	7	1
Synasterope cushmani	0	0	0	0	0	0	0	0

TABLE 1.—*Data within each quadrat* (SM = Smith-McIntyre grab (0.10 m^2), Ep = Epibenthic sled, N = Naturalist dredge)—continued

Data	2122				2126				
Date	7 Jan 69				7 Feb 66				
Surface salinity (‰)	32.265				32.480				
Bottom salinity (‰)	32.264				no data				
Surface temperature (C)	1.9				1.0				
Bottom temperature (C)	1.9				1.0				
Locality in quadrat	1	2	4	5	1	2	3	4	5
Sampling method	SM	SM–Ep	SM	SM	SM	SM	SM	SM–N	SM
Depth below mean low water (m)	22.3	24.4	21.4	23.2	21.0	21.0	18.0	17.1	17.5
Sediment analysis									
Percent gravel	0	0	0	0.09	1.44	5.18	0	0.07	0.10
Percent sand	71.43	48.42	61.57	60.67	81.75	84.74	62.11	86.20	51.22
Percent silt	18.59	33.92	27.13	28.64	12.01	6.31	28.93	10.02	36.64
Percent clay	10.04	17.66	11.30	10.58	4.76	3.73	8.93	3.68	12.02
Sediment class	silty sand	silty sand	silty sand	silty sand	sand	sand	silty sand	sand	silty sand
Major mode									
Phi unit	3.40	3.50	3.50	3.50	0.60	0.70	3.50	2.50	3.50
Percent	43.8	39.6	47.2	44.1	35.9	29.9	56.0	64.8	37.8
Median (phi)	3.49	4.14	3.76	3.76	1.01	0.79	3.80	2.73	4.02
Mean (phi)	4.26	5.32	4.69	4.68	1.86	1.31	4.53	3.23	4.82
Standard deviation (phi units)	2.35	2.74	2.44	2.45	2.63	2.40	2.0	1.74	2.22
Skewness	0.84	0.57	0.74	0.79	0.88	1.05	0.90	1.39	0.47
Kurtosis	2.15	0.47	1.59	2.10	2.55	4.76	2.46	8.57	0.40
Myodocopina									
Sarsiella zostericola	3	2–3	2	4	3	1 (lost)	3	19–3	6
Synasterope cushmani	0	0	0	0	3	0	0	0	1

Data	2220			2224		2228	2326		2424	
Date	7 Jan 69			27 Mar 69		16 Oct 69	21 Jul 69		16 Oct 69	
Surface salinity (‰)	32.117			32.295		31.620	31.174		31.573	
Bottom salinity (‰)	32.124			32.288		31.643	31.170		31.590	
Surface temperature (C)	1.5			3.5		15.5	18.0		15.5	
Bottom temperature (C)	1.5			3.5		15.0	17.0		15.1	
Locality in quadrat	1	3	4	4	5	2	2	5	2	5
Sampling method	SM	SM	Ep	SM–Ep	SM	SM	SM	SM–Ep	SM	SM
Depth below mean low water (m)	17.1	16.8	15.9	18.6	21.4	13.1	14.0	10.4	14.6	10.4
Sediment analysis										
Percent gravel	0	0.01	0	0.01	0.29	0.14	0.22	0.55	0	0
Percent sand	93.80	92.04	94.84	69.79	50.94	92.75	90.20	94.54	91.84	90.11
Percent silt	2.79	4.12	3.09	23.11	33.53	2.79	5.89	1.67	3.87	4.79
Percent clay	3.07	3.80	2.06	7.08	11.24	4.28	3.69	3.36	4.24	5.10
Sediment class	sand	sand	sand	silty sand	silty sand	sand	sand	sand	sand	sand
Major mode										
Phi unit	2.50	2.70	2.50	3.50	3.40	2.50	2.60	2.50	2.60	2.50
Percent	56.4	51.3	57.7	57.6	25.0	70.0	61.8	75.1	52.8	64.4
Median (phi)	2.44	2.92	2.48	3.66	3.79	2.65	2.75	2.52	2.80	2.72
Mean (phi)	1.66	3.25	2.69	4.27	4.44	3.05	3.14	2.74	3.16	3.18
Standard deviation (phi units)	1.63	1.65	1.44	1.94	2.65	1.74	1.67	1.64	1.76	1.86
Skewness	1.50	1.55	1.66	1.00	0.52	1.73	1.51	1.73	1.57	1.55
Kurtosis	11.47	10.65	14.28	3.69	0.89	12.23	10.61	14.77	10.45	9.58
Myodocopina										
Sarsiella zostericola	1	1	2	12–1	2	14	12	1–6	8	19
Synasterope cushmani	0	0	0	0	0	0	0	0	0	0

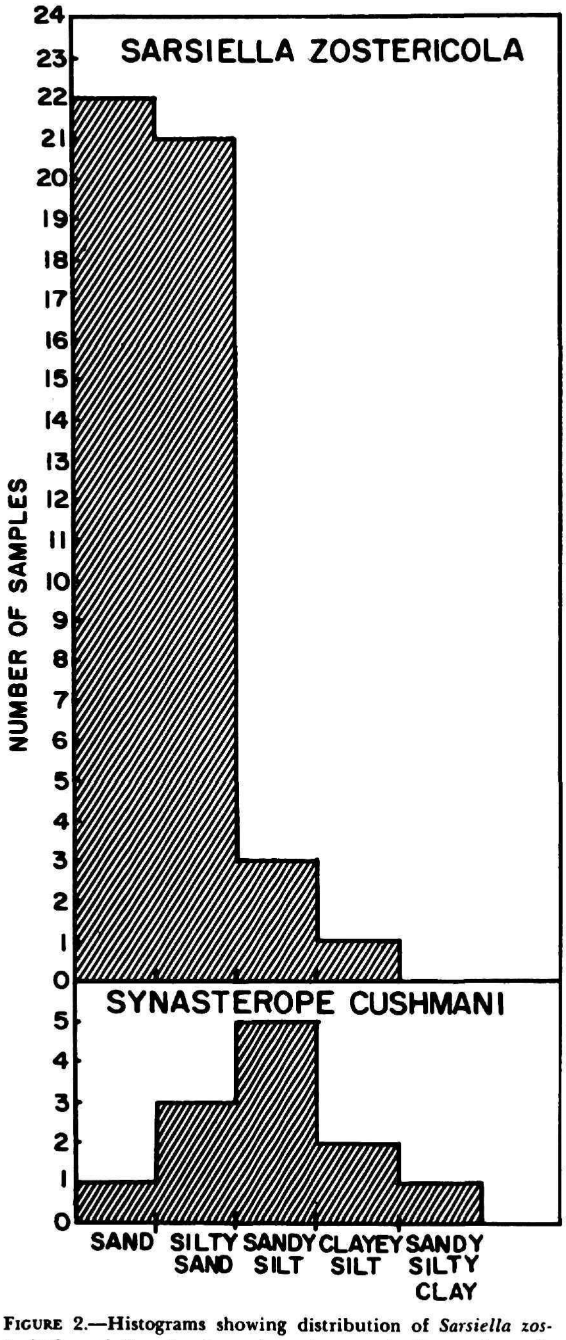

FIGURE 2.—Histograms showing distribution of *Sarsiella zostericola* and *Synasterope cushmani* on sand, silty sand, sandy silt, clayey silt, and sandy silty clay.

Cape Cod Bay to 44.5 m. The depth range in the bay is 0.6–44.5 m. The species was collected on various sediments: sand, silty sand, sandy silt, and clayey silt; but it was rarely collected in the last two (Figure 2).

In the Point Richmond area, California, *S. zostericola* was collected at depths of 2–11 m, but the abundance decreased markedly at depths greater than about 6 m (Jones, 1954; Kornicker, 1967). In Cape Cod Bay, abundance decreases markedly at depths less than 10 m and greater than 26 m (Figure 3).

The species was common in the southwestern part of the bay at depths of less than 26 m (Figure 4). Its distributional pattern in that locality is fan-like, and it appears to be spreading from the Cape Cod Canal, but too little is known concerning the effect of the Canal on the bay to draw that conclusion. The species is also common in the Provincetown Harbor, and probably also in Plymouth Bay, although only a few samples were collected there. Specimens were collected in deeper water (34.2–44.5 m) at stations 1028 and 1126. These might represent an isolated population, or might be a northern continuation of the western arm of the larger population in the southwestern part of the bay.

It is difficult to account for the absence of the species in the shallow waters along the eastern and southeastern parts of the bay. The bottom in the southeastern part consists of a broad expanse of sand (Young and Rhoads, 1971:243, fig. 1). Possibly the sand is kept in motion by waves in this area, thereby making it inhospitable for myodocopid ostracodes.

The 35 quantitative samples containing *S. zostericola* averaged 5 specimens per 0.1 m^2 of bottom, with a maximum number of 19. The samples with many specimens were from the southwestern part of the bay.

The new species, *Synasterope cushmani,* which is known only from Cape Cod Bay, has a known temperature range of 0.9°–13.1°C, a salinity range of 31.5–32.3‰, and a depth range of 10.7–35.9 m. The species was collected on substrates of sand, silty sand, sandy silt, clayey silt, and sandy silty clay, but unlike *Sarsiella zostericola* it was rare in sand (Figure 2). The species is a filter feeder (see Cannon, 1933) and both sexes are without eyes.

In the bay, the species was collected mainly from

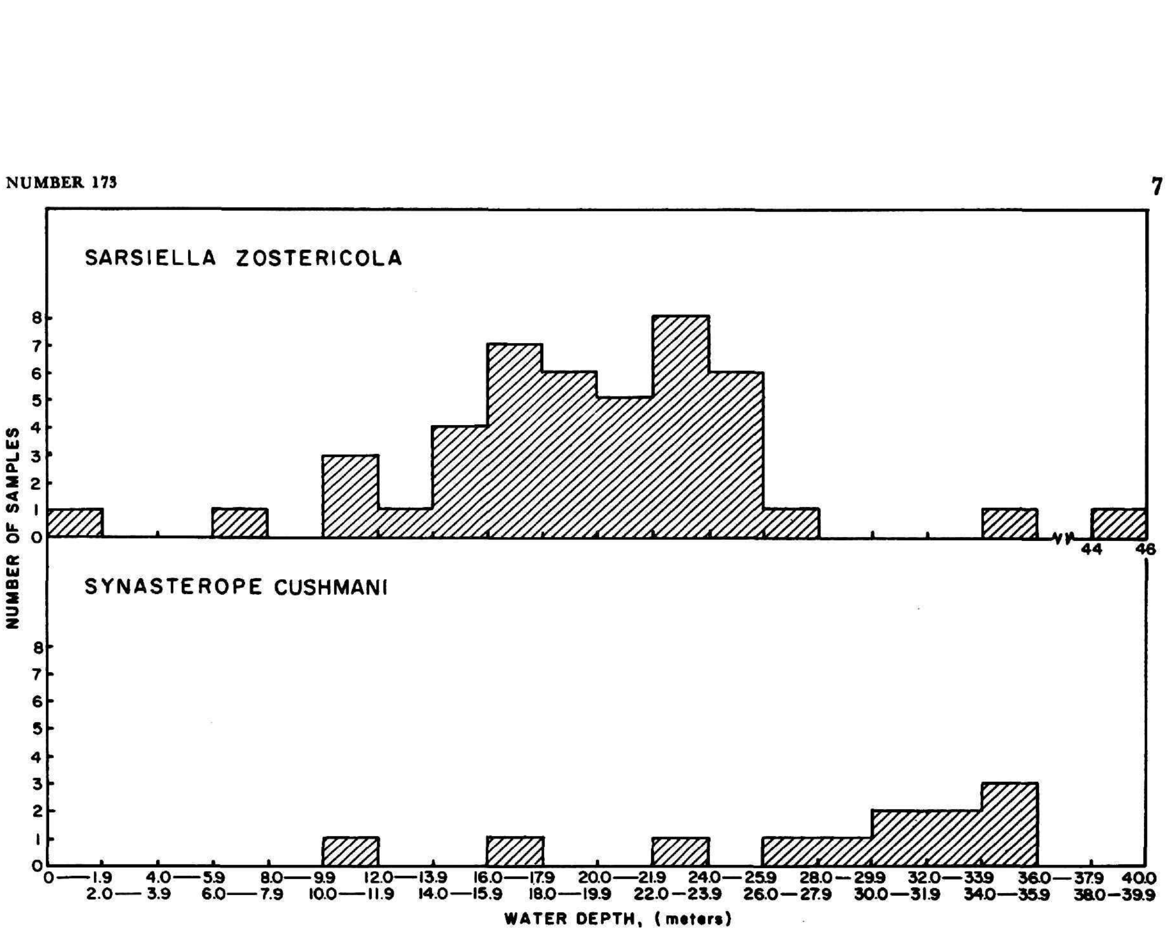

FIGURE 3.—Histograms showing the depth distribution of *Sarsiella zostericola* and *Synasterope cushmani.*

two centrally located patches at water depths of 26–36 m (Figures 3, 4). Its restriction mainly to the deeper waters of the bay may be controlled by temperature or by food requirements. The temperature where the species commonly occurs ranges from about 1.5°–13.1°C, with an annual variation of 10.0°–12.4°C (Table 2). Higher temperatures and greater annual variations are encountered in shallower water.

TABLE 2.—*Bottom water temperatures in Cape Cod Bay* [1]

Depth (m)	*Number of samples*	*Temperature (°C) maximum*	*minimum*	*Range*
0–10	21	23.5	1.0	22.5
10–20	16	15.0	0.4	14.6
20–30	21	13.1	0.7	12.4
30–40	15	9.6	1.5	10.0
40–50	12	6.2	0.4	5.8

[1] Information from Allan D. Michael (pers. comm., 1972)

Based on analyses of sediments on a transect from shallow to deep water in Cape Cod Bay, Young and Rhoads (1971:249) concluded that the "total carbon content is positively correlated with increasing depth of water, high clay content and decreasing particle size." This suggests that more food might be available for filter-feeding ostracodes in deeper water.

The greatest concentration of *S. cushmani* is within the more extensive population of the holothurian *Molpadia oolitica* (Pourtales, 1851) as described by Rhoads and Young (1971). Reworking of the sediment by *Molpadia* probably results in a high level of turbidity (Rhoads and Young, 1971: 260). Possibly, characters developed by *S. cushmani* because of the absence of eyes give it an adaptive advantage in turbid water over seeing forms.

The seven quantitative samples containing *S. cushmani* had only one specimen per 0.1 m^2, reflecting the sparcity of the species in the bay.

It was necessary to examine specimens of *Par-*

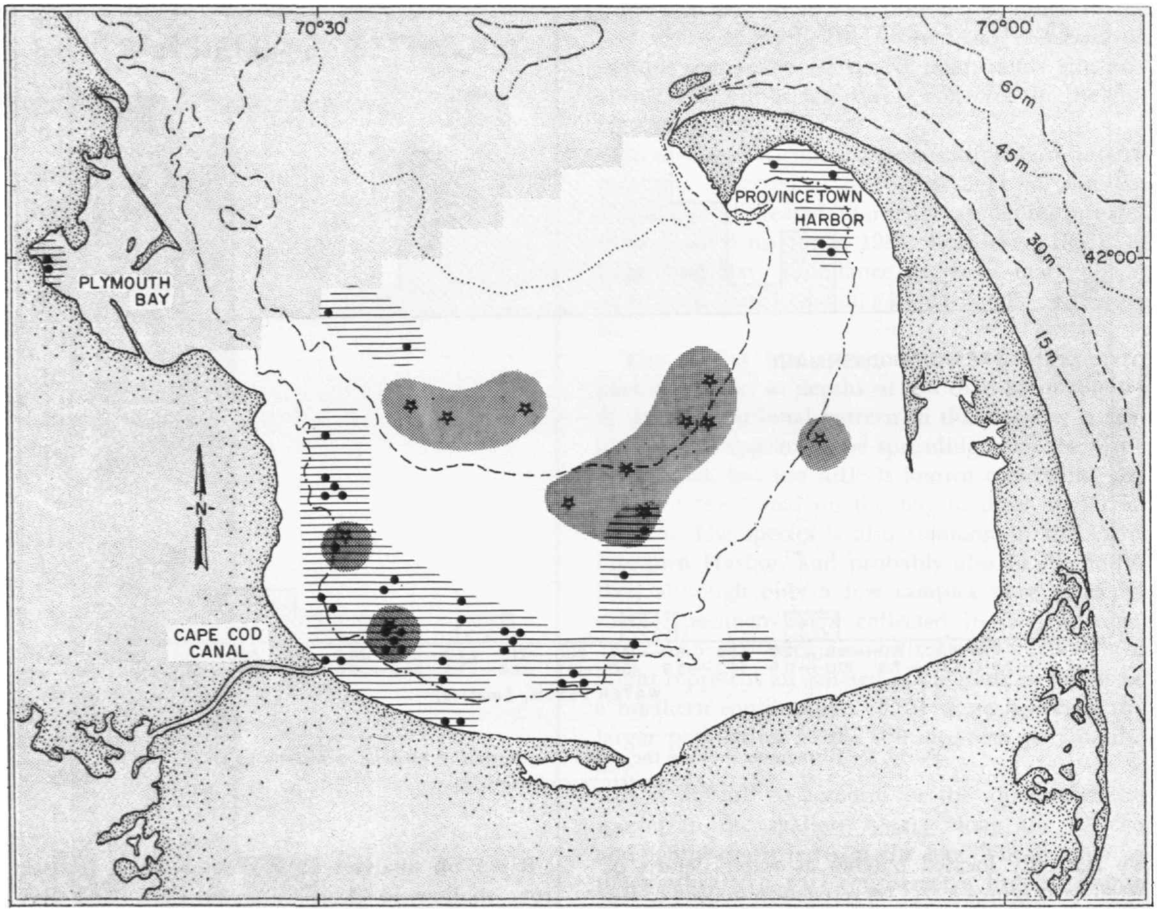

Figure 4.—Map of Cape Cod Bay showing the distribution of *Sarsiella zostericola* (circle) and *Synasterope cushmani* (star).

asterope psitticina Darby, 1965, from the vicinity of Sapelo Island, Georgia, in order to determine how it differed from *S. cushmani.* A supplementary description of that species is present herein, and it is referred to the genus *Synasterope.*

Comparison with Quantitative Studies Elsewhere.—Kornicker (1971; in press) reported on myodocopid ostracodes collected during 1967–1970 in 0.1 m^2 and 0.2 m^2 Petersen grabs in Discovery Bay, Greenwich Island, one of the South Shetland Islands, Antarctica, and in English Strait which lies off the mouth of Discovery Bay. Discovery Bay is a U-shaped bay 3.5 km wide and 5.5 km long with a maximum depth at its mouth of about 230 m. Thus, it is much smaller, but deeper than Cape Cod Bay. The bottom consists of fine sands with varying amounts of silt and clay (Gallardo and Castillo, 1969). English Strait, which has bottom sediment similar to that in Discovery Bay, was sampled mainly near the mouth of the bay at depths of 249–405 m.

The myodocopid ostracodes in both the Antarctic and Cape Cod Bay studies were removed from the fraction retained on a 1.0 mm sieve. Some juveniles probably went through the sieve and, therefore, the areal abundances reported here are low. In general, adults of the Cape Cod Bay ostracodes are smaller than those from the Antarctic localities. Therefore, a relatively greater proportion of juveniles might have been lost in the Cape Cod Bay

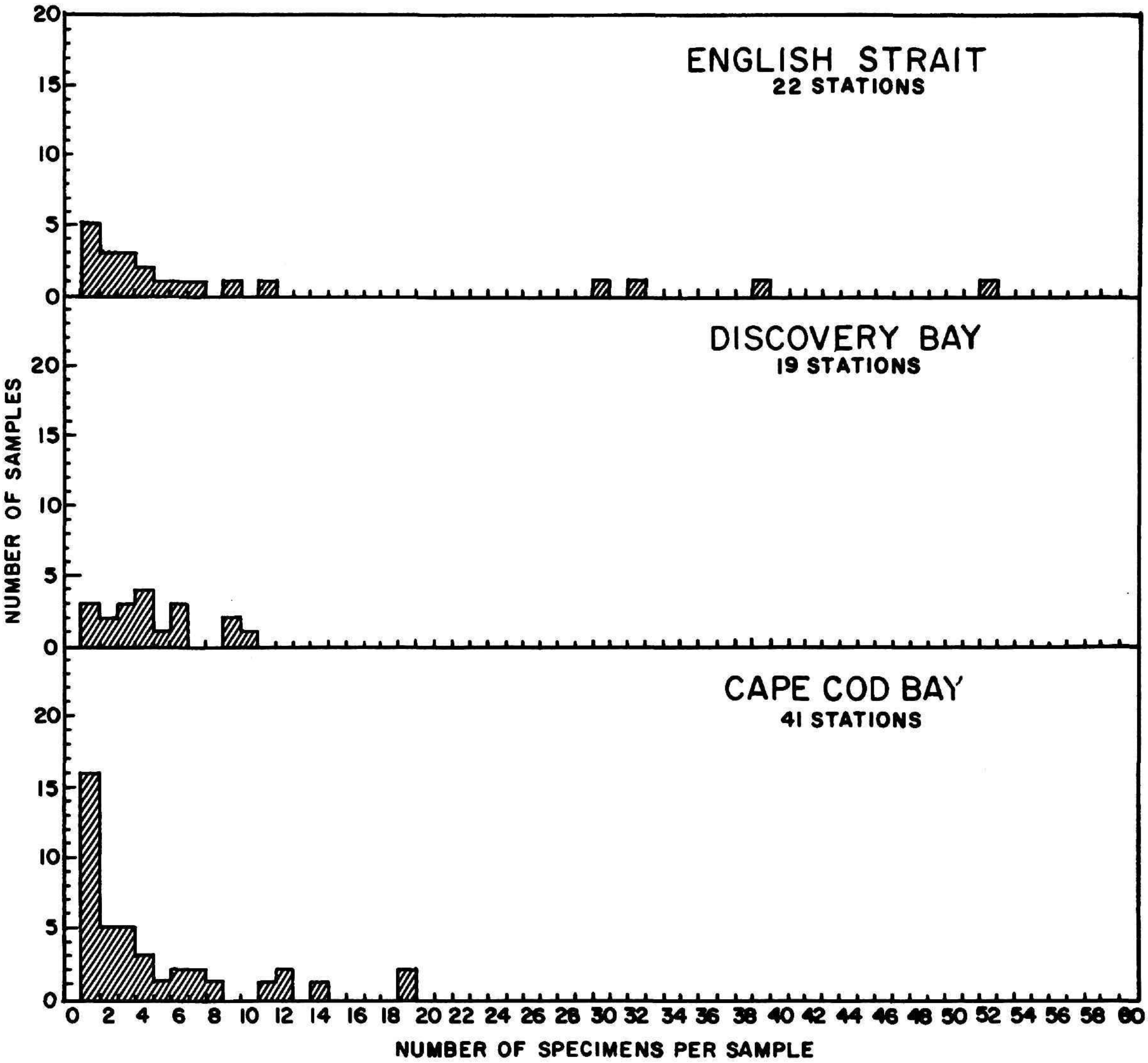

FIGURE 5.—Histograms showing the number of specimens of myodocopid ostracodes per 0.1 square meters in Cape Cod Bay, Discovery Bay, and English Strait, Antarctica.

study than in the Antarctic study. This possibility has not been considered in comparing abundances in the two areas.

Forty-three quantitative samples were collected in 1968 from Discovery Bay and English Strait (Gallardo and Castillo, 1969). Twenty-eight of these (65 percent) contained myodocopid ostracodes (Kornicker, 1971). In Cape Cod Bay, only 8 percent of the samples contained myodocopid ostracodes, indicating that they are less widely distributed in the bay than in the two Antarctic localities.

In those samples containing myodocopid ostracodes, the number of myodocopids per 0.1 m^2 in Cape Cod Bay (average 4, maximum 19) is similar to that in Discovery Bay (average 4, maximum 10) and lower than that in English Strait (average 10, maximum 52) (Figure 5).

Both the quantitative and qualitative samples in

Cape Cod Bay contained the same two species (Table 1). The quantitative samples from Discovery Bay contained four species; additional qualitative trawl samples produced two additional species, but only one specimen of each (Kornicker, in press). The quantitative samples from English Strait contained six species; additional qualitative trawl samples produced one specimen of an additional species.

The dominant species (Kornicker, 1967) in Cape Cod Bay is a carnivore, whereas in Discovery Bay and in English Strait it is a collector—detritus feeder (Table 3). Carnivores were not collected in either Antarctic locality. In all three areas, species that are neither carnivores nor collectors are filter feeders, but in Cape Cod Bay, the carnivore and filter feeder occupy different areas; whereas, in Discovery Bay and English Strait, the collectors and filter feeders occur together.

In summary, Cape Cod Bay contains only two species of myodocopid Ostracoda: *Sarsiella zostericola* Cushman, 1906, and *Synasterope cushmani*, new species. The former species lives mainly in the southwestern part of the bay and in Provincetown Harbor at depths generally shallower than 26 m. The latter species lives mainly in the central part of the bay at depths of 26–36 m. *Sarsiella zostericola* is a species with a wide distribution along the Atlantic Coast from Maine to Delaware and has been reported from the coasts of Texas, California, and England, where it also has been collected in shallow water. *Synasterope cushmani* is known only from the bay. It is suggested that the reasons for *S. cushmani* being primarily confined to the deeper part of the bay are the presence there of lower and less variable temperatures, greater food availability—the latter indicated by the high total carbon content of the sediment—and perhaps its adaptation to turbid water conditions. Myodocopids are less widely distributed in Cape Cod Bay than in Discovery Bay and English Strait, Antarctica. Samples with myodocopids contain about the same number of specimens in Cape Cod Bay and Discovery Bay, fewer than in English Strait. Myodocopids in Cape Cod Bay are carnivores and filter feeders, and they mainly live in different areas of the bay; whereas, Discovery Bay and English Strait contain collectors and filter feeders, both feeding types living in the same area. Cape Cod Bay supports fewer species of Myodocopa than either Discovery Bay or English Strait.

Magnifications given for the scanning electron micrographs are those at which photographs were taken; however, Figures 6, 7, and 8 have been reduced to 73 percent for publication.

TABLE 3.—*Species abundance and feeding types in Cape Cod Bay, Mass., Discovery Bay, and English Strait, Antarctica*

Species	Total specimens[1]	Percent	Feeding type
Cape Cod Bay (41 stations)			
Sarsiella zostericola	172	96	carnivore
Synasterope cushmani	7	4	filterer
Discovery Bay[2] (19 stations)			
Philomedes orbicularis	75	91	collector
Scleroconcha gallardoi	4	5	collector
Parasterope ohlini	2	3	filterer
Empoulsenia[3] *pentathrix*	1	1	filterer
English Strait[2] (22 stations)			
Philomedes orbicularis	168	76	collector
Scleroconcha gallardoi	22	10	collector
Empoulsenia pentathrix	22	10	filterer
Parasterope ohlini	3	1	filterer
Skogsbergiella[3] *spinifera*	3	1	filterer
Skogsbergiella skogsbergi	3	1	filterer

[1] Number of specimens in Cape Cod Bay based on 0.1 m^2 Smith-McIntyre grab; number of specimens in Discovery Bay and English Strait based on 0.1 m^2 and 0.2 m^2 Petersen grabs; the number of specimens from the 0.2 m^2 Petersen grab was halved for the above table.

[2] Data from Kornicker (1971; in press).

[3] New genera described by Kornicker (in press).

ACKNOWLEDGMENTS.—I thank Dr. Allan D. Michael and Ms. Margaret A. Mills for supplying specimens and data, and for courtesies I received while visiting Woods Hole; Dr. Robert V. Kesling for supplying type specimens of *Parasterope psitticina;* and Drs. A. D. Michael, T. E. Bowman, and Joseph E. Hazel for criticizing the manuscript. The scanning electron micrographs were taken by Mary J. Mann. Mr. Jack Schroeder prepared figures of appendages from my penciled camera lucida drawings.

Genus *Sarsiella* Norman, 1869

Sarsiella zostericola Cushman, 1906

Sarsiella zostericola Cushman, 1906:364–366, pl. 28: figs. 7–18. —Williams, 1907:79 [listed].—Fish, 1925: 141 [listed].—Blake, 1933:230 [listed].—Kornicker and Wise, 1962:61, figs.

2A–G, 4A–C.—Kornicker, 1967: 4–32, figs. 1–5, pls. 1–2.—Kornicker, 1974, figs. 1–3.
Sarsiella americana Cushman, 1906:363–364, pl. 27: figs. 1–6.—Fish, 1925:141 [listed].
Sarsiella tricostata Jones, 1958a:48–52, figs. 1–2; 1958b, figs. 1–3; 1961:261, 262, figs. 20, 28, table 19 [listed].
Eusarsiella zostericola (Cushman).—Poulsen, 1965:83 [in key].
Eusarsiella americana (Cushman).—Poulsen, 1965:83 [in key].

LECTOTYPE.—USNM 113357, male designated by Kornicker (1967).

TYPE-LOCALITY.—Cushman (1906:366) reported collecting specimens used in describing the species from a channel across from Woods Hole Harbor, known locally as the "Gulf of Canso." Fish (1925: 141) referred to that locality as the "Gut of Canso." On the United States Coast and Geodetic Survey map of Woods Hole (no. 348; reissued 1917) the locality is designated "Gate of Canso."

MATERIAL.—From the Cape Cod Bay quadrat area, 251 specimens (the number of specimens at each station is listed in Table 1); 1 male from a water depth of about 10 cm at low tide at Grays Beach, Kingston, Massachusetts, and 2 specimens from a water depth of about 10 cm at low tide at the inlet to Jones River, Kingston, Massachusetts.

Genus *Synasterope* Poulsen, 1965

Synasterope cushmani, new species

FIGURES 6–10

HOLOTYPE.—USNM 143863, adult female; some appendages on slide, remaining appendages and valves in alcohol.

TYPE-LOCALITY.—Station 1424 (5), Cape Cod Bay.

PARATYPES.—USNM 143864, 1 adult male from station 1412(2); USNM 143865, 1 adult female from station 1416(5); USNM 143866, 2 adult females from station 1326(3); USNM 143867, 1 adult female from station 1416(2); USNM 143868, 1 adult female, 1 juvenile from station 1620(4); USNM 143869, 2 adult males, 1 adult female from station 1518(4,Ep); USNM 143870, 1 adult male from station 1216(3); USNM 143961, 1 juvenile, length 1.27 mm, height 0.61 mm, from station 1828(2); USNM 143962, 2 adult females from station 1322(3); USNM 143963, 1 A-1 male, length only 1.67 mm, from station 1718(2); USNM 143964, 1 adult female from station 1518(4); USNM 143965, 1 juvenile, length 1.24 mm, height 0.63 mm, from station 2126(5).

ETYMOLOGY.—This species is named for Dr. Joseph A. Cushman.

DESCRIPTION OF FEMALE (Figures 6–9).—Carapace elongate with slitlike incisur below valve middle, and posterior evenly rounded or slightly truncate dorsally; ventral and dorsal margins slightly convex (Figure 9*a-c*).

Infold (Figures 7, 8, 9*b,c*): Infold between list and anterodorsal margin of rostrum with about 32 bristles followed by row of about 14 shorter bristles along dorsal margin anterior to juncture; list and area below list with about 17 bristles; about 29 long bristles and about 20 short bristles present on infold below incisur to point on ventral margin where single row of bristles starts, infold of ventral margin with about 11 bristles forming single row; posterior ridge with about 21 flaplike bristles, each separated by 3, rarely 2, short bristles; 57 bristles forming row between posterior ridge and posterior valve margin (includes 5 bristles anterior to ventral end of ridge); 3 or 4 processes present near posterior margin.

Size: Holotype length 1.59 mm, height 0.78 mm, height 49% length; USNM 143865, length only, 1.65 mm; USNM 143866a, length 1.62 mm, height 0.75 mm, height 46% length; USNM 143866b, length 1.63 mm, height 0.77 mm, height 47% length; USNM 143867, length 1.60 mm, height 0.83 mm, height 52% length; USNM 143868a, length 1.62 mm, height 0.79 mm, height 49% length; USNM 143869c, length 1.60 mm, height 0.75 mm, height 47% length; USNM 143962a, length 1.61 mm, height 0.76 mm, height 47% length; USNM 143962b, length 1.60 mm, height 0.76 mm, height 48% length.

Micromorphology of carapace (Figures 6–8): Outer surface (Figure 6). Surface with widely scattered long and short bristles (Figure 6*b–f*); long bristles emerging from lipped pores surrounded by about 5 narrow concentric ridges (Figure 6*c–f*); short bristles emerging from simple pores; simple pore present below and slightly in front of concentric pore (Figure 6*c–f*). The concentric rings around certain pores suggest that a viscous fluid may be emerging periodically from the pores and spreading over the valve surface.

Infold (Figures 7, 8). Bristles between posterior broad list and valve margin emerging from lipped pore (Figure 7*d,e*); short bristles between broad

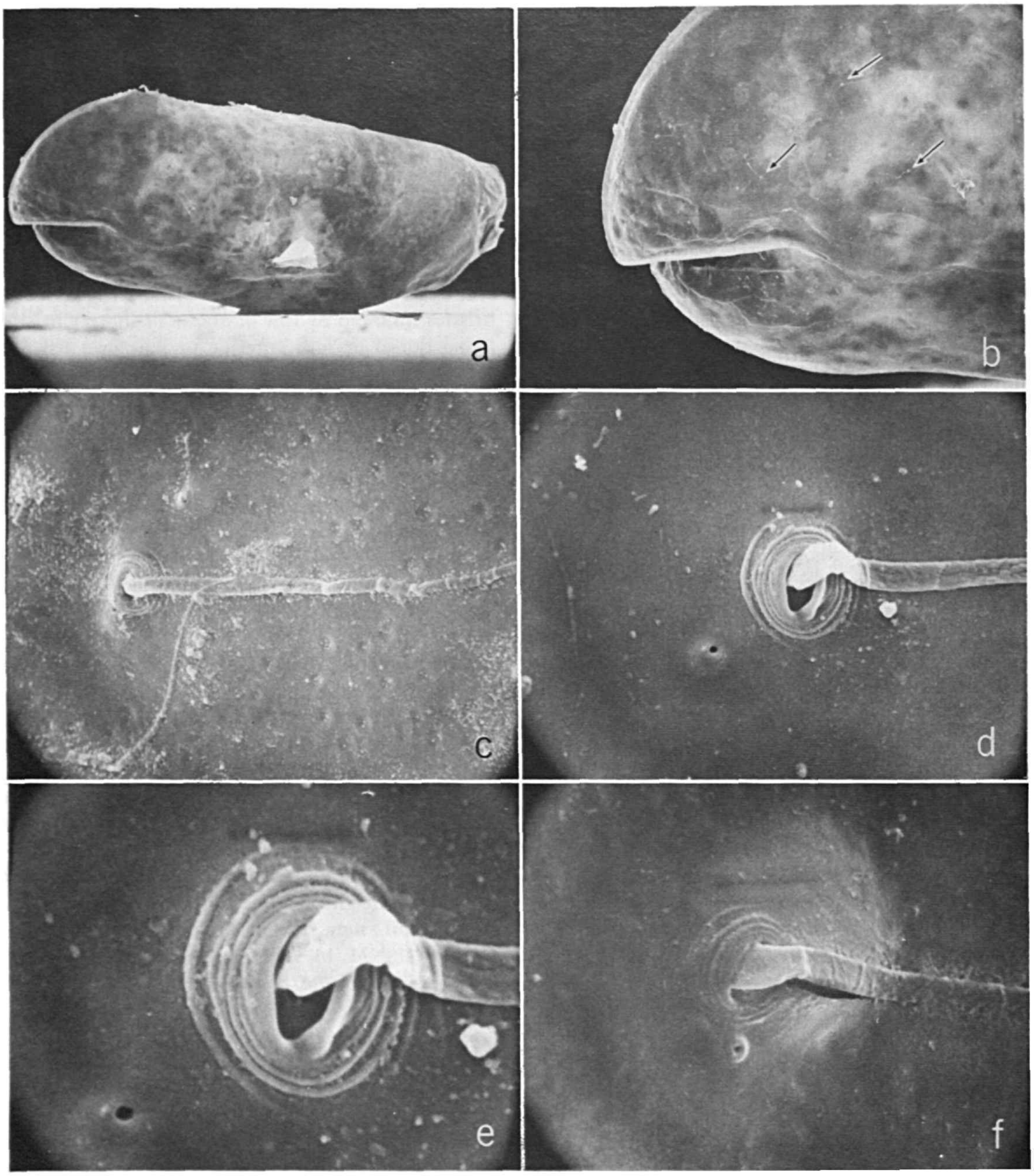

FIGURE 6.—*Synasterope cushmani*, USNM 143869c, left valve, lateral view: *a*, complete valve, valve distorted and dorsal margin folded inward during freeze-drying preparation of specimen, × 60; *b*, detail of anterior part of valve shown in "*a*," arrows point to some long bristles emerging from shell, × 155; *c*, detail from "*b*" showing long bristle emerging from concentric pore, 2 short bristles emerging from simple pores, and simple pore without bristles below and slightly anterior to concentric pore, × 2900; *d*, detail from "*b*" showing another concentric pore and simple pore, × 5000; *e*, same as "*d*," × 10,000; *f*, concentric pore with hair and associated simple pore from posterior part of valve, × 5000.

flaplike bristles on posterior list also emerging from lipped pores (Figures 7*e*, 8*c–f*); posterior processes between posterior list and valve edge consisting of pore with lateral tapered extension (Figures 7*f*, 8*b*); 1–3 large lipped pores present medial to bases of flaplike bristles on posterior list (Figures 7*e*, 8*c–f*); tubelike processes present between bases of flaplike bristles and medial lipped pores (Figures 7*e*, 8*c–f*; tubes compressed in photographed specimen).

Selvage. Posterior selvage with marginal fringe consisting of tapering spines (Figures 7*f*, 8*a,b*); selvage absent in vicinity of posterior processes between broad list and valve margin (Figures 7*d*, *f*; 8*b*). The absence of selvage opposite the scooplike processes indicates that when valves are closed, openings remain opposite the processes, and suggests that a substance may be extruded through the processes.

Posterior pores. 2 or 3 pores present on posterior margin outside selvage in vicinity of posterior processes between broad list and valve margin (Figures 7*f*, 8*b*).

First antenna (Figures 9*d–f*): 1st joint with numerous spines forming clusters on medial and lateral surfaces; small process present at middle of distomedial margin; 2nd joint with spines forming clusters on ventral and dorsal margins and medial and lateral surfaces, 1 short spinous lateral bristle and 1 long spinous dorsal bristle; 3rd joint with 1 short ventral bristle and 6 spinous dorsal bristles; 3rd and 4th joints quadrate and only weakly separated from each other; 4th joint with slightly concave distal margin, 1 long spinous dorsal bristle and 2 spinous ventral bristles; longer of 2 ventral bristles about three times length of shorter bristle and reaching beyond 8th joint; 5th joint with few spines forming row distally on dorsal margin and on lateral surface near dorsal margin; sensory bristle of 5th joint with stout proximal part and 6 terminal filaments, no proximal filament; distomedial bristle of 6th joint spinous, reaching just beyond tip of a-claw of 7th joint. Seventh joint: a-claw bare or with few faint teeth near tip; b-bristle stout, almost twice length of a-claw, with 5 marginal filaments; c-bristle about two and one-half times length of a-claw, with 5 marginal filaments and bifurcate tip. Eighth joint: d-bristle represented by minute spine; e-bristle bare, longer than a-claw; f-bristle reflexed with 3 long spinous marginal filaments and 1 short distal spinous marginal filament; dorsal margin of f-bristle with spines between bases of distal filament and proximal filaments; g-bristle about same length as c-bristle, with 5 marginal filaments.

Second antenna (Figure 9*g*): Protopodite with minute distomedial bristle and slender spines forming clusters on anterior half of medial surface. Endopodite 3-jointed with terminal bristle (tip appears to be broken on holotype). Exopodite: 1st joint without distomedial spine, but with long hairs forming subterminal row on dorsal margin; bristle of 2nd joint reaching 9th joint, with abundant slender spines along ventral margin; joints 2 to 8 with short spines forming row along distal margin; 9th joint with broad lateral spine about one-half length of 9th joint; bristles of joints 3-8 with natatory hairs and with minute spines along part of ventral margins; joint 9 with 3 bristles, 2 long with natatory hairs, 1 short with short marginal spines.

Mandible (Figure 9*h*): Coxale endite remained in mouth of holotype when mandible was removed from body. Medial surface of coxale hirsute. Basale endite with 4 spinous end bristles, 2 dwarf bristles, 3 triaenid bristles with about 6 pairs of minute spines excluding terminal pair, and a glandular peg with minute fingerlike processes; a small bristle present on basale near base of endite; ventral margin of basale with U-shaped sclerotized process; dorsal margin of basale with spinous backward-pointing midbristle, 2 terminal spinous bristles, and some short spines forming rows. Exopodite about two-thirds length of dorsal margin of 1st endopodite joint; tip hirsute, with 2 short bristles. Endopodite: 1st joint with 3 long spinous ventral bristles; dorsal margin of 2nd endopodite joint with 1 short proximal bristle and stout spinous a-, b-, c-, and d-bristles; 1 short spinous bristle present medially between a- and b-bristles, and b- and c-bristles; 5 short spinous cleaning bristles forming oblique row present near c-bristle; 1 long spinous medial bristle present just distal to d-bristle; 1 long spinous lateral bristle present between c- and d-bristles; ventral margin of 2nd endopodite joint with 3 long spinous terminal bristles; medial surface of joint with spines forming short rows. End joint with dorsal claw with minute spines near middle of ventral margin and along dorsal margin near tip, 1 short spinous medial bristle, 1 long

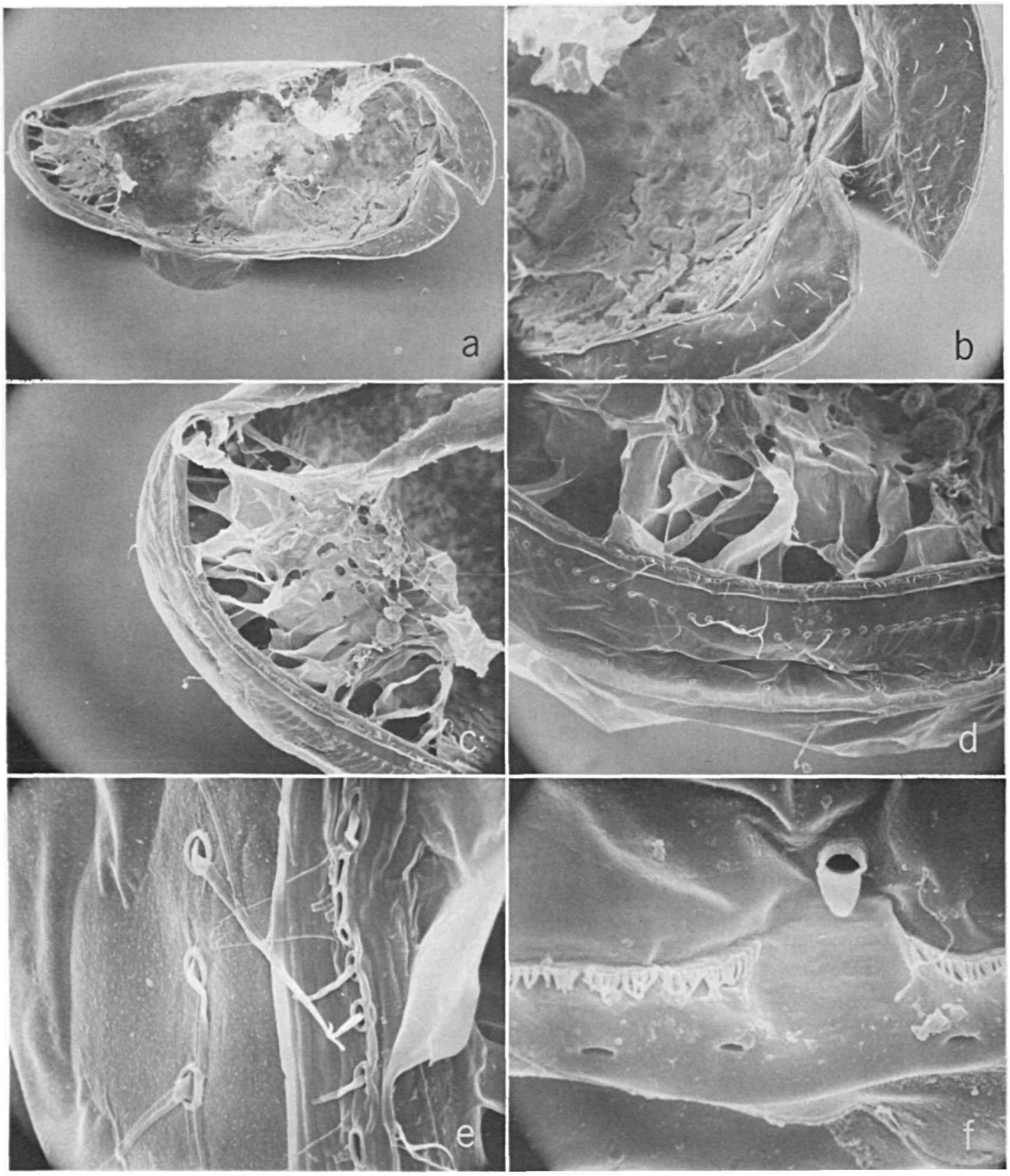

FIGURE 7.—*Synasterope cushmani*, USNM 143869c, left valve, medial view: *a*, complete valve, dorsal margin folded inward during freeze-drying preparation of specimen, × 65; *b*, detail of anterior shown in "*a*," × 200; *c*, detail of posterior shown in "*a*," × 200; *d*, detail of "*c*," posterior end of valve toward bottom in figure, note 4 minute processes between broad list and valve margin, × 950; *e*, detail of "*d*" near dorsal end, posterior end of valve to left in figure, × 2000; *f*, detail of posterior process, selvage, and three posterior pores shown in lower right of "*d*," posterior end of valve toward bottom of figure, × 3800.

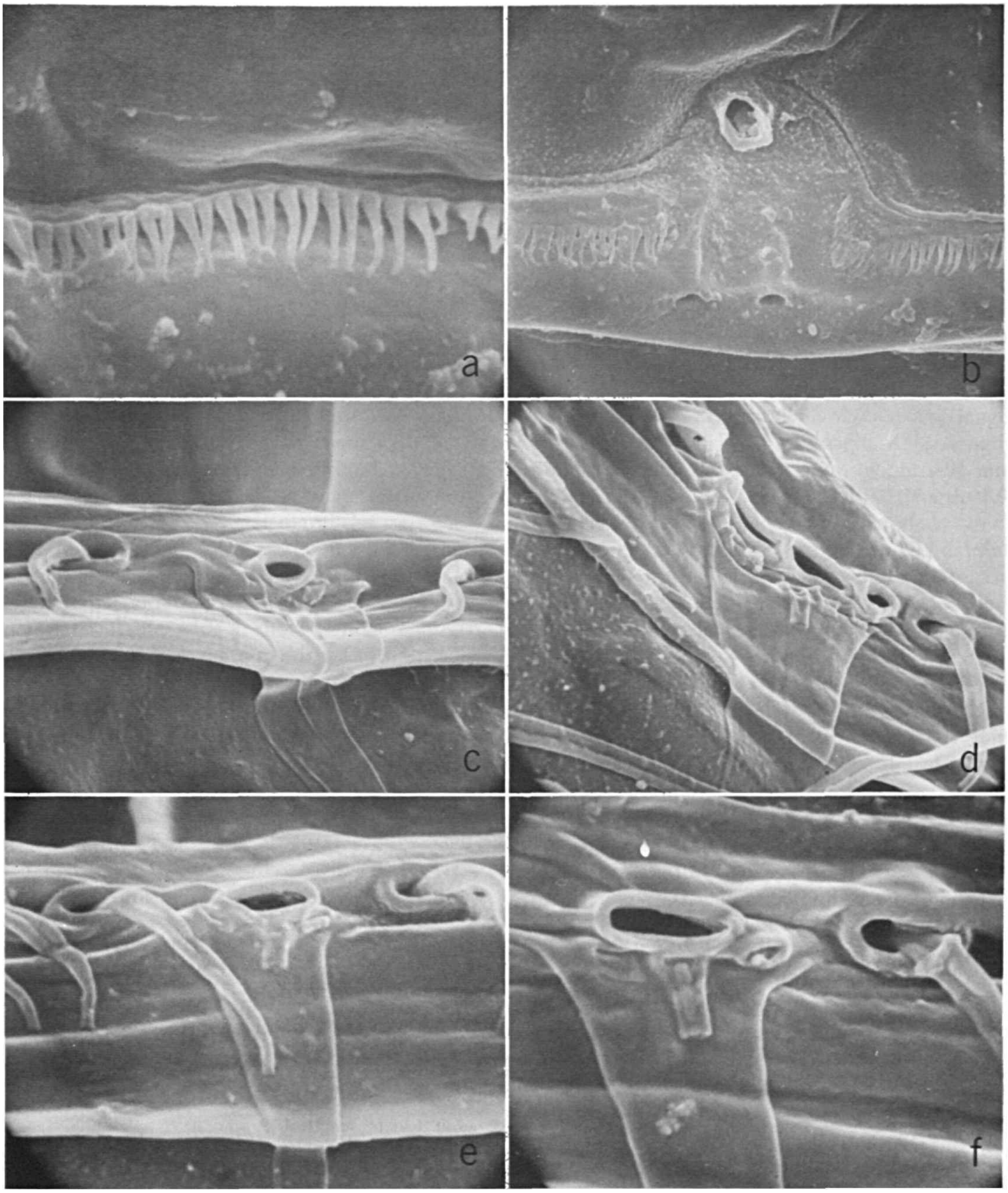

FIGURE 8.—*Synasterope cushmani*, USNM 143869c, left valve medial view, valve margin toward bottom: *a*, detail of selvage fringe shown in lower right in Figure 7*f*, × 6000; *b*, detail of posterior, selvage, 2 posterior pores, and process shown in lower middle of Figure 6*d*, × 3800; *c–f*, detail of pores, tubes, and bristles on posterior list: *c*, *d*, × 5000; *e*, × 6250; *f*, × 8250.

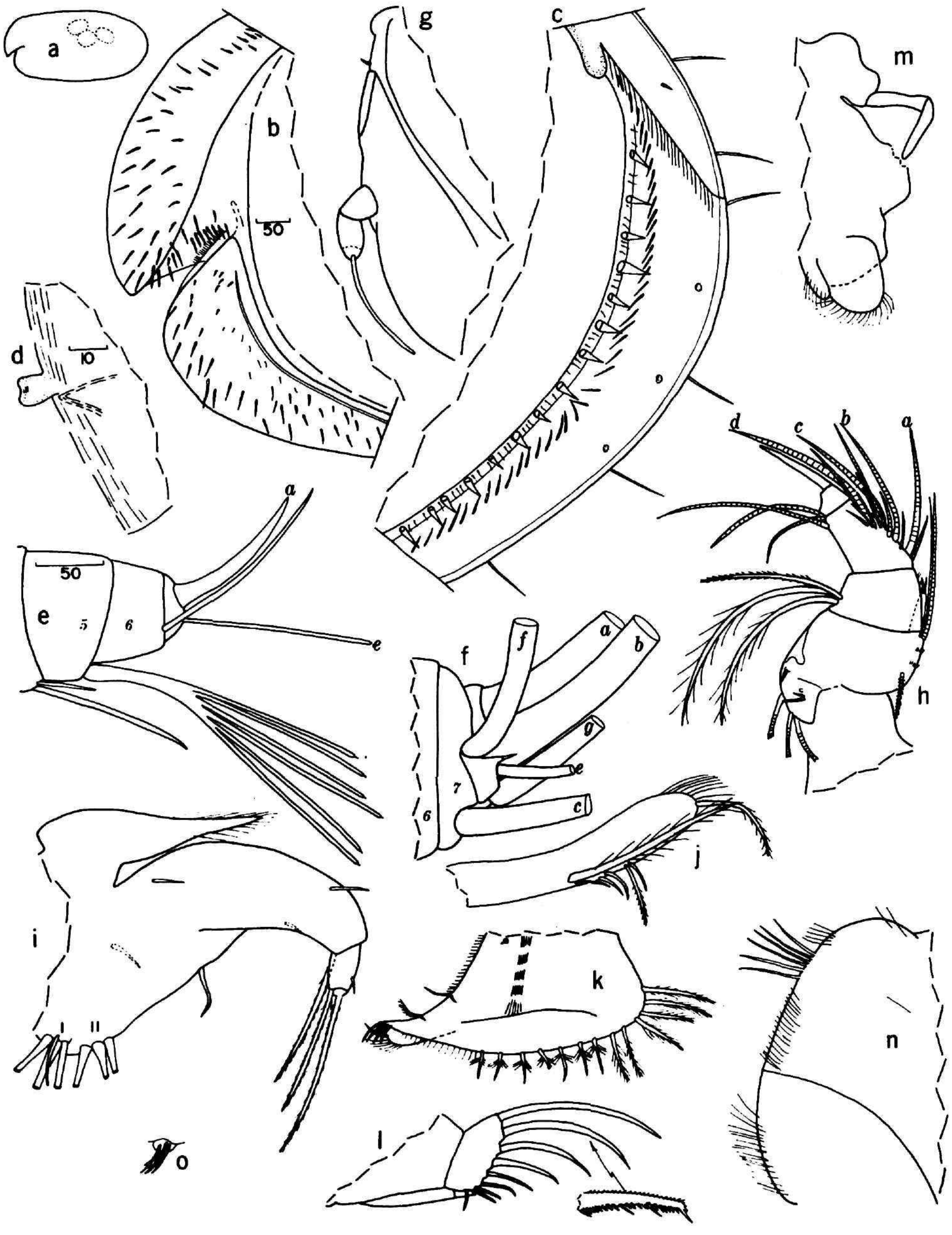

FIGURE 9.—*Synasterope cushmani*, USNM 143863, adult female, length 1.59 mm: *a*, complete specimen showing position of eggs. Right valve, medial view: *b*, anterior; *c*, posterior. Left 1st antenna, medial view: *d*, process on terminal margin of 1st joint; *e*, tip of limb (not all bristles shown). *f*, Tip of right 1st antenna, lateral view; *g*, endopodite and distal part of protopodite of right 2nd antenna, medial view; *h*, right mandible, medial view (end bristles of basale endite, bristles on end joint of endopodite, and marginal spines on some bristles not shown); *i*, left maxilla, medial view; *j*, comb of right 5th limb, lateral view; *k*, right 6th limb, medial view; *l*, right furcal lamella, lateral view; *m*, anterior of body showing medial eye, rod-shaped organ, and upper lip; *n*, posterior of body (gills not shown); *o*, brushlike organ. (Same magnification in microns: *b, h, k–m; c, e, g, i, j, n, o; d, f*.)

spinous lateral bristle reaching past end of dorsal claw, and 3 stout spinous clawlike bristles.

Maxilla (Figure 9*i*): Epipodial appendage with hirsute pointed tip reaching middle of dorsal margin of basale. Endite I with 1 short and 3 long bristles; endite II with 3 long bristles. Dorsal margin of basale hirsute with 2 short, bare bristles, 1 proximal, 1 distal (both with bases on medial side); ventral margin with 1 short bare proximal bristle, 1 minute bare distal bristle, and 1 long spinous terminal bristle; lateral surface with 1 short proximal bristle; medial surface hirsute. Endopodite; 1st joint with 1 short bare dorsal bristle and long spinous β-bristle; end joint with spinous terminal bristle longer than β-bristle.

Fifth limb (Figure 9*j*): Distal margin of comb with long hairs; lateral surface of comb with long spinous exopodial bristle, 1 short slender bristle with base just ventral to base of long bristle, and 2 pairs of bristles near ventral margin.

Sixth limb (Figure 9*k*): Anterior margin with 1 upper and 1 lower bristle, latter bristle with long marginal hairs; anterior tip with 4 short spinous bristles; lateral sole with 1 short slender spinous bristle; posteroventral margin with 13-15 bristles (posterior 6 bristles with long hairs from their bases to tips, others with long proximal and short distal spines); minute medial bristle present in anterodorsal corner of limb; anterior, ventral, posterior margins and medial surface hirsute; long hairs present on lateral surface near ventral margin.

Seventh limb: Proximal and distal groups each with 6 bristles, 3 on each side; each bristle with 2–4 bells; opposing terminal combs each with 9 or 10 spinous teeth.

Furca (Figure 9*l*): Each lamella with 9 claws, of which posterior 2 are bristlelike secondary claws; posterior claw pointing backward; primary claws with long and short spines along concave margin and slender spines along convex margin; short spinous process present on corner of furca near last posterior secondary claw.

Rod-shaped organ (Figure 9*m*): 1- or 2-jointed, elongate with rounded tip.

Eyes: Medial eye bare (Figure 9*m*); lateral eyes absent.

Upper lip (Figure 9*m*): Lip consisting of 2 hirsute lobes without spines; small hirsute flap posterior to upper lip present on each side of mouth.

Posterior (Figure 9*n*): Posterior hirsute with broadly rounded dorsal corner.

Brushlike organ: Consisting of minute process with about 5 bristles (Figure 9*o*).

Eggs: USNM 143863, 3 eggs; USNM 143865, 4 eggs; USNM 143866a, 5 eggs; USNM 143867, 2 eggs (valve torn, some eggs probably lost); USNM 143868a, 6 eggs; USNM 143969c, 15 eggs (well developed); USNM 143962b, about 9 eggs (shell not opened).

DESCRIPTION OF MALE (Figure 10).—Carapace with posterior half of dorsal margin lower than ventral half; surface with hairs forming row near posterior margin (Figure 10*a*).

Size: USNM 143864, length 1.71 mm, height 0.87 mm, height 51% length; USNM 143869a, length 1.89 mm, height 0.90 mm, height 48% length; USNM 143869b, length 1.83 mm, height 0.95 mm, height 52% length; USNM 143870, length 1.95 mm, height 1.00 mm, height 51% length.

First antenna (Figure 10*b*): 1st and 2nd joints with spines forming clusters on medial surface; 2nd joint with 1 short spinous lateral bristle and 1 long spinous dorsal bristle; 3rd joint with 1 minute ventral bristle and 6 spinous dorsal bristles; 4th joint with 2 short ventral bristles and 1 long dorsal bristle; 5th joint with stout sensory bristle with numerous filaments; medial bristle of 6th joint reaching beyond a-claw of 7th joint; dorsal margin of 6th joint undulate. Seventh joint: a-claw with minute teeth along dorsal margin; b-bristle about three times length of a-claw, with 2 short proximal and 2 long distal filaments; c-bristle extremely long with 24 marginal filaments. Eighth joint: d-bristle absent; e-bristle bare, about twice length of a-claw; f-bristle similar to c-bristle, with 20 marginal filaments; g-bristle about twice length of b-bristle, with 8 marginal filaments.

Second antenna: Protopodite with short slender medial bristle. Endopodite 3-jointed (Figure 10*c*): 1st joint bare; 2nd joint with 3 short ventral bristles; 3rd joint reflexed on 2nd, with 1 slender proximal bristle and pointed serrate tip. Exopodite: bristle on 2nd joint long, reaching well beyond 9th joint, with natatory hairs; 9th joint with lateral spines and 4 bristles, all with natatory hairs; bristles on joints 2-8 with natatory hairs and without spines; 2nd joint same length as joints 3 to 6, inclusive; distal end of 3rd joint of endopodite reaching middle of 4th joint of exopodite.

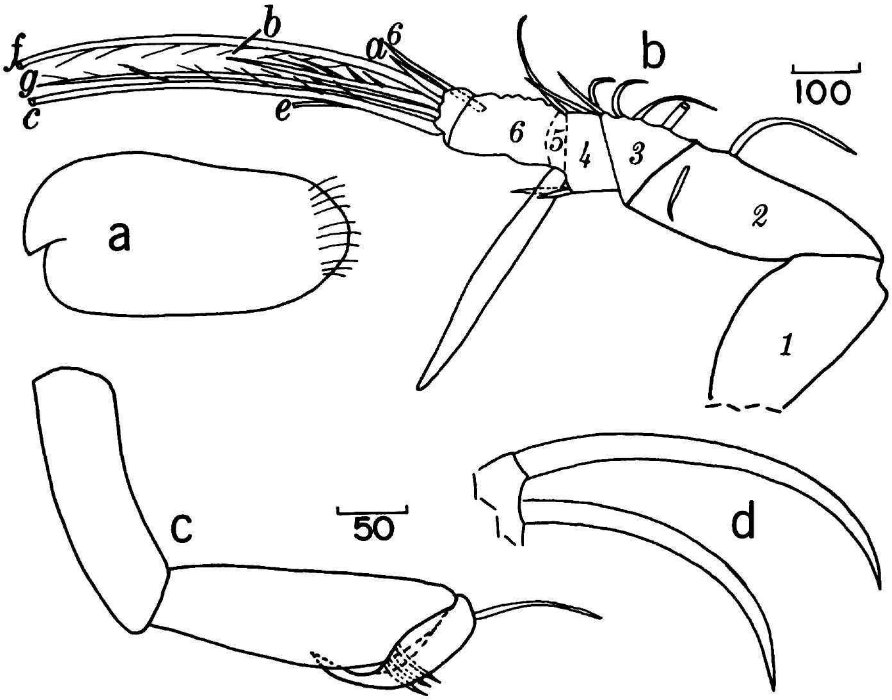

FIGURE 10.—*Synasterope cushmani*, USNM 143864, adult male, length 1.71 mm: *a*, complete specimen; *b*, right 1st antenna, lateral view (marginal spines and hairs on bristles not shown); *c*, endopodite of right 2nd antenna, medial view; *d*, claws 1 and 2 of right furcal lamella, lateral view (marginal teeth not shown). (Same magnification in microns: *c*, *d*.)

Mandible: Exopodite about one-half length of dorsal margin of 1st exopodite joint; dorsal margin of 2nd endopodite joint with 2 bristles proximal to a-bristle; limb otherwise similar to that of female.

Maxilla, fifth limb, sixth limb, seventh limb: Similar to those of female.

Furca (Figure 10*d*): Each lamella with 8 claws, of which posterior 2 are bristlelike secondary claws; posterior claw pointing backward; arrangement of teeth and hairs on claws similar to those of female; primary claws with greater curvature than those of female.

Rod-shaped organ, upper lip, eyes, posterior: Similar to those on female.

COMPARISONS.—The carapace of the new species, *S. cushmani*, differs from that of *S. psitticina* (Darby, 1965) in being smaller and less elongate. The bristles on the dorsal margin of the basale of the maxilla of *S. psitticina* are longer than those on *S. cushmani*.

Synasterope psitticina (Darby, 1965)

FIGURE 11

Cylindroleberis psitticina Darby, 1965:31–33 [part], pl. 19: fig. 6, pl. 20: figs. 1, 2, 5, 8.

HOLOTYPE.—UMMP 48801 (University of Michigan, Museum of Paleontology), adult female on slides.

TYPE-LOCALITY.—Offshore Sapelo Island, Georgia. Slides containing holotype bear the number 1071, which might be the station number. Depth range of the species given by Darby (1965: 32) is 45 to 405 feet; however, his material included more than one species.

MATERIAL.—Darby (1965) described and illus-

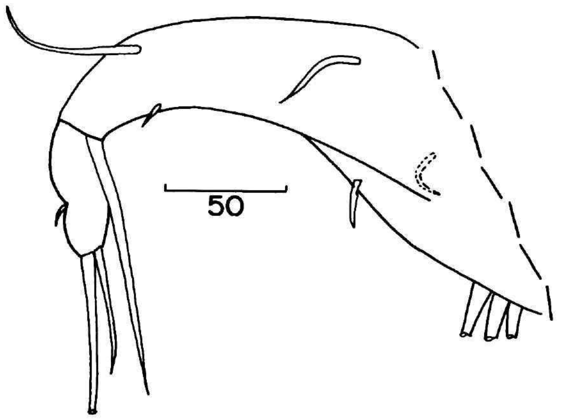

FIGURE 11.—*Synasterope psitticina*, UMMP 48801, adult female, right maxilla, medial view.

trated a female (holotype, UMMP 48801) and a male (paratype, UMMP 48802). I received both specimens for study from Dr. Robert V. Kesling. The female holotype does not bear a long lateral bristle between the b- and c-bristles of the 2nd endopodial joint of the mandible. Therefore, I have referred the species to the genus *Synasterope* Poulsen, 1965. The male paratype is not adult as stated by Darby, but instead is a juvenile male (probably an A-1 instar). The specimen bears a long lateral bristle between the b- and c-bristles of the 2nd endopodial joint of the mandible. Therefore, I refer it herewith to the genus *Parasterope* Poulsen, 1965, and designate it *Parasterope* species.

SUPPLEMENTARY DESCRIPTION OF MAXILLA OF HOLOTYPE (Figure 11).—Endite I with 1 short and 3 long bristles; endite II with 3 long bristles. Dorsal margin of basale with 1 short proximal bristle and 1 distal bristle reaching beyond distal end of basale (both bristles with bases on hirsute medial side of basale); ventral margin of basale with 1 short proximal bristle, 1 minute distal bristle, and 1 long terminal bristle (lateral surface with 1 short proximal bristle). Endopodite 2-jointed: 1st joint with short dorsal bristle and long β-bristle; end joint with long terminal bristle.

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