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ECOLOGY AND TAXONOMY OF OSTRACODA IN THE VICINITY OF SAPELO ISLAND, GEORGIA

By

David Grant Darby

A dissertation submitted in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy in the

University of Michigan

1964

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INTRODUCTION

The following work describes podocopid ostracods inhabiting a complex estuarine-lagoonal environment between the mainland and Sapelo Island, Georgia, and the myodocopid ostracods offshore from the island. Twenty-four species were found, thirteen of which are new.

Sampling was carried out in June through September, 1961; December, 1961; April, 1962; December, 1962; and March through June, 1963.

Most work on Recent Ostracoda was done during the last century and the early part of the present one by Baird, Brady, Mueller, and Sars. With few exceptions, contemporary work has been undertaken by paleontologists who wish to extend information on these stratigraphically useful microfossils which are common in all periods from Ordovician to Recent. Interpretation of fossil occurrences must be firmly based on modern ecology. Much of the ecological data is the product of work by paleontologists. Two factors have contributed to the still separate ostracod classifications used in zoology and paleontology. The first is the inadequate description of carapace morphology, e.g. hinge structure, normal and marginal pore canals, and central muscle scars, by zoologists. The second is the description of only the carapace by paleontologists working on Recent faunas. Both approaches are understandable, but unfortunate. If a more functional classification is to develop, it will probably be based upon a classification of Recent forms utilizing both carapace and internal morphology. The erection of genera, indeed families, upon soft parts only, and the subsequent injection of these taxa into a classification based wholly upon characteristics of the carapace make for some very unusual affinities. Certain features of internal morphology, such as gills or mandibular

pinchers apparently have no expression in the carapace of the animal; these occur, however, in Myodocopida only, which are uncommon as fossils. The Podocopida is the group most split by the dual classification.

The present work was undertaken to describe an estuarine fauna. Initially, over 50 species were found as empty carapaces. For most of these species, specimens were never found alive, and carapaces were rare. They were brought into the area by tidal currents and do not make up any significant portion of the death assemblage. Time did not allow a detailed analysis of these forms. The death assemblage is complicated in this area by submarine erosion of deposits as old as Miocene and the distribution of this material to Recent sediments (Darby and Hoyt, 1964). The living ostracod fauna in the areas sampled inshore proved to be unusual in that it was composed mainly of one extremely prolific species: Cytheromorpha curta. First described from the Miocene by Edwards (1944), this species has rightly been thought to be characteristic of brackish water environments; it has been reported before from the Recent in San Antonio Bay by Swain (1955, p. 567, etc.). Better than any other ostracod of the Sapelo Island area, it is able to withstand turbid waters, large and rapid daily salinity ranges, and large seasonal temperature range. The great amount of organic matter in the water and substrate and the high oxygen content of the water support the large population. Geologic formations containing numerous specimens of only one or two species may have been deposited in such an environment as described herein; at least the possibility should be considered.

It is hoped that the simple techniques described for the dissection and staining of the soft parts will prove useful to others in examina-

tion of internal morphology of ostracods.

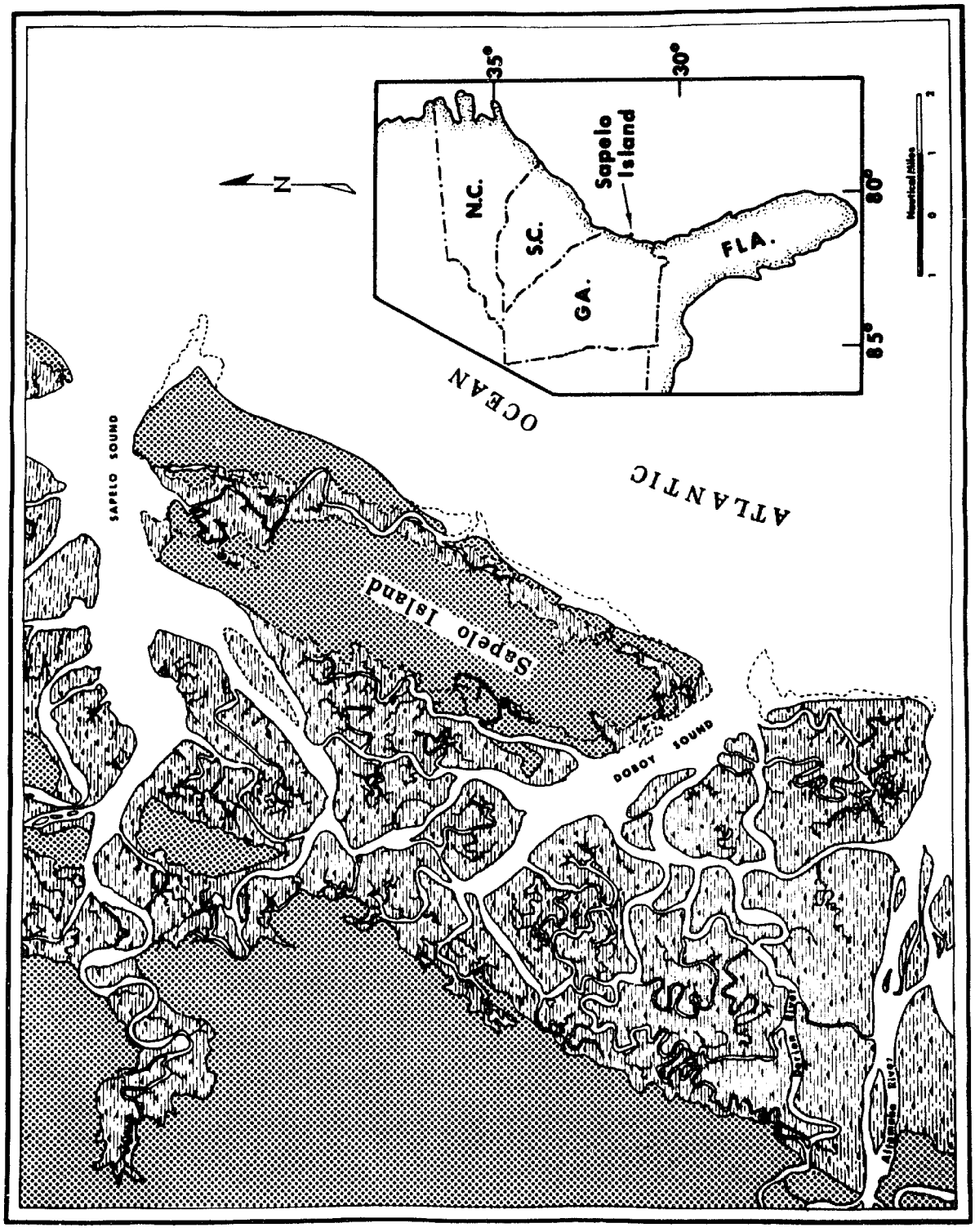
All specimens described are deposited in the University of Michigan Museum of Paleontology (UMMP).

HYDROGRAPHY

Sapelo Island, a remnant barrier island, lies parallel to the Georgia coast about five miles offshore (text-fig. 1). The island has wide, relatively deep tidal channels at its northern and southern boundaries, separating it from similar islands. An elongate area of salt marsh dissected by open and blind tidal channels lies between the island and the coast, forming an irregular lagoonal estuary. Fresh water from the Darien and Altamaha rivers, to the south of the island, dilutes the saline water in complex patterns. Mixing of fresh and saline waters is relatively rapid and areas other than Doboy Sound are only slightly stratified (table 1). Measured salinities are lowest up the Darien River (less than 1.8 °/oo) and highest in Doboy and Sapelo sounds (nearly 30 °/oo). The effects of the fresh water from the rivers near Sapelo Island and others along the coast are evident over 60 miles offshore where the salinities may still be less than 35 °/oo.

Tides along the Georgia coast are relatively higher than adjacent areas either north or south, averaging about seven feet (U.S. Coast and Geodetic Survey, 1964). The tides in the estuarine-lagoonal area take the form of a standing wave, the currents being lowest at high and low tides.

Tides are essentially concurrent in Doboy and Sapelo sounds. The hydrodynamic pressure from the fresh water entering Doboy Sound from the two rivers to the south causes the tidal flow in back of the island to be directed northward. The confluence of the tidal currents is, therefore, not approximately midway between the two sounds, but near Sapelo Sound; one area is in the vicinity of points 17-21 (text-fig. 2). The opposing currents during the flood cause a velocity decrease in this



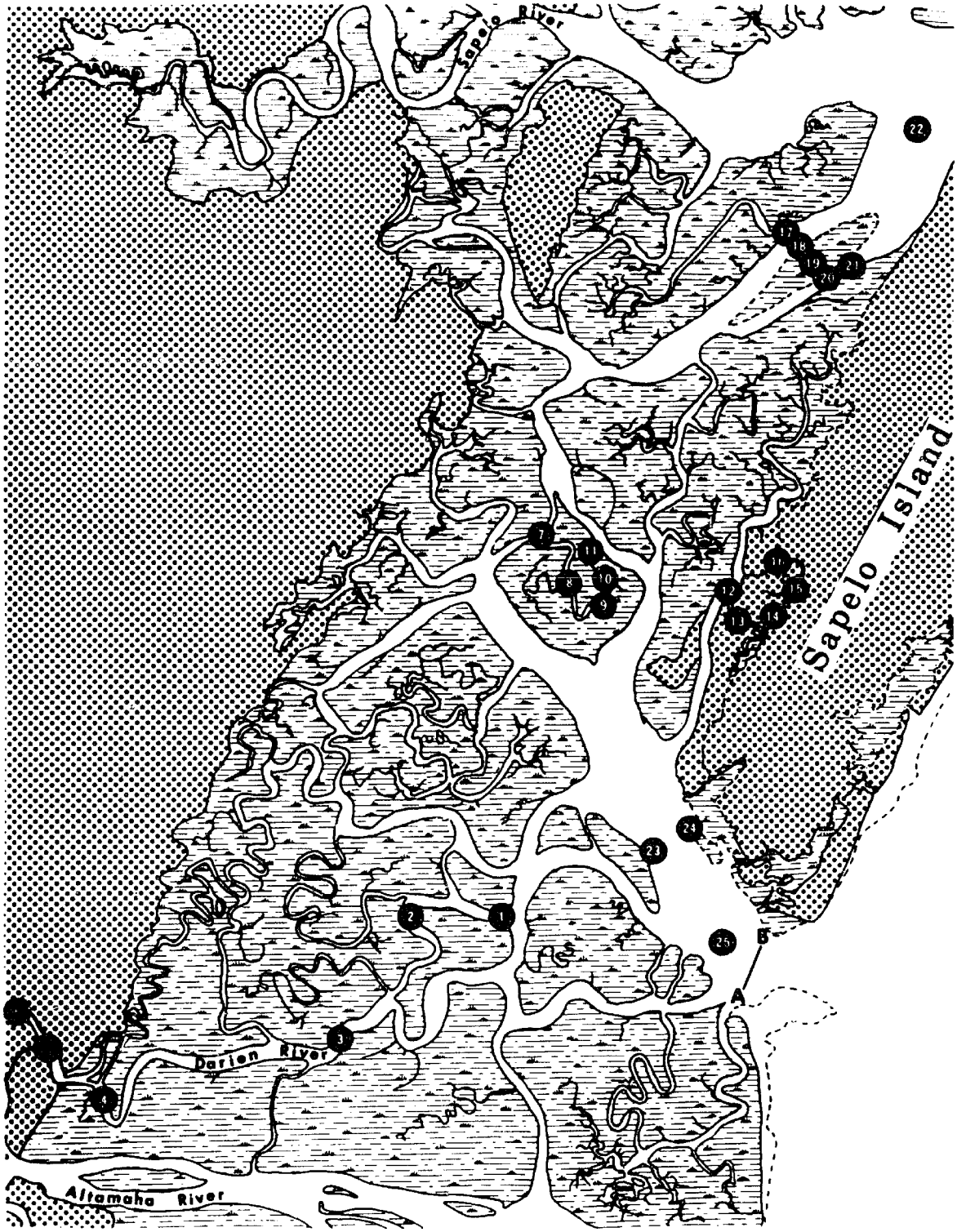
TEXT-FIGURE 1

Map showing location of Sapelo Island and configuration of the salt marsh area between the island and mainland.

	Station	Stage	Depth	Salinity ‰	Temp. °C	Date
BACK OF ISLAND	7	High	bottom	26.1	12	12/16/61
			surface	25.9		
	8	,,	b	25.5		
			s	25.4		
	9	,,	b	26.3		
			s	26.3		
	10	,,	b	26.2		
			s	26.8		
	11	,,	b	25.7		
			s	25.6		
	7	Low	b	13.2	21	4/9/63
			s	13.1		
	8	,,	b	13.2		
			s	13.1		
	9	,,	b	13.6		
			s	13.4		
	10	,,	b	13.9		
			s	13.9		
	11	,,	b	13.9		
			s	13.8		
DARIEN RIVER	1	Mid Flood	b	14.9	16.5	12/19/61
			s	14.1		
	2	,,	b	13.7		
			s	13.7		
	3	,,	b	12.5		
			s	12.5		
	4	,,	b	4.1		
			s	3.8		
	5	,,	b	2.8		
			s	2.7		
	6	,,	b	<1.8		
			s	<1.8		
DOBOY SOUND	25	Low	s	10.6	8.5	2/7/63
			5 meters	19.2		
	25	High	s	25.7	9.5	1/11/63
			5 meters	28.3		
			10 meters	29.2	9.0	

TABLE 1

Depths, salinities, and temperatures from selected sample points shown in Text-figure 2.



TEXT-FIGURE 2

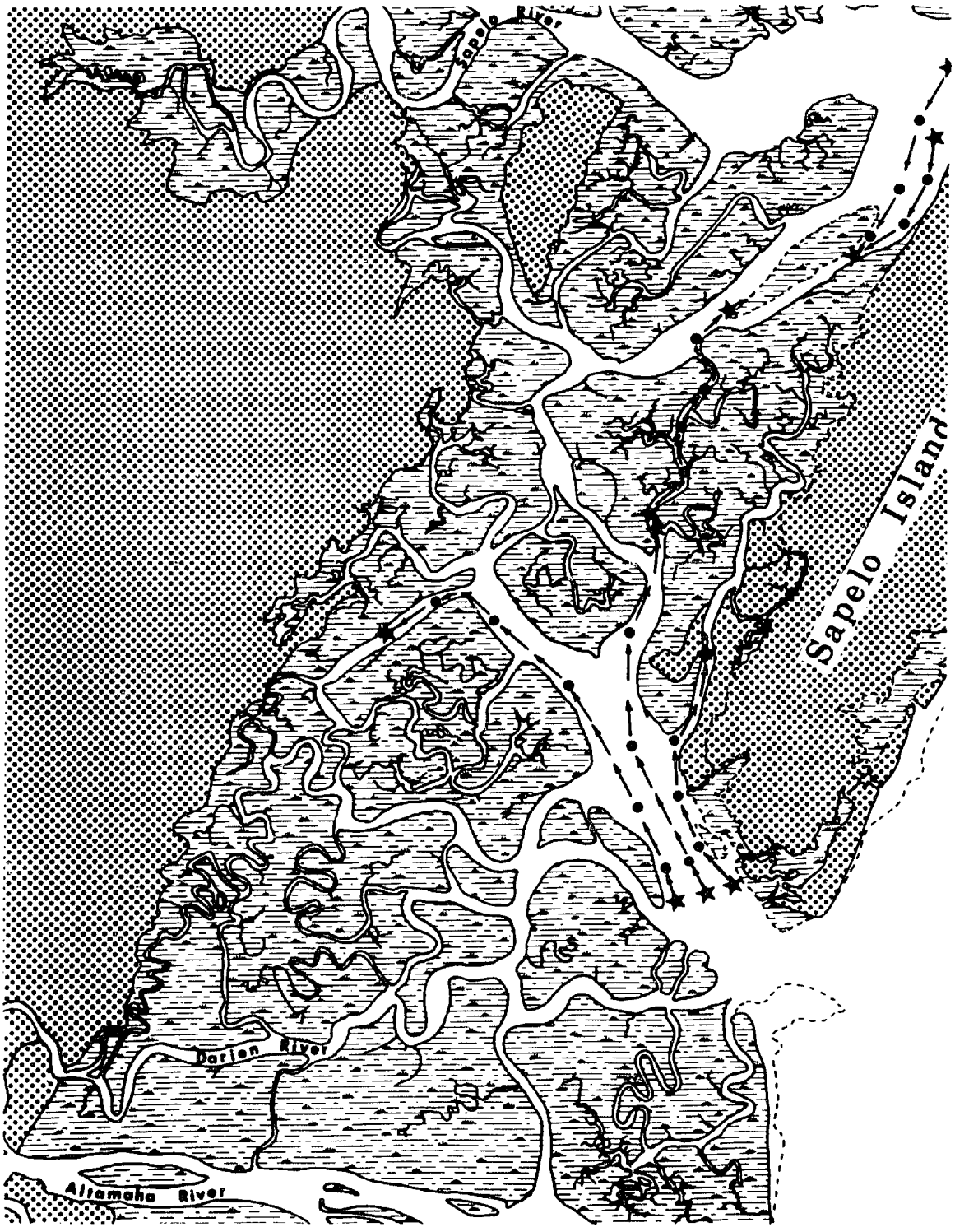
Map showing areas which were seasonally sampled.
Line A-B refers to cross-section shown in Text-figure 2

area and consequent sediment deposition in the channel. This situation results in fresh water being carried northward during the flood, with a consequent effect on the biota. The tidal current map (text-fig. 3) shows the relative lengths and directions of tidal flow from the northern and southern sounds. Text-figure 4 shows the tidal current pattern through a cross section of Doboy Sound. The greater velocities on the ebb are the result of the additional fresh water emptying from the estuary. The current pattern in this area is typical of estuaries, and current reversal occurs near high and low tides. The current on the southern side of the sound begins the ebb first, due to the pressure from the fresh water reinforced by the effect of Coriolis force which tends to direct the flow to the right in this hemisphere.

Table 1 shows typical salinity measurements up the Darien River, in back of the island, and in Doboy Sound. Sapelo Sound, with no direct influx of fresh water, does not exhibit the stratification found in Doboy Sound. Salinity values there seldom vary more than 1 °/oo between the surface and five meters deep. Water temperatures measured in back of the island varied from about 8° C in January to 31° in July.

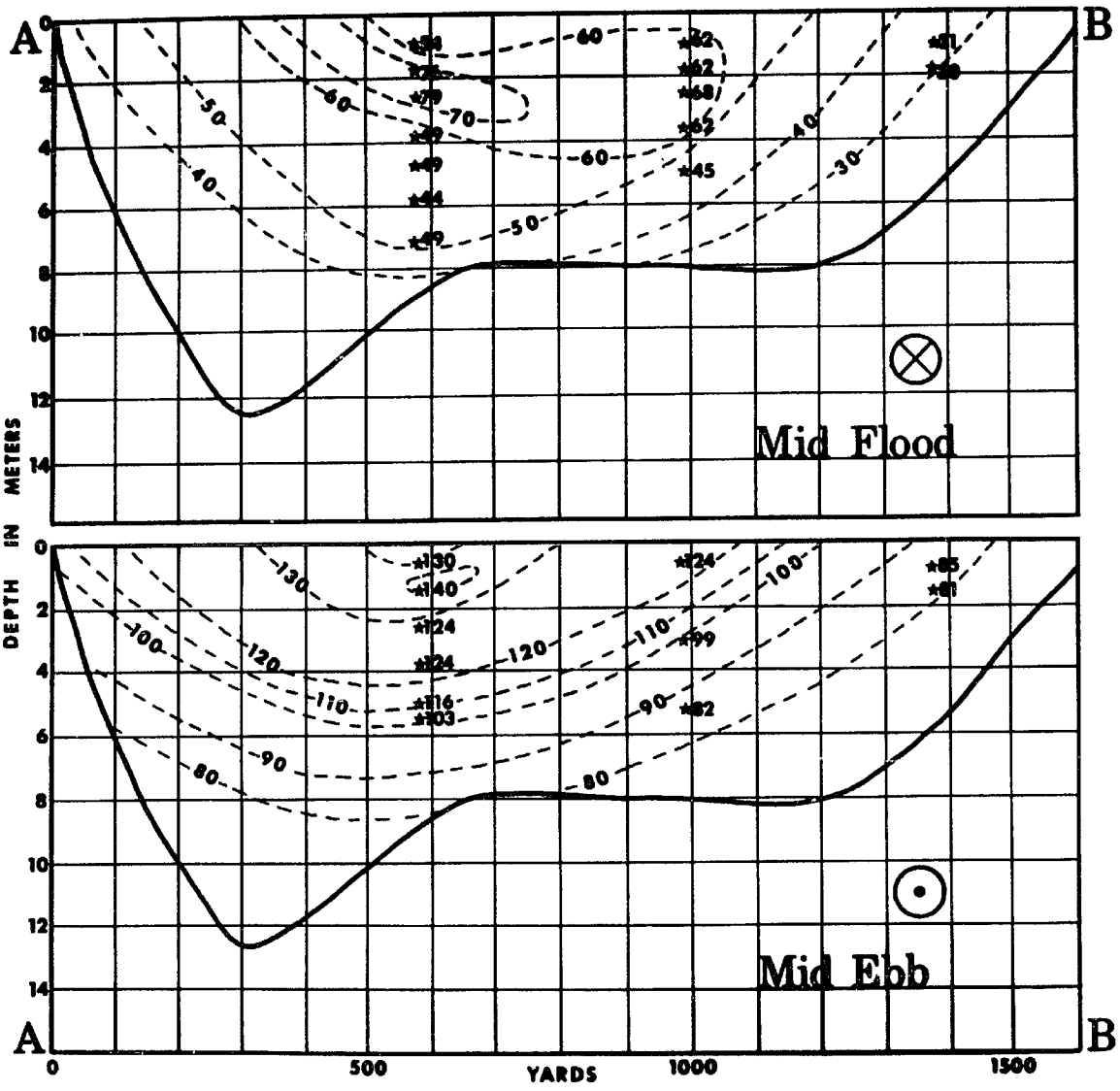
The water is always turbid, and typical Secchi disc readings are approximately 60 cm. The turbidity does not decrease noticeably at the outlets of the estuary due to the high velocities of the tidal currents through the restricted channels (sounds), where a maximum speed of over three miles per hour was measured. As discussed in the section following, this clastic suspended material is introduced principally by the rivers.

The waters are well oxygenated, although reducing conditions exist a few millimeters below the surface of the finer sediments. Typical values near the bottom varied from 3.14 to 4.17 ml/liter of oxygen.



TEXT-FIGURE 3

Map of tidal currents. All data taken with drogues released at low tide. Stars indicate beginning and end of movement during flood, dots indicate approximate hour intervals. Note difference in length of tidal flow between north and south.



TEXT-FIGURE 4

Diagram of cross-sectional current flow in centimeters per second along line A-B of text-fig. 2 across Doboy Sound. From unpublished data by Dr. L. R. Pomeroy and students, University of Georgia.

SEDIMENTS

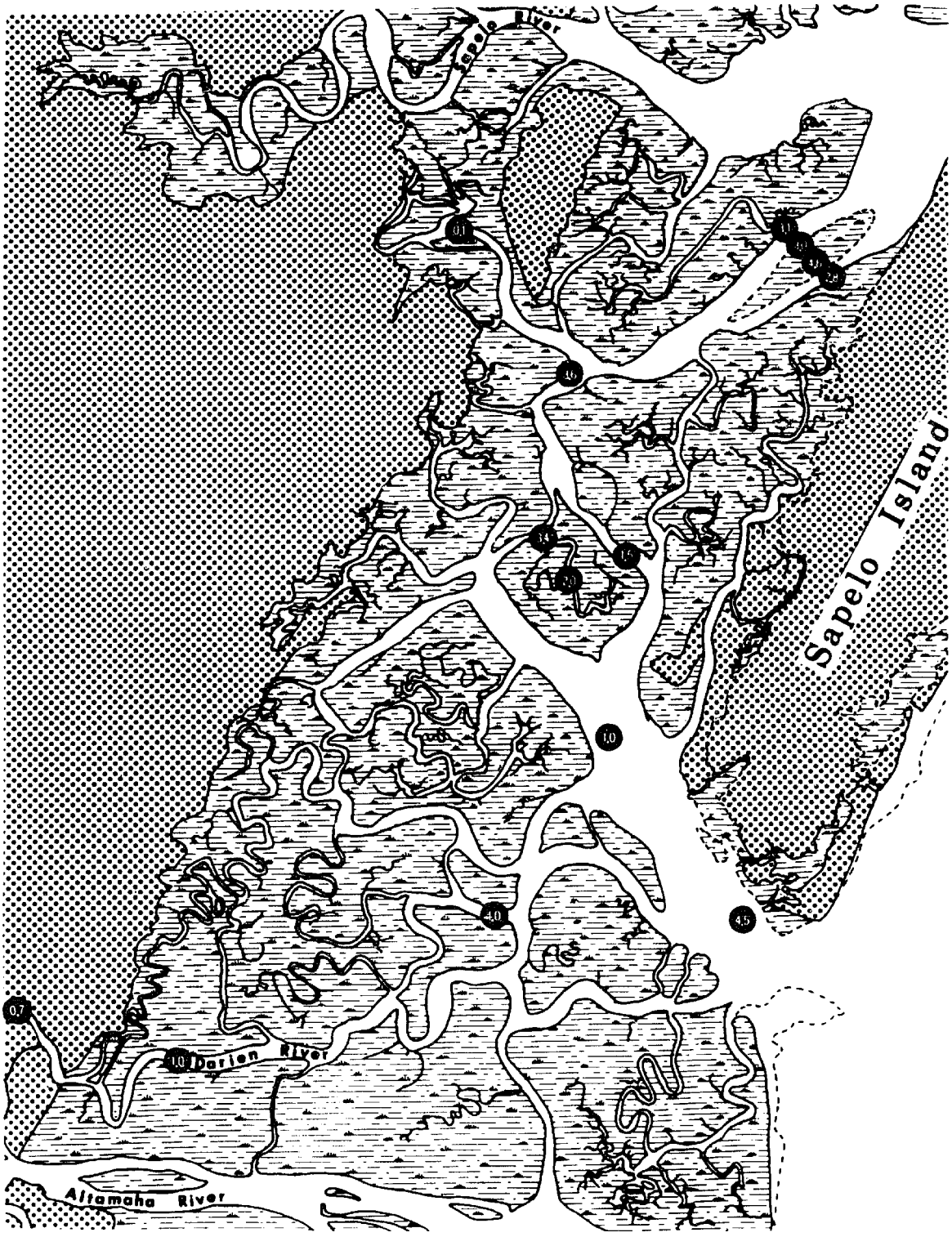
Inshore.- The waters of the estuarine-lagoonal complex contain large amounts of clastic and organic suspended material. Some of the suspended matter is derived from the salt marshes, some from the reworking of the tidal channels themselves, but the greatest portion is directly from the mainland. Both rivers emptying near Sapelo Island are turbid, and the rate of allocthonous sedimentation varies seasonally with their flow. During times of heavy rainfall many small intermittent streams probably contribute a significant amount of clastic material. The clay fraction from the fresh water sediment undoubtedly flocculates upon encountering brackish water. This increases the effective particle size and contributes to the sedimentation of the clays. Experiments have shown that clays in fresh water for 30 months may settle less than the same amount of clay in salt solution (percent not given) in 30 minutes (Grabau, 1913). Without flocculation, much more of the clay fraction would be carried out to sea. The flushing time of this estuary is not known, but the morphological complexity of the area and the high degree of mixing indicate it is not rapid.

The material in suspension contains a large percentage of organic matter. The predominantly clay and silt deposits also contain a relatively large percent of organic matter, mainly in the form of plant detritus derived from the salt marsh. The salt marsh deposits are the result of deposition of fine sediments in areas of low current velocity, their subsequent stabilization by vegetation (chiefly Spartina alterniflora), and the further supplementation during flooding at atypically high tides when additional sediment is trapped by the vegetation. The typical salt marsh deposit stands a foot or two above normal high water.

The organic content of some of the sediment was determined by finding the percentage of organic carbon using the chromic acid reduction technique. The percent organic carbon was multiplied by a factor of 1.8, a recommended figure based on an assumed 56 percent organic carbon of the total organic matter (Trask, 1939). The results are shown in text-figure 5. These data are taken from approximately the upper ten centimeters of sediment as brought up in a grab sampler.

Tidal flat sediments have little interstitial migration of water, hence little diffusion of dissolved gases. The salinity of water about one foot away from a recently exposed tidal flat was measured and compared to that of water seeping into a 6 inch hole dug into the sediment (a technique described by Alexander et al., 1932). At sample point 7 (text-fig. 2) interstitial water was 22.05 °/oo, that of the adjacent channel water 18.86; at sample point 18 the salinity of the interstitial water was 22.94 °/oo, that of the channel 19.22; at sample point 24, interstitial water was 25.23 °/oo, that of the channel 22.75. At high tide the salinities over these same areas are higher than those of the interstitial water: 25.53 °/oo at point 7, and 27.18 °/oo at sample point 18.

Teal and Kanwisher (1961) have studied some of the sediments of areas still inundated by normal high tides. Nearly all were oxygen-free within a few millimeters of the surface, and had pH values varying from 6.5 to 7.4. Hydrogen sulfide was present in the more reduced sediments of lower pH. Water samples taken over similar areas just before exposure at lower tide levels at stations 4, 11, and 25 (text-fig. 2) in 1963 showed dissolved oxygen contents of from 3.14 to 4.17 ml/liter (standard Winkler method).



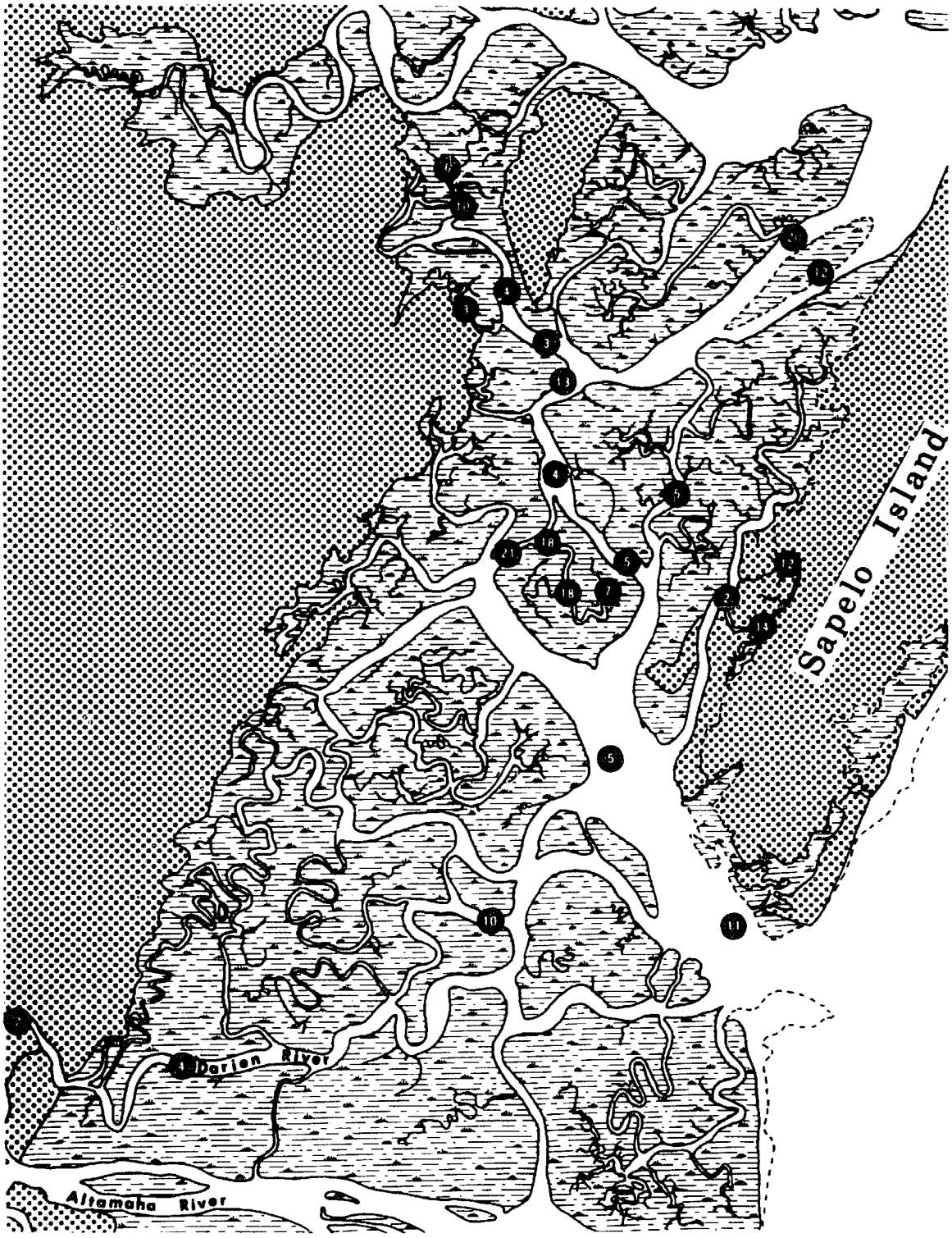
TEXT-FIGURE 5

Map showing approximate percentages
of organic material in sediments

Carbonate content of some samples was measured. Large pieces of mollusc shell were removed, but shell fragments comparable to the sediment size were included. In effect, the results are a measure of the carbonate content of the clastic sediment in equilibrium with the environment. The results are shown in text-figure 6.

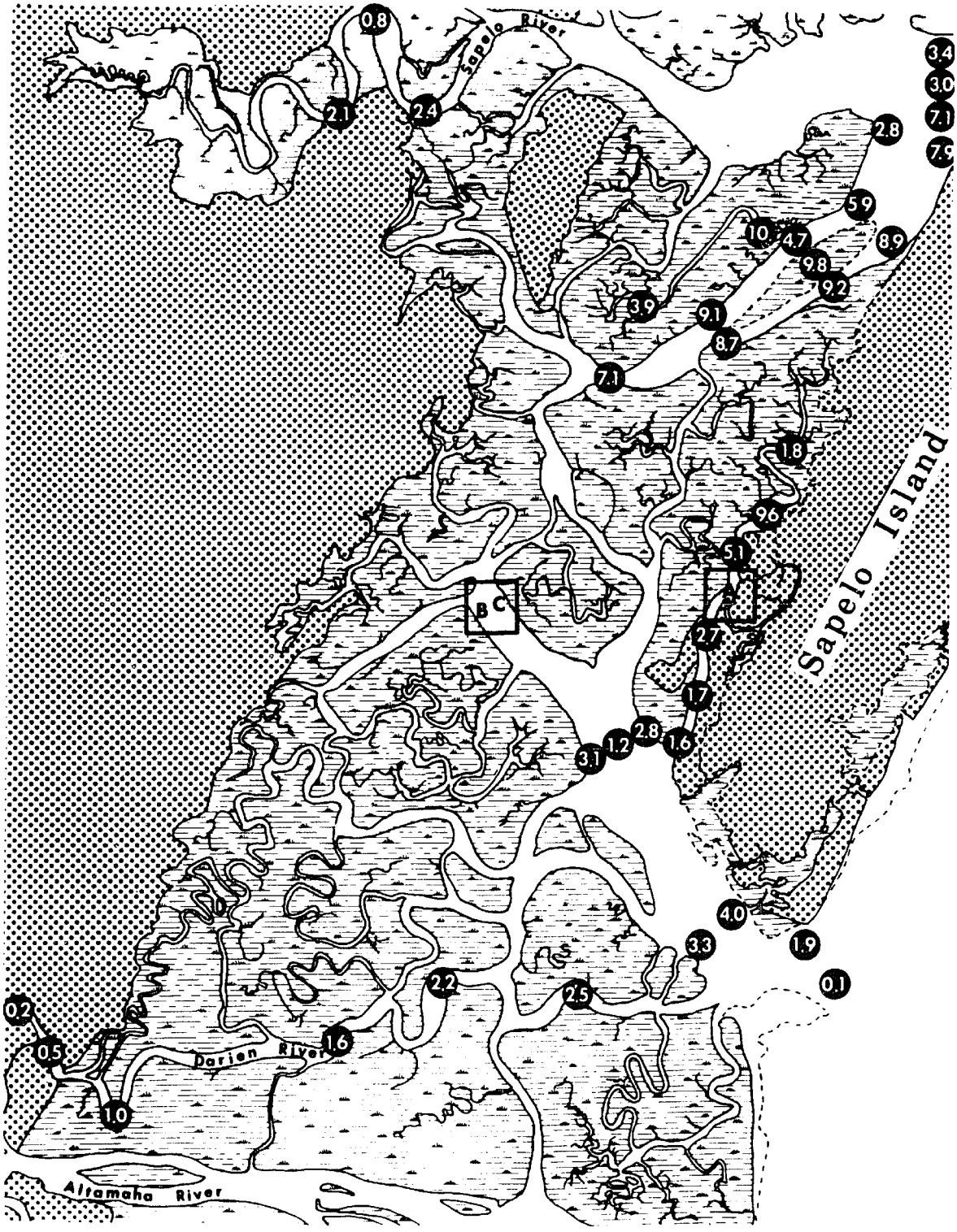
Grain size was determined for sediments at the stations shown in text-figure 7. These were done by the standard pipette method; results are from as yet unpublished data by V. J. Henry of the University of Georgia. Median phi values are high in tidal flat areas, indicating slower current action and consequent deposition of fine sediments. They are generally lower in the sounds and open channels where tidal currents keep the clay-silt fraction in suspension. The series of values along the Darien River indicates an increasing grain size upstream, with the last three stations over 95 percent sand. The series along the tidal channel along the western border of Sapelo Island shows a large variation in grain size, owing, no doubt, to the supply of sand from the island. Sediments sampled from area A (text-fig. 7) across the channel had median phi values varying from 9.73 on the side away from the island (73.73 % clay) to 2.16 on the side nearest the island (88.66 % sand). These conditions are capable of rapid change. At areas B and C samples were taken one week apart. The median phi value at B changed from 7.45 to 9.08, and that at C 2.74 to 7.25! Dr. Henry (personal communication) has pointed out that the resampling was not done in the precise spot and debris from oyster reefs could be responsible for the change rather than currents. This does, however, indicate the extreme complexity and variability of the sediment patterns.

When lithified these sediments would probably result in dark grey



TEXT-FIGURE 6

Map showing approximate percentages of calcium carbonate in sediments.



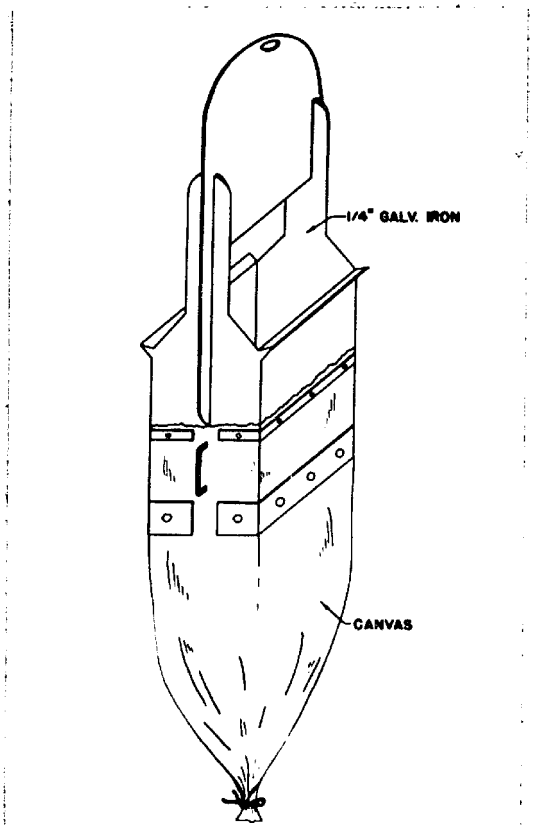
TEXT-FIGURE 7

Map showing median phi values of sediments. Areas A and B-C are referred to in Sediment section of text

to black shale with varying amounts of carbonate and arenaceous material. Due to the very high organic content, the area is a likely source of future petroleum.

Offshore.- The benthonic podocopid ostracods living offshore are not included in this work. The offshore myodocopids are primarily nektonic, swimming close to the sediment-water interface. I do not believe there is a close relationship between the substrate and the nektonic ostracods. With the exception of one planktonic species, the myodocopids are not prolific and if there is a preference for substrate in any species, it was not evident. For these reasons no detailed analysis of the offshore sediments is included.

In general, the shelf off Sapelo Island is very gently sloping, about 2.2 feet per mile. The continental slope begins approximately 73 miles out from the island. Sediment samples were taken with the modified Forster-Anchor dredge shown in text-figure 8. The data are shown in Table 2. The sediments are nearly all predominantly sand although areas do occur where the sediments are very silty. The turbidity from the river-borne clastic sediments is noticeable ten to fifteen miles offshore.



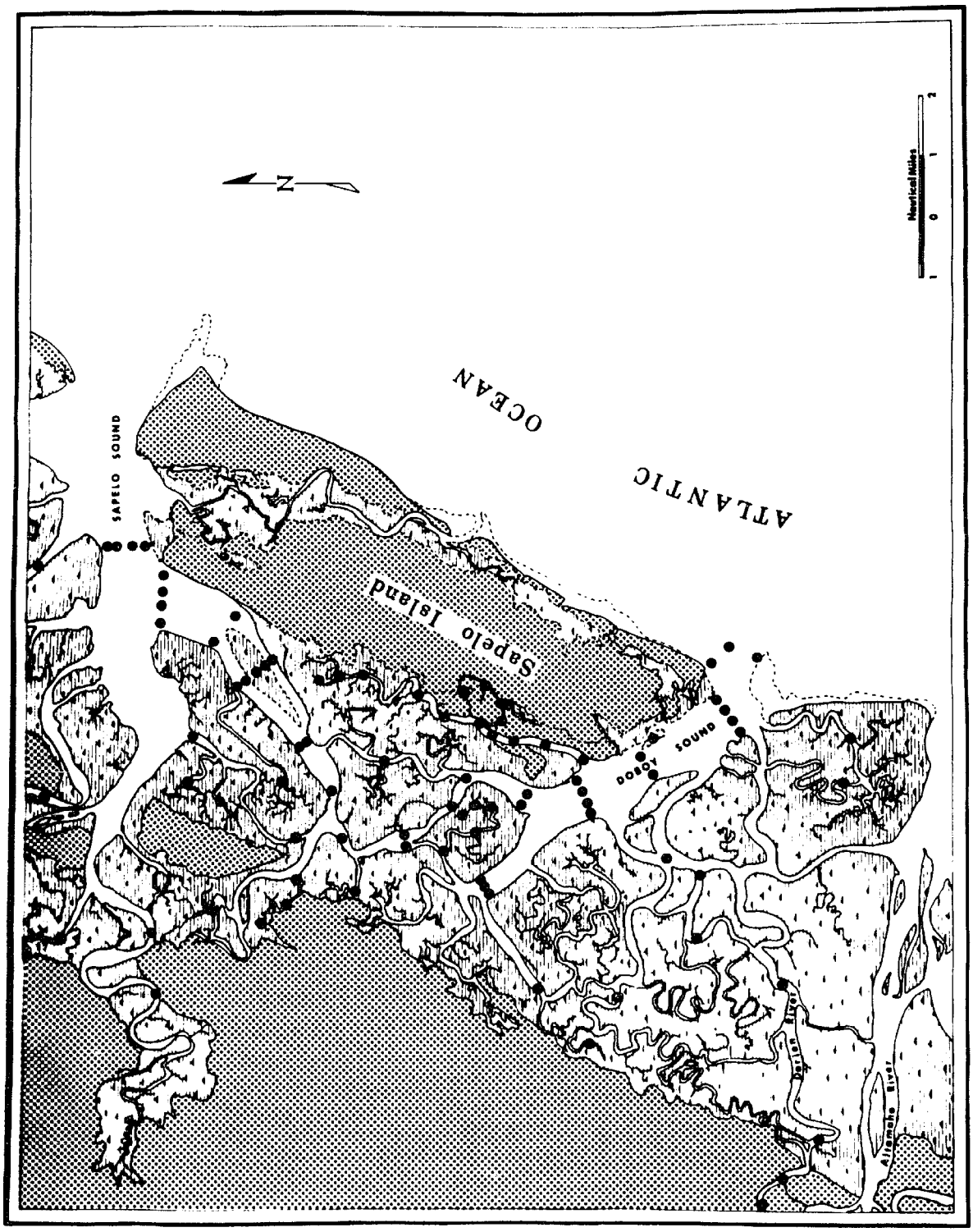
TEXT-FIGURE 8

Sketch of modified Forster-Anchor dredge used in offshore sampling.

Naut. Mi. From Is.	Depth in ft.	Phi Median	Carbonate Percent
29	81	1.2	5.5
38	85	1.2	6.5
43	96	1.2	7.0
55	115	1.3	7.0
65	142	1.1	9.5
72	161	1.4	27.0
74	381	1.4	36.0
75	625	2.4	59.0

TABLE 2

Data from offshore sample stations, taken May, 1963.



TEXT-FIGURE 9

Map showing areas sampled (some more than once) and examined for ostracods during summer (1961)

OSTRACOD POPULATION

To my knowledge, no ostracod fauna has been described previously which is so completely dominated by a single species existing in such large numbers. From a total of 209 samples examined from the estuarine-lagoonal facies in back of Sapelo Island (text-fig. 9), 4,550 ostracods were found alive and identified. About 85 percent were of one species, Cytheromorpha curta. Of the remaining 15 percent, ten percent were obtained from one sample area, stations 17-21 (text-fig. 2), where the less euryhaline species seem to be concentrated.

For the ostracod fauna, the limiting factor in this environment is salinity. The currents generated by semidiurnal tides attain such velocities in the sounds and channels that the ostracod population is in nearly constant flux, moving to and fro with each tidal cycle. Reducing conditions which exist a few millimeters beneath the sediment-water interface prevent the ostracods from burrowing deeply enough to escape the current. The fresh water from the rivers entering south of the island mixes with the marine water and a daily salinity range of over 15 °/oo is common in many areas. C. curta was found alive and active in salinities varying from less than 2 to over 30 °/oo.

An extremely dense summer population is supported by the relatively high organic content of the water and substrate, principally in the form of plant detritus, and the large oxygen content of the well-mixed water. As many as 277 specimens of C. curta were found in 5 cc of sediment.

The population boundary between the extremely euryhaline Cytheromorpha curta and the other inshore podocopids lies in the zone of tidal confluence along the southern boundaries of Sapelo Sound. One such zone is in the vicinity of sample points 17-21 (text-fig. 2), where opposing

current from Sapelo Sound prevents larger amounts of fresh water from being carried northward. Conflicting currents and the consequent reduced velocity in this area cause much of the suspended load to be deposited in the channel near these sample points. The ostracods from Sapelo Sound are also deposited, and may be concentrated in larger numbers here than in the sound. An interesting relationship between Cytheromorpha curta and Cyprideis floridana exists in this region and is described in the discussion of the latter species.

Additional information on the habits and habitats of each species, including the offshore myodocopids, may be found in the discussion sections in the taxonomic descriptions.

METHODS OF COLLECTION AND PRESERVATION

Inshore ostracods.- The ostracods were usually collected from the sample points shown in text-figure 9 by means of a modified Van Veen grab sampler mounted on a small inboard or outboard motorboat. An "A" frame was fitted to the thwarts of the boat and the grab lowered and raised with a winch. The Van Veen sampler has a useful feature for sampling animals living at the sediment-water interface: a small door in the flattened top of the grab enables the investigator to subsample the full grab without dumping out its contents. This preserves, to an extent dependent upon bottom conditions, the stratification between the substrate and the overlying water. Subsamples were taken by reaching with a small jar into the top of the grab as it rested, filled but unopened, on a thwart. If sediments are free from large shells, sponges, etc., a quantitative subsample could be taken through the door by means of a small plastic tube fitted with a piston and operating like a typical piston corer; in this turbid environment, however, this proved impractical, because of the small cross sectional area measured no consistent count of living ostracods could be obtained. For example, in five samples taken within a few minutes over a square meter of bottom, the count of C. curta varied by over 200 percent.

The jars, each containing about 25 cc of sediment, were filled with seawater, capped and taken back to the laboratory. The greater part of a day could be spent sampling, and the ostracods collected in the morning were still alive and active in the evening. The filled jars were kept out of direct sunlight.

In the laboratory a 5 cc subsample was taken from a jar and placed on a large sieve of about 200-micron mesh size. If the ostracod popula-

tion was low, the entire contents of the jar were used. The sample was then gently washed with a small hose. Sea water or fresh water can be used without ill effects on an estuarine population. When the sediment was broken up and the fine fraction washed away, the remainder was transferred, with the aid of a wash bottle, to a counting tray. The ostracods were then removed, alive, by means of a small brush. A certain amount of practice is needed to become proficient at picking out ostracods, since the sediments usually also contain a large quota of decapods, worms, etc., all moving vigorously. The movement of most ostracods is quite characteristic, even when burrowing beneath the saturated sediment; that of other arthropods of similar size tends to be much more jerky. When teased with a needle, the ostracod withdraws within its shell, whereupon the surrounding sediment can be pushed aside and the animal removed with a brush. It is then placed in a depression square filled with distilled water. Although estuarine ostracods will eventually die in a relaxed position in distilled water, this takes a very long time due to their salinity tolerance. A quicker method is to kill them by means of the addition of a crystal or two of chloral hydrate or menthol; this leaves them with the shell agape and the appendages relaxed, making dissection and slide mounting easier. The animals can then be transferred to a preserving medium or immediately dissected.

If necessary the samples can be preserved prior to examination; a small amount of alcohol is added to the jar, which should contain only a small amount of water in addition to the sediment. As soon as the animals relax more alcohol can be added to bring the solution up to 70 percent concentration. The addition of preservative prior to examina-

tion was avoided whenever possible, because dead ostracods were extremely difficult to find and remove from the washed inshore samples which still contained large amounts of organic detritus. Staining with rose bengal, which has proved useful for separating live from dead foraminifers, was tried. This proved completely ineffective due to the high quantity of organic detritus which also took the stain, so that the ostracods were still inconspicuous. Examination of samples while the ostracods are still living is not only far easier, but the living and dead populations can be determined accurately.

Ostracods which could not be dissected immediately were placed, after being killed gently, in 70 percent alcohol in a small vial which was taped around the cap or dipped in paraffin and taped to prevent evaporation. Experimentally, some were placed in neutral formalin of four percent, and a small amount of magnesium carbonate buffer, enough to cover the bottom of the small vial, was added. Both of these methods proved adequate, although both seemed to cause hardening of the appendages after two years. This inhibited the appendage from leveling itself in the slide mounting medium so it could be photographed well. I found it always easier to dissect specimens within a few months.

A suggested, but not personally tried, preservative is a solution of equal amounts of glycerine, water, and alcohol.

Offshore ostracods.- Collection offshore was done in depths up to 625 feet. This requires a well-equipped, fairly large vessel. All collections were made from the 65 foot research vessel KIT JONES. To dredge at these depths required a cable of nearly 1000 feet. The dredge used was a modified Forster-Anchor, as shown in text-figure 8. With a 12 cm bite on either side, it was 40 cm wide and 50 cm long; it

was equipped with a canvas bag about 50 cm in length. This particular dredge was constructed for obtaining a representative benthonic fauna including molluscs, etc., which may have burrowed several inches into the substrate. Were a dredge of this type to be designed expressly to collect ostracods, one with a lesser bite, perhaps three or four centimeters, would be preferable. This would permit the dredge to be dragged over a greater surface area before filling; because the littoral ostracod fauna is not dense, this is an important factor.

After the dredge was dragged a few feet and filled, it was brought over the side of the vessel and suspended over a large bucket which had a rectangular spout a few inches below the rim. A galvanized corrugated garbage container of about 30 gallons capacity serves this purpose well. The canvas bag was then slowly opened by releasing the slip knot in the tying cord, emptying the contents of the dredge into the bucket. A hose with running sea water was shoved down into the sediments, the elutrient carrying the microfauna passing through the spout onto a sieve or series of sieves held beneath. Two or three persons can adequately carry out this procedure and work a great quantity of sediment for its fauna. Upon filling, the sieves (the smallest of about 200 micron mesh) were washed out into a liter bottle. Decay of a marine microfauna begins relatively rapidly, especially in warm weather, and except when the vessel was heading directly for the laboratory, preservative was added to most of the samples. The best method of preservation was to add neutral formalin to the jar slowly until a 3-4 percent solution was reached. This requires only small amounts of preservative, and when added in small doses over an hour period, no contraction of appendages was noted. To adequately preserve the samples

with alcohol requires not only large amounts of alcohol but the mixing with sea water may form precipitates. Inasmuch as sea water will additionally buffer the neutral formalin, no extra amount of buffer compound need be added if the storage period for the samples is brief. To keep the fauna alive in selected samples, the water was oxygenated and the jars immersed in covered basins of sea water to maintain nearly normal temperature.

Upon reaching the laboratory, the same procedures were used as for inshore samples. The dead ostracods are generally easily picked out with a brush since there is not obscuring organic detritus and fine sediments such as are present in the inshore samples.

Plankton tows were taken at each station where dredging was carried out. The tows were usually of about fifteen minutes duration, about 3000 liters passing through the Clarke-Bumpus sampler. All were carried out close to the surface, about ten meters of wire being let out. This procedure not only collects the planktonic ostracod fauna, but it reveals whether planktonic forms are being introduced into the benthonic fauna during elutriation by running sea water.

DISSECTION TECHNIQUES

The ostracod was removed from the preserving medium, placed in distilled water for a few minutes, and transferred to a drop of glycerine on a depression square. The animal was then removed from the shell with a pair of needles which were made by the following method. While held with a forceps, a piece of tungsten wire about as thick as a normal commercial dissecting needle and about three to five inches long is quickly dipped about an inch into molten sodium nitrite which has been melted in a small crucible over a bunsen burner. Initially the flame is strong enough to heat the sodium nitrite such that the immersed wire incandesces. The wire is then slowly drawn from the seething crucible, tapering itself by the loss of oxidized tungsten. A number of wires are given this initial taper, the quick immersion and slow withdrawal being done five or ten times for each, then the flame is lowered. After the sodium nitrite has cooled somewhat, each wire is given its final taper; it should not incandesce at this point. A microscope should be at hand for checking the points during the process. Extremely fine dissection needles can be cheaply and quickly produced by this method. They can be made finer than insect mounting pins usually used, do not rust, and are not springy. The wire can be mounted in a dissecting needle holder, a dowel, or left as is.

After the shell has been removed from the ostracod, it is mounted in glycerine jelly, if it is lightly or noncalcareous, on a depression slide. If calcareous it is transferred to a 50 percent Clorox solution for only a minute or two to remove excess organic matter. It is then washed in distilled water and placed on a micropaleontology slide which has been lightly coated with a gum tragacanth solution. Occasionally it

was necessary to remove the small amount of calcium carbonate of some myodocopid ostracods so that the shell could be mounted in a combination staining-mounting medium, which is acid. Decalcification was done in a five percent acetic acid solution.

Bubbles which lodge inside the vestibule or elsewhere in the shell inhibit mounting the shell in glycerine jelly or stain-mountant; they can be removed by placing the shell in glycerine on a slide warmer for an hour.

Appendages are removed from the animal, one by one, with the needles, and each is mounted on a separate slide. Usually some whole mounts are made to confirm the appendage orientation of a species. Dissections are performed under magnifications of 25 to 80 X, depending upon the size of the animal. After a little practice, one can remove appendages quite accurately and rapidly.

STAINING AND MOUNTING TECHNIQUES

As each appendage is removed, it is mounted. Only a few stains work well with chitin, and nearly all involve difficulties due to the minuteness of the appendages and the necessity of dehydrating and fixing. All ostracods used in this study were stained and mounted with the water-soluble staining-mounting medium CMC-S, manufactured by General Biological Supply House (Turtox) of Chicago, Illinois. This medium is ideal for this use and even if the soft parts are not to be photographed, the staining greatly facilitates observation of morphological details.

A good working container for the medium is a small weighing bottle, a glass rod being used for a dropper. After an appendage has been removed, a drop of the medium is placed on a clean glass slide; the appendage is picked out of the glycerine with a needle; the depression square removed from beneath the microscope and the slide put in its place; the microscope is focused on the drop and the appendage placed in the medium with the needle. When the appendage is pushed to the bottom of the drop its contact with the slide prevents lateral movement; then the slide is removed from beneath the microscope. A coverslip is slowly placed on the staining-mounting medium and the whole returned to the microscope stage. With the appendage in focus the coverslip is gently pressed to spread the medium and shifted as necessary to orient the appendage. Some practice will facilitate orientation of the appendage. A high-power microscope is used to check the setae and other features to see they are well displayed. When the appendage is satisfactorily displayed, the slide is set aside and the next appendage dissected off. After each slide has set about 24 hours

the stain within the mounting medium has been absorbed by the appendage, coloring it carmine. The coverslip may then be ringed.

If a particular structure absorbs too much stain, or internal structures of a whole mount are being studied, the stain-mountant may be diluted with water. This is seldom necessary.

Since this stain-mountant is acid, no calcareous test should be placed in it. Additional care must be taken if the ostracod has been eating foraminifers or if calcareous algae have grown on its appendages. If this is the case, the soft parts may be placed in a 5 percent acetic acid solution prior to mounting.

SYSTEMATIC DESCRIPTIONS

Phylum ARTHROPODA

Class CRUSTACEA

Subclass ENTOMOSTRACA

Order OSTRACODA

Suborder PODOCOPIDA

Superfamily Cytheracea Baird, 1850

Family Loxoconchidae Sars, 1925

Genus Cytheromorpha Hirschmann, 1909

Cytheromorpha curta Edwards (emended herein)

Pl. 1, figs. 1-12; pl. 2, figs. 1-6

Cytheromorpha curta Edwards, 1944, p. 516, pl. 86, figs. 19-22; Swain, 1951, p. 49, pl. 7, fig. 22.

(?) Cytheromorpha pascacoulaensis Mincher; Swain, 1955, p. 630, pl. 63, fig. 4; pl. 64, fig. 5; text-fig. 34c.

Carapace.- Female: calcareous, short, highest anteriorly. Broadly rounded anteriorly, dorsally nearly straight, steeply sloped toward rounded posterior; ventral margin essentially straight, slightly concave anterior to midpoint, more strongly so on right valve. Length about 1.5 times height.

Surface nearly smooth in adult, slightly punctate; earlier instars conspicuously reticulate. Valves not inflated posteriorly, more gently sloped anteriorly. Normal pore canals sieve-type, sparse.

Inner lamella forming anterior vestibule about twice as wide as adhesive strip, a very narrow vestibule posteroventrally. Radial pore

canals tapering distally, straight, simple - about 18.

Central muscles forming a ventrally forward curved vertical row of 4 adductor scars in mid-ventral region, and an irregularly crescent-shaped scar anteriorly. Mandibular fulcral point a circular scar just anterior to topmost adductor scar.

Hinge amphidont. Right valve with a distinct rounded tooth in a curved negative area which forms a more prominent socket anterior to tooth, entire element overhung by a thin "locking" bar; median portion with a narrow groove; posterior element a crescent-shaped tooth, anterior extremity being smaller than posterior, mid-portion depressed, serving as a distinct socket; left valve complement of right, anterior element a crescent-shaped tooth, anterior end much more toothlike than posterior, mid-portion depressed, serving as a distinct socket; median element a narrow ridge; posterior element a crescentric socket with a central tooth, entire element overhung with a thin "locking" bar.

Indistinct eye spot may be present close to anterior cardinal angle.

Male: slightly dimorphic. Shell nearly always somewhat smaller, but size overlap occurs in adults. Height/length ratio about same. Slightly reticulate on posterior two-thirds as adult.

Antennule.- Six segments; basal podomere largest, no setae; second podomere dorsoproximally coarsely hirsute, a thin ventrodistal seta; third podomere short, a long dorsodistal spine with a short very thin seta off distal portion of spine, extending beyond point; fourth podomere as preceding, in addition a flagellum off lateral distal margin; fifth podomere slightly elongated, bearing a spine as on third and fourth podomeres, and two additional distal flagella; sixth (terminal)

podomere elongated, distally bearing a long spine as on preceding three segments, two flagella-like setae, and a long distally expanded sensory seta; latter may not be well developed in every adult.

No dimorphism observed.

Antenna.- Protopod elongate, no setae. Exopod reduced to a long dorsally situated rodlike flagellum of three indistinct segments, distal portion bent downward. Endopod of three segments; first podomere short, one to four dorsoproximal setae and a ventrodistal seta; second podomere long, probably a fusion of two segments, proximal half dorsally hirsute, two mid-dorsal setae, three mid-ventral setae (one quite large), and one large ventrodistal seta; third (terminal) podomere very short, one ventroproximal and one dorsodistal clawlike spine.

No dimorphism observed.

Mandible.- Protopod elongate, heavily chitinous, gnathobase of basal podomere with short blunt teeth, a few short setae between teeth. Exopod reduced to an anterodorsally directed seta. Endopod of three segments; first podomere with about four ventrodistal setae, one dorsodistal seta; second podomere with one ventrodistal seta, two long dorsodistal setae; third (terminal) podomere with two or three coarse distal clawlike setae.

Dimorphic. Endopodal setae of male more numerous, longer; masticatory portion of basis of protopod wider.

Maxilla.- Basal podomere with four distal rami, the anteriormost (maxillary palp) of two segments, first segment with one or two long distal setae, second segment short, distally tipped with three short clawlike setae and three or four thinner setae; three other rami

similarly distally equipped. Exopod a lobate process with about 18 long pinnate "branchial" setae.

No dimorphism observed.

Fifth limb.- Elongate crusiform, four segments; basal podomere with two or three proximal setae, two anterodistal setae; second podomere with an anterodistal seta; third podomere with a very short anterodistal spine; fourth (terminal) podomere tipped with a long stout forward curved claw which is somewhat segmented about one-third of way from proximal end. No dimorphism observed.

Sixth limb.- As fifth limb but longer and with only one anterodistal seta on basal podomere. No dimorphism observed.

Seventh limb.- As sixth, but larger. No dimorphism observed.

Furca.- Very reduced, bilobate pair, hirsute with few setae.

Copulatory appendage.- Paired, very large, complex. Capable of being extended well below shell such that attachment point of thoracic limbs is also out of shell.

Eye.- Paired, situated near anterior cardinal angle. Shiny under reflected light. A mass of irregularly grouped granules.

Habitat.- Estuarine-lagoonal; less than 2 to over 29 °/oo salinity.

Size.- See discussion.

Range.- Miocene to Recent.

Types.- Hypotypes UMMP nos. 48754, 48755, 48756, 48757, 48758,

48759, 48760, 48761, and 48762.

Remarks.- Males of this genus have generally been found to be distinctly larger than the females, e.g. C. fuscata (Brady, 1869a); however there is no sure way to determine the males of the species herein without observation of internal morphology.

The young are so distinctly reticulate that a separate species could easily be erected if fossil remains were the sole evidence.

The species is distinguished from C. fuscata (Brady) by its smaller size, adults being about 390 microns long in this environment while those found in the Miocene by Edwards varied from 380 to 440 microns. The species assigned by Swain (1955, p. 630) to C. pascagoulaensis Mincher vary from about 413 to 420 microns. C. fuscata (female) is generally over 550 microns in length, while the male is about 700 microns (see Schaefer, 1953, p. 373). The exopod of the mandible is much more reduced in C. curta. In other respects the internal morphology of the two species is very similar.

C. curta is very similar in carapace outline to C. pascagoulaensis Mincher (1941, p. 344) from the Miocene of Mississippi. Although Mincher states the greatest height is at center, his figures indicate it is anterior. He saw no normal pore canals or muscle scars. His description of the hinge is borne out by his figure, and the right valve has no distinct posterior tooth, while the left has no crescentric-shaped posterior tooth.

The genus is typical of brackish water environments.

Discussion.- This species makes up, by far, the greatest percentage of the estuarine-lagoonal ostracod assemblage. It is extremely well

adapted to the harsh environment of salinities ranging from less than 2 °/oo at sample point 6 (text-fig. 2) up the Darien River to salinities of about 30 °/oo at the northern and southern ends of Sapelo Island in the sounds. The water temperature in which the species lives varies from 7.7° C (45.8° F) in December to 31° C (87.8° F) in July. The tidal currents are of such a magnitude that in most areas it is unlikely the animal can withstand being swept along. The entire population probably fluctuates to-and-fro with the tidal motion. The ability of this one species to withstand such ecological rigors accounts for its predominance over all others.

The population varies in number considerably, being quite low in winter, e.g. in December, 1961, 25 samples were taken over a period of ten days at sample points 1-25 (text-fig. 2) - a total of 102 specimens was found alive; in July of 1961, 277 specimens were found alive in one 5 cc sample, and counts of over 100 specimens per 5 cc were common.

The sampling was done during June-September, 1961; December, 1961; April, 1962; December, 1962; March-June, 1963. Adults were found of both sexes at all periods. During April the instars far outnumbered the adults, in the ratio of 50 to one. These instars were 195-230 microns long. In March the young did not significantly outnumber the adults - neither were found in great numbers, although very small instars may have been overlooked in the clay-silt and organic sediments. The instars were commonly only 120 microns long at this time. It appears that the animals hatch in the early spring, mature throughout the summer, breed either in the fall, winter, or very early spring (no eggs were ever found), and those adults which survive the winter may reach 429 microns in length. Most female adults, at least they have a

full complement of appendages, are about 380 microns in length, with a range of 343-429 microns. Males are usually 340-380 microns long. The adult size range of 343 to 429 microns is so large as to inhibit the use of growth statistics unless one assumes post-maturation molting that still increases the size of the animal by a significant ratio, i.e. on the order of 1.2 - 1.25. Since no appendages are being added, this is improbable. Since the adults are so variable in size, the growth formulae of Kesling (1951) Anderson (1964), and others do not appear applicable here for the determination of number of instars.

Instars with only one pair of thoracic limbs developed were 195 and 200 microns long, one pair and anlagen of the second 215 microns long, and two pair 235 and 240 microns long. It may take two molts for the complete development of some appendages, and the well-developed copulatory organs in males about 350 microns in length may not yet be functional until another molt.

The life span appears to be one year.

Specimens of this species were found in all areas of the estuarine-lagoonal province in back of the island described in the environmental discussion of the area.

Cytheromorpha warneri Howe & Spurgeon (emended herein)

Pl. 2, figs. 7-10

Cytheromorpha warneri Howe & Spurgeon, in Howe et al., 1935, p. 11, pl. 2, figs. 5,8,9; pl. 4, fig. 4; Van den Bold, 1946, p. 105; Van den Bold, 1950, p. 86; Malkin, 1953, p. 787, pl. 80, figs. 18, 19; Puri, 1953, p. 277, pl. 6, figs. 5-7, text-figs. 11f,g; Puri &

Hulings, 1957, p. 187, fig. 11, no. 10 (bottom); Puri, 1960, p. 114, pl. 3, figs. 11,12, text-fig. 36.

Carapace.- Entire surface of valves punctate, indistinct posteriorly, reticulations more distinct posteriorly. Marginal pore canals simple, straight; normal pore canals sieve type, sparse. Central muscle scars a vertical row of four adductor scars, a V-shaped frontal scar.

Antennule.- Typical of genus (cf. C. curta, pl. 2, fig. 2). Six segments; basal podomere largest, no setae; second podomere dorsoproximally hirsute, a thin ventrodistal seta; third podomere short, a long dorsodistal spine with one or two short very thin setae off distal portion of spine extending beyond point; fourth podomere short with two long dorsodistal spines each bearing a distal flagella; fifth podomere short bearing two dorsodistal spines with a distal flagella and two laterodistal setae (one longer); sixth (terminal) podomere elongated, distally bearing a long spine as on preceding three podomeres, a flagellumlike seta, and a long distally expanded sensory seta.

No dimorphism observed.

Antenna.- Typical of genus. Protopod elongate, no setae. Exopod reduced to a long dorsally situated rodlike flagellum, distally bent downward. Endopod of three segments; first podomere short, four to six thin hairlike dorsoproximal setae and a long ventrodistal seta; second podomere long, probably of two fused podomeres, two mid-dorsal setae of unequal length, two mid-ventral setae of unequal length, a mid-ventral sensory seta with distal expansion, and one ventrodistal large seta; third (terminal) podomere very short, one ventroproximal

and one dorsodistal clawlike spine.

No dimorphism observed.

Mandible, maxilla, fifth, sixth, and seventh limbs, labrum, and copulatory appendages.- As in C. curta, but proportionally larger in adult.

Eye.- Not seen.

Habitat.- Brackish water, salinities of 13 to 28 °/oo.

Size.- Length of adult 500-585 microns.

Types.- Hypotypes UMMP nos. 48763, 48764, and 48765.

Remarks.- The animal is easily distinguished from others of its genus by the shell structure. It is not easily distinguished from Leptocythere paracastanea Swain (see herein) by its gross shell features. Under normal viewing with a dissecting microscope of approximately 80 power, very close examination did not always serve to distinguish the two - especially males. The internal morphology is very alike, and grossly the two are homeomorphs. They may easily be differentiated under high magnification with transmitted light. Leptocythere has polyfurcate radial pore canals, open type normal pore canals, and different dentition. C. warneri has simple radial pore canals and sieve type normal pore canals.

Discussion.- Adults were found in March in Sapelo Sound and adjacent areas and were not common.

Family Leptocytheridae Hanai, 1957

Genus Leptocythere (Leptocythera, errore) Sars, 1925

Pl. 3, figs. 1-10; pl. 4, figs. 1-9

Leptocythere paracastanea Swain (emended herein)

Leptocythere paracastanea Swain, 1955, p. 640, pl. 62, fig. 7; pl. 63, figs. 1a-c; text-figs. 39, 5a,b.

Carapace.- Female: calcareous, somewhat tumid, greatest height slightly anterior of mid-line, greatest width nearly central. Anterior broadly rounded, dorsally gently curving to a less broadly rounded posterior, the posterior cardinal corner protruding, more so on left valve. Ventral margin nearly straight, sinuous near mid portion. Two short shallow sulci anterodorsally; a posteroventral groove creating an indistinct lobe. Anterior two-thirds punctate, posterior portion coarsely reticulate. Inner lamella usually fused with inner surface of shell forming pseudomarginal pore canals, occasionally a narrow anterior and posteroventral vestibule. Normal pore canals open type, radial pore canals polyfurcate, each with a short marginal seta.

Central muscle scars a nearly vertical row of four adductors, a curved frontal scar anterior to topmost adductor, very indistinct.

Teeth of right valve: anterior tooth distinct, slight lateral crenulations, indistinct sockets on both sides of tooth; median element a long ridge; posteriorly a distinct tooth with dorsal crenulations, an indistinct shallow socket posterior to tooth; left valve: anterior elements a small tooth followed by a slightly crenulate socket and a posterior larger elongate tooth which grades into the lower positive portion of a median groove; posterior elements a crenulate socket

bordered by two teeth and overhung and reinforced by extension of upper positive portion of median element.

Male: longer in relation to height, punctations over whole surface, reticulations more subdued. Median hinge element of left valve dorsally crenulate, more so posteriorly. Posteroventral groove less distinct.

Antennule.- Five segments; stout; basal podomere largest, no setae; second podomere thinner, nearly as long, a thin ventrodistal seta; third podomere short, a stout dorsodistal curved claw; fourth podomere with two dorsomedian claws (one small, more distal large with a flagellum), three dorsodistal claws (two small, more distal one large with a flagellum), and a thin dorsodistal seta; fifth (terminal) podomere narrow elongate with a short dorsomedian spine, terminated with a stout claw bearing a short distal flagellum, a long thin spine, and a long sense club (cf. Cytheromorpha warneri, pl. 2, fig. 10), usually distally expanded.

No dimorphism observed.

Antenna.- Protopod elongate, no setae. Exopod reduced to a long thin dorsally situated rodlike flagellum, distally bent downward. Endopod of three segments; first podomere short, a long pinnate ventrodistal seta; second podomere long, probably two fused segments, a dorsomedian seta, three ventromedian setae (one heavy, one a sense club, and one ventrodistal heavy pinnate seta with a flagellum); third (terminal) podomere short with two terminal claws, the dorsal claw off an extended base.

No dimorphism observed.

Mandible.- Protopod elongate, heavily chitinous, gnathobase of basal podomere with approximately eight short teeth and two or three short spines; second podomere of protopod with two posteriorly directed marginal spines. Exopod not seen, probably very reduced. Endopod of three segments; first podomere with two small distal setae off lateral edge and two large pinnate posterodistal setae; second podomere with one long pinnate seta, two short posterodistal setae, two anteromedian setae, and one anterodistal seta; third (terminal) podomere with three terminal setae.

No dimorphism observed.

Maxilla.- Basal podomere with four distal rami, anteriormost (maxillary palp) of two segments, first with three long distal pinnate setae, second with three long pinnate terminal setae; three other rami similarly distally equipped; exopod a lobate process with about 18 long pinnate "branchial" setae.

No dimorphism observed.

Fifth limb.- Elongate crusiform, four segments. Basal podomere with anteromedian seta, posteromedian pinnate seta, and two anterodistal setae; second podomere with anterodistal seta; third podomere with very short distal spines; fourth (terminal) podomere with short distal spines, terminated with a long stout anteriorly curved claw with a constriction one-third out from base.

No dimorphism observed.

Sixth and seventh limbs.- As fifth limb but increasingly larger, with only one anterodistal seta on basal podomere.

No dimorphism observed.

Furca.- Reduced, lobate, hirsute. Dorsally straight on female.

Genital lobe.- Spinose, vaginae two chitinous rings.

Copulatory appendage.- Very large, complex. Distal extension broad, quickly tapered, lightly chitinous.

Eye.- Paired, well forward. Observed to move forward and backward.

Habitat.- Brackish water, salinities of 13 to 28 °/oo.

Size and types.- Hypotypes: UMMP 48769, male, 445 microns long, 195 microns high; UMMP 48767, female, 445 microns long, 235 microns high; UMMP nos. 48766, 48768, 48770, and 48771.

Remarks.- The genus Leptocythere differs from Cytheromorpha in the dentition, the presence of open vs. sieve type normal pore canals, and in polyfurcate vs. straight radial pore canals. The internal morphology of the two genera is nearly the same; the antennule of Cytheromorpha has six podomeres, while that of Leptocythere has five, the fourth and fifth equivalents of Cytheromorpha being fused. In all other respects the appendages are essentially alike.

This species differs from L. castanea Sars (1925, p. 174, pl. 80, fig. 1) by the presence of reticulations on the shell surface, in addition to the punctae, and by the more blunt distal process of the copulatory organ. The length of L. castanea is given as 690 microns, the specimens of L. paracastanea described by Swain from San Antonio Bay, Texas as male: 560 microns, female 490 microns; the specimens described herein are smaller, usually 445 microns long.

All other species of the genus may be easily distinguished by the shell.

Discussion.- This spedies is typically found in brackish water. It is not as euryhaline as Cytheromorpha curta and has a general salinity range of 13 to 28 °/oo. It is found in Sapelo Sound, and occasionally behind the island adjacent to the sound.

Adults have been found in the winter, but are uncommon. The greatest numbers appear to occur in March and April. The appendages are quite yellow in appearance. The shell is a close homeomorph of Cytheromorpha warneri, but smaller.

The male is capable of extending the copulatory organs such that the entire thoracic region is outside of the shell. No eggs were found in any female.

Occurrence uncommon.

Family CYTHERIDEIDAE Sars, 1925

Genus Cyprideis Jones, 1856

Cyprideis floridana (Howe & Hough) (emended herein)

Pl. 5, figs. 1-8; pl. 6, figs. 1-8

Cytheridea floridana Howe & Hough, 1935, in Howe et al., 1935, p. 10, pl. 2, figs. 15, 16, 18; pl. 4, figs. 6, 10.

Anomocytheridea floridana (Howe & Hough), Stephenson, 1938, p. 142, pl. 23, fig. 15; pl. 24, figs. 7,8; text-figs. 2, 6, 19, 20. Edwards, 1944, p. 510, pl. 85, figs. 16, 17. Puri, 1953, p. 229, pl. 2, fig. 10, text-figs. 3a,b. Howe, 1961, Q 273, fig. 203, no. 1a-e.

(?) Cytheridea ? (Anomocytheridea) floridana Hough & Hough, Van den Bold, 1946, p. 82.

Cyprideis littoralis Brady; Swain, 1955, p. 615, pl. 59, figs. 11a-c; text-figs. 38, 5a,b.

non Cyprideis floridana Puri, 1960, p. 110, pl. 2, fig. 5, text-figs. 1-3.

Carapace.- Normal pore canals sieve type.

Antennule.- Five segments; basal podomere large, nearly as wide as long, distally hirsute; second podomere long, medially hirsute, a long distally segmented ventrodistal seta; third podomere short with a dorsodistal long pinnate spine; fourth podomere short, consisting of two fused segments, two spines dorsomedially (one pinnate), two spines dorsodistally (one pinnate), and a short laterodistal seta; fifth (terminal) podomere narrow, long, with three thin terminal setae.

No dimorphism observed.

Antenna.- Protopod somewhat smaller than basal podomere of antennule, no setae. Exopod reduced to dorsally situated rodlike flagellum, distally bent downward. Endopod of three segments; basal podomere short, hirsute in areas, with a comparatively long ventrodistal seta; second podomere long, two dorsal setae of unequal length, a long pinnate ventral spine; two long distomedial setae, and a ventrodistal pinnate spine; third (terminal) podomere very short, bearing two large claw-like spines.

Dimorphic. One distomedial ventral seta on second podomere of male is longer, reaching as far as terminal spines of distal podomere.

Mandible.- Basal podomere of protopod heavily chitinous, gnathobase broad, tipped with long blunt spines and one or two blunt setae, a short seta off the anterior portion proximal from the tip; second podomere of protopod short with a long pinnate median seta directed posteriorly.

Exopod of four setae, one very small, three large and very pinnate similar to branchial setae of maxilla. Endopod of two segments, basal podomere longest, with an anteromedian long distally segmented seta, a long posteromedian seta, two lateral median setae, six anterodistal setae, a lateral distal seta, and a long posterodistal seta; second (terminal) podomere very reduced with two long heavy terminal setae.

No dimorphism observed.

Maxilla.- Basal podomere with four rami, anteriormost (mandibular palp) of two segments; first segment with four long distally segmented anterodistal setae, one posterodistal seta; second (terminal) segment with three terminal setae; other three rami with about six heavy terminal setae. Exopod with about 16 long pinnate "branchial" setae.

No dimorphism observed.

Fifth limb.- Elongate, crusiform, four segments; basal podomere large, an anteromedian distally segmented seta, two anterodistal segmented setae and a large posterior segmented very pinnate seta one-fourth way from proximal end; second podomere narrow, one short seta and one long pinnate anterodistal seta; third podomere with two or three small distal spinules; fourth (terminal) podomere with a long anteriorly curved claw as long as last two podomeres.

Dimorphic. Right fifth limb of male has three distal podomeres thicker, the anterodistal seta of second podomere larger and clawlike, distal claw heavier.

Sixth limb.- As fifth limbs of female and left fifth limb of male, but larger and only one anterodistal seta on basal podomere.

Dimorphic. Right sixth limb of male with normal basal podomere,

last three podomeres very reduced, weakly developed; terminus a small node, not a claw.

Seventh limb.- As sixth limb but longer and with the proximally situated posterior seta of basal podomere distinctly smaller, not as pinnate; last three podomeres with spinules around distal peripheries.

Dimorphic. Male has about eight thin, nearly hairlike setae along anterior margin of second podomere and a like clump of these on proximal portion of basal podomere. Both appendages symmetrically developed.

Furca.- Reduced; nodular with two small setae.

Copulatory appendage.- Paired; very large, quadrate; lobate extensions, a "copulatory string" of three-fourths whorl. Basal quadrate portion of figured male (pl. 5, fig. 2), 390 microns across.

Eye.- Paired, stalked, no lenses. Visual area a mass of darkly pigmented granules. Situated near dorsal border 275 microns from anterior end of female 890 microns in length.

Habitat.- Brackish water of salinities from 13 to 28 °/oo.

Size and types.- Hypotypes: UMMP 48772, female, 890 microns long, 475 microns high; UMMP 48773, male, 975 microns long, 500 microns high; UMMP nos. 48774, 48775, and 48776.

Range.- Upper Miocene to Recent.

Remarks.- The internal morphology differs from that of C. torosa (Jones) (= C. littoralis Brady) in only a very minor way, if at all. The mandible of that species has an exopod with three large and two

small setae (as figured by Sars, 1925, pl. 71), while C. floridana has three large setae and only one small seta. C. torosa possesses a spine on the posteroventral corner of the right valve, and the uppermost adductor muscle scar is not directed upward at an angle as in the species herein, hence the carapaces are easily distinguished.

Discussion.- Young instars were found in December and throughout the spring and summer. Adults, the females bearing eggs, were first found in April. The males were comparatively rare. The young instars are not readily assigned to the species since they taper considerably toward the posterior, needing no carapace room for penes or eggs.

It appears that eggs are developed and hatch during the early spring. The new-born may only reach maturity early the next spring since none were found in winter. Too few adults were found, even in spring, to state categorically that this is the life cycle.

The species is confined to Sapelo Sound and directly adjacent areas where the salinity ranges are not as great as in the marsh areas. An interesting occurrence was noted in June, 1961, when sampling at points 17-20 (text-fig. 2). At sample point 17, off the tidal bar, 98 specimens of Cytheromorpha curta were obtained from 5 cc of sample at the sediment-water interface; at sample point 18, on the flank of the bar, 62 specimens of that species were found in 5 cc of sediment plus 50 specimens of Cyprideis floridana; at sample point 19, on the bar, three specimens of C. curta were found in 5 cc of sediment and 67 specimens of C. floridana; at sample point 20, off the tidal bar near shore, 6 specimens of C. floridana were found in 5 cc of sediment, and no C. curta. This was thought at first to be a classic ecological situation wherein Cyprideis floridana preferred the type of substrate and the

shallower water of the tidal bar, while Cytheromorpha curta preferred the deeper water and its coarser substrate. This was the first time I had been to this area, and was unaware of the current situations and the fact that the bar was exposed at low tide - leaving only 100 feet or so navigable along the western bank of the tidal river. When the tidal currents were understood, it was found that an opposing action occurs in this area, and is responsible for the deposition of sediments forming the bar. The tidal map (text-fig. 3) shows the incoming tide from Sapelo Sound is not strong in this area (note length of movement of drogue for incoming tide) and is confined to the eastern bank of the channel. The tide from the south is much greater and actually causes opposing current flows on either side of the bar for a period of time. Note the median phi diameters (text-fig. 7), which reflect the tidal currents in this area. C. floridana is brought onto the bar by the tidal current and is deposited there, just as are the fine sediments which make up the bar, when the current velocity drops off due to opposing currents. In fact, there may be some increase in concentration of number of specimens per unit area higher than in the sound. C. curta occurs in very high concentrations within the tidal channels in back of the island, and is brought from this area to the sound by the tidal current from the south, the resultant being the lateral stratification of species in a short distance.

Sampling on the bar when exposed at low tide showed that nearly all specimens were carried back into the sound, the population being very reduced. There is generally enough moisture to maintain these reduced populations during the exposure period. The sediment is saturated to the point that during sampling of the bar the investigator nearly

disappears. Capillary action keeps some moisture at the surface even under the summer sun.

An adult female placed in a small cup of brackish water was noticed to be gravid. After 13 days two young were born (April 19) and molts were already noticed. The young were 195 microns long at this time. On April 25 six young were seen, and the adult was still alive. The contents were observed on April 29 and the adult was quite weak, doubtless not being fed properly, and only three of the six young were seen. To my surprise, the shell of the female opened and the other three swam out! At least in this case some post-birth parental care exists. All young died within the following week.

The thoracic legs of this female were observed to act in cleaning the outside of the carapace as well as the inside.

Family CYTHERURIDAE Mueller, 1894

Genus Semicytherura Wagner, 1957

Semicytherura elongata (Edwards) (emended herein)

Pl. 7, figs. 1-12

Cytherura elongata Edwards, 1944, p. 526, pl. 88, figs. 21-25; Swain, 1951, p. 50, pl. 7, figs. 24, 25; Swain, 1955, p. 628, pl. 64, figs. 12a,b.

(?) Cytherura johnsoni Mincher; Benson & Coleman, 1963, p. 31, pl. 6, figs. 3-5 (non 1,2), text-fig. 18b.

Carapace.- Teeth; right valve: anterior tooth slightly crenulate, followed by a socket; median element a strong bar overhanging a narrow groove; posteriorly a socket followed by a slightly crenulate reduced

tooth; left valve: anterior and posterior elements sockets; median bar expanded at both ends into crenulate teeth (see remarks). Right valve overlaps left in median dorsal region, left valve with overlapping flanges distally both anterior and posteriorly.

Male expanded posteriorly, somewhat more elongate; lateral ornamentation much more distinct than cross ribs, some specimens with cross ribs very indistinct.

Normal pore canals few, widespread, open. Very rarely a sievelike area exists, no borders as in a sieve-type pore, function unknown. Marginal pore canals few, long, not all reaching margin, somewhat grouped.

Antennule.- Six segments, distal four long and narrow; basal podomere largest, no setae; second podomere with a long thin ventromedian seta; third podomere with one dorsodistal seta; fourth podomere with three dorsodistal setae; fifth podomere with three dorsodistal setae; sixth (terminal) podomere with three thin terminal setae (one blunt).

Dimorphism. The seta of the third podomere, and one of those of the fourth and fifth podomeres is heavier in the male.

Antenna.- Protopod with no setae. Exopod reduced to a dorsally situated rodlike flagellum distally bent downward. Endopod of four segments, penultimate one a fusion of two; basal podomere short with two ventrodistal setae; second podomere elongate tapering with a ventrodistal seta; third podomere long with a short dorsomedian and a ventrodistal seta; fourth (terminal) podomere short with a dorsodistal short spine and long clawlike seta, a ventrodistal clawlike seta, and a small inner lateral seta.

Essentially no dimorphism, male has two bulbous glands in back of labrum with tubule into antennae - probably leading to sensory setae.

Mandible.- Basal podomere of protopod heavily chitinous, gnathobase with heavy blunt teeth; second podomere of protopod relatively short. Exopod a long thin seta. Endopod with three segments; basal podomere relatively long with one anterodistal seta and one posterodistal seta; second podomere with three or four anterodistal and four or five posterior setae; third (terminal) podomere short, narrow, with three or four relatively short terminal setae.

No dimorphism observed.

Maxilla.- Terminal segments of basal posomere relatively elongate, "palp" of two segments, the proximal about five times the length of the distal. All four rami terminated with four to six setae; branchial plate of exopod with about 16 long pinnate setae.

No dimorphism observed.

Fifth limb.- Elongate, crusiform, four segments; basal podomere somewhat ovate, two anterodistal setae, one anteromedian seta, and one posteromedian seta; second podomere with one anterodistal seta; third podomere with no setae; fourth (terminal) podomere with a terminal claw anteriorly curved, as long as podomere.

No dimorphism observed.

Sixth limb.- As fifth limb but larger, basal podomere with only one anterodistal and two anteromedian setae.

No dimorphism observed.

Seventh limb.- As sixth limb but larger.

No dimorphism observed.

Copulatory appendage.- Paired, very large, complex; "copulatory string" of only one loop. Much like that of C. (?) intumescens Sars (1925, p. 96)

Habitat.- Found in or adjacent to Sapelo Sound during spring; salinities from 13 to 28 °/oo, usually in upper range. Uncommon.

Types.- Hypotypes UMMP nos. 48777, 48778, and 48779.

Size.- Adults from 460 to 520 microns in length.

Range.- Miocene to Recent.

Remarks.- In all respects described by Edwards, the valves of this species agree with his Cytherura elongata. The inner lamella are not as wide, especially posteriorly, as in those species which Wagner lists for his genus Semicytherura (1957, p. 80-89). The terminal teeth of the median element of the left valve are crenulate in the species herein (pl. 7, figs. 8, 9) and this is the principal difference from the genus Cytherura. The crenulations are not easily seen. By orienting the shell in glycerine jelly with a hot needle, they may be observed from within nearly on the plane between the valves, and under a magnification of 400-500.

No differences in internal morphology were noted between Cytherura and Semicytherura.

Discussion.- One female specimen taken in April was put in a Nembutal solution and several days later observed. Prior to death the animal had laid eggs, all but one of the six laid had hatched. The

antennules and antennae were observable, the young were approximately 190 microns long.

Superfamily BAIRDIACEA Sars

Family MACROCYPRIDIDAE Mueller, 1912

Genus Macrocypris Brady, 1868a

Macrocypris sapeloensis, n. sp.

Pl. 8, figs. 1-9; pl. 9, figs. 1-9

Carapace.- Male: calcareous, elongate, dorsal margin curved, ventral margin slightly concave. Greatest height slightly anterior; anterior end broadly rounded, posterior sub-acute, rounded, apex nearly on a line with ventral margin. Surface smooth. Inner lamella wide anteriorly and posteriorly, narrow ventrally; anteriorly inner lamella curves close to inner shell surface, posteriorly more parallel to plane of valve contact. Large posterior and anterior vestibula.

Radial pore canals numerous, non-branching, nearly all reach anterior edge. Line of concrescense very irregular, following thick pore canals toward edge. Normal pore canals simple, open, sparse, most numerous posteroventrally.

Central muscle scars a large group of about 12 adductors circularly arranged, located slightly ventral of midpoint. Two smaller scars anteroventrally, two smaller scars anterodorsally.

Right valve larger, overlapping left ventrally. Hinge advanced merodont/entomodont; right valve: anteriorly a crenulate elongate socket becoming a positive crenulate element toward mid-line, from mid shell to posterior portion slightly curved, essentially acting as a positive ridge

curving outward into a more positive comparatively short crenulate element which posteriorly becomes an elongate crenulate socket; left valve: complementary, the area opposite the median element of the right valve correspondingly slightly concave, a long positive ridge overlaps the right valve.

Antennule.- Seven segments; basal podomere about as wide as long; second podomere fused to basal, two long ventrodistal setae with very finely saw-toothed distal margins; third podomere short, fused to second, one ventrodistal seta, distal margins finely toothed, and one dorsodistal seta of like structure; fourth podomere articulated with third, shorter setae in same arrangement as preceding podomere; fifth podomere with a large dorsodistal seta, distally nearly smooth, and a smaller ventrodistal seta; sixth podomere with two ventrodistal setae, nearly smooth; seventh (terminal) podomere with four essentially smooth stout setae.

Antenna.- Similar to antennule, six segments; basal podomere with a short sagittal seta directed ventrally; second podomere with a long sagittal seta; third podomere with two long, one short dorsoproximal setae, dorsodistal edge with three or more very short spines, ventroproximally a cluster of six long setae; fourth podomere with two dorsodistal setae, one ventroproximal seta, two short setae, one long seta, and two sensory setae ventrodistally, the latter distally broadened and spinose; fifth podomere with one short and one long stout setae ventrodistally, dorsodistally four long stout setae, one shorter; sixth (terminal) podomere overhung by dorsodistal portion of fifth, one or two long stout and two shorter setae terminally.

Mandible.- Basal podomere of protopod elongated for leverage of gnathobase. Gnathobase terminated with approximately eight chitinous spines posteriorly decreasing in size, numerous short setae between spines; second podomere of protopod with three distal setae. Exopod reduced to about six long pinnate setae, not heavily chitinized, off a raised base. Endopod of four segments; basal podomere with approximately six long distal setae; second podomere with four laterodistal setae, about six marginal distal setae; third podomere short, about two distal setae; fourth (terminal) podomere very short with approximately four terminal setae, one larger and more heavily chitinized.

Maxilla.- Basal podomere with two long setae directed anteriorly off lateral portion, one short seta off posterior margin; terminus of four rami, anteriormost (maxillary palp) of two segments, all rami distally equipped with numerous setae, posterior ramus with a long marginal proximal seta. Epipod lobate, about 10 long pinnate marginal setae, three or more short proximal setae.

Fifth limb.- Short, non-crusiform. Protopod low, moundshaped; palp (exopod ?) small, elongate, two or three segments, two long proximal setae, three terminal setae; endopod essentially two segments, basal podomere large with one seta and two blunt stout spines distally, second podomere heavily chitinous, curved forward for grasping.

Sixth limb.- Elongate crusiform, five, possibly six, segments; basal podomere with three long seta on anterior margin and one posterodistal seta; second podomere long, one seta just inside posterior margin somewhat proximal of mid-point, distally very finely pinnate, and one long anterodistal seta; third podomere long, one long anterodistal seta;

fourth podomere elongate with one long and one short anterodistal seta; fifth (terminal) podomere long, distally a possible segmentation, terminus with one short and two long, very stout clawlike setae.

Seventh limb.- Elongate crusiform, five segments; basal podomere with four or five setae off anterior margin, one off posterior; second podomere long, one anterodistal seta; third podomere as second, shorter; fourth podomere with two anterodistal setae, both shorter than preceding setae; fifth (terminal) podomere with two anteriorly directed setae and one posterodorsally directed large cleaning seta, distal two-thirds of which is toothed on both edges.

Furca.- Each branch with two segments; first segment elongate, with a few very small setae in two spots along one edge; second segment a curved claw as long as preceding segment.

Copulatory appendage.- Paired, simple, triangular, acute end proximal, affording the entrance for vas deferens.

Sperm and ejaculatory system.- Sex system paired. Sperm very long, no complete one could be determined because they are so intertwined. No expanded "head" bearing a nucleus was seen. Testes not distinct. Vas deferens begins tightly coiled, enters an ampulla (probably for sperm storage although sperm seem too long for much storage capacity), continues through a muscular ejaculatory apparatus (Zenker's organ), and coils again upon emerging. It tapers prior to entering the penis and its exit is so narrow that only a few, possibly only one, sperm may exit at a time. Entire system was tightly packed with sperm.

Eye.- None present in genus.

Habitat.- Taken from 625 feet of water, salinity approximately 35 °/co, water temperature 23°C, 75 miles offshore near edge of Gulf Stream; one living specimen from Sapelo Sound.

Size and type.- Holctype UMMP no. 48780, male, length 1.56 mm, height 0.60 mm.

Remarks.- The genus Macrocypris differs from Macrocyprina Triebel (1960, p. 118) by the nature of the sperm ejaculatory system, Zenker's organ being thicker and the vas deferens looped about it in Macrocyprina, and a three rather than two segmented maxillary palp. Triebel also states that Macrocyprina has a rounded posterior rather than pointed, however the species herein, and others, seem to bridge that gap.

This species differs from M. minna (Baird, 1850a, p. 171) by the non-pointed posterior and the shape of the penes. The internal morphology of that species is figured by Sars (1923, pls. 26, 27). M. schmitti Tressler (1949, p. 341) differs in the setation of the seventh limb, has a shorter terminal segment on the sixth limb, and a somewhat more curved shell.

The shells of the following species are incompletely described and no internal morphology is considered, affinities are in doubt: M. decora (Brady, 1866, pl. 57, fig. 13a), the figure shows muscle scars that make generic assignment to Macrocypris, as Brady later did (1880, p. 44), questionable; M. maculata (Brady, 1866, p. 367) the anterior appears to have a much more narrow adhesive strip; M. orientalis Brady (1868, p. 61) appears to have a different hinge line shape; M. hieroglyphica Brady (1868, p. 62) appears to have a different hinge line shape; M.

canariensis Brady (1880), M. setigera Brady (1880), M. similis Brady (1880, p. 42), and M. tumida Brady (1880, p. 43) are too poorly described; M. tenuicauda Brady (1880, p. 41) appears to have a more drawn out posterior and the palp of the fifth limb is unsegmented as shown in pl. 3, fig. 2a; M. turbida Mueller (1908, p. 94) has a higher shell, different adductor muscle scars, one of the fifth limbs has a distal spine elongated, and the furcae have shorter terminal claws; M. inaequalis Mueller (1908, p. 95) has different adductor muscle scars, a narrower anterior adhesive strip, the fifth limbs have one, rather than two, blunt distal spines on the penultimate segment, and the furcae are unsymmetrical in length; M. tensa Mueller (1908, p. 96) has different adductor muscle scars and short terminal claws on the furcae; M. dispar Mueller (1908, p. 96) has different adductor muscle scars, and the terminal claws of the furcae do not appear to be well differentiated; M. africana Mueller (1908, p. 97) has different adductor muscle scars and short terminal claws on the furcae; M. succinea Mueller (1894, p. 242) has been placed in the genus Macrocyprina Triebel (1960) by virtue of the three segmented maxillary palp (maxillartaster) and the arrangement of the coils of the vas deferens.

Suborder MYODOCOPIDA

Superfamily CYPRIDINACEA Baird, 1850

Family Cypridinidae Baird, 1850

Genus Philomedes Liljeborg, 1853

Philomedes lilljeborgi (Sars) (emended herein)

Pl. 10, figs. 1-11

Bradycinetus lilljeborgi, Sars, 1866, p. 112.

Philomedes lilljeborgi, Skogsberg, 1920, p. 402, figs. 70-73 and synonymy therein; Poulsen, 1962, p. 346, fig. 151, and synonymy therein.

(?) Philomedes levis Mueller, 1894, p. 211, pl. 3, figs. 4,18,22,29-31.

Carapace.- Female: noncalcareous, subovate, tumid. Rostrum very pronounced, anteriorly and posteriorly pointed, ventrally concave, lined with broad setae, each terminated with approximately five smaller round setae ("selvage" of Skogsberg, 1920, pl. 70, figs. 1,2,4). Inner portion of rostrum with a prominent row of setae. Incisure rounded. Shell posteroventrally produced. Surface essentially smooth, checkered with pentagonal "cracks", very sparsely covered with either short broad setae similar to those of rostrum or long setae. Vestibule wide posteriorly and anteriorly, narrow along mid-portion.

Radial pore canals occasionally branching.

Adductor muscle scar pattern a circular group of over ten scars anteroventrally of mid-point.

See Skogsberg, 1920, for complete description of internal morphology.

Antennule.- Six, possibly seven, segments; basal podomere longest, no setae; second podomere nearly as long, articulated with basal, margins hirsute, three ventrodistal setae with secondary setae and one dorsodistal seta; third podomere very short, fused to second and fourth, two dorsodistal and one ventrodistal seta; fourth podomere with one dorsodistal and three ventrodistal setae, all bearing secondary setae (one very long extending beyond terminus); fifth podomere articulated with fourth, bearing a very long ventrodistal seta whose distal portion is divided into four or five secondary setae, this seta appears to origi-

nate from the terminal podomere unless closely observed; sixth (terminal) podomere very short, possibly two fused podomeres, distally bearing two short or medium and five long setae (two thinner and blunt, three distally split with secondary setae along length). All setae striated normal to length.

Antenna.- Protopod large, ovoid. Endopod reduced, apparently of two segments, basal podomere short bearing six setae; second podomere proximally bearing a long seta with subsetae, at about two-thirds way from proximus bearing two setae off a nodose area, and a long thin seta just short of terminus. Exopod of nine segments; basal podomere about as long as all succeeding, no setae; second through eighth podomeres each bearing a long pinnate natatory seta; ninth (terminal) podomere bearing four long natatory setae and three smaller setae. All but two natatory setae on each antenna broken.

Mandible.- Protopod with forked pinnate process at distal end, not heavily chitinous for mastication. Exopod reduced, dorsally directed, two segments; basal podomere terminated in two setae, one pinnate; second podomere obliquely off first, terminated in a very short spine. Endopod of four segments; basal podomere with six lateral setae on proximal portion, three large with several teeth along one margin, three dorsodistal pinnate setae, and seven or eight ventral pinnate setae; second podomere with about four ventrodistal setae (three long and pinnate); third podomere long, approximately five ventrodistal pinnate setae in two groups, approximately four dorsoproximal setae, and five long dorsal setae at about mid-point; fourth (terminal) podomere with two smooth curved claws and several shorter setae at terminus.

Maxilla.- Protopod with three endites; first with ten distal pinnate setae, second with about four distal pinnate setae; third terminated with about four pinnate setae, others laterally. Endopod with approximately 12 setae and three curved claws.

Fifth limb- Exopod with about four heavily chitinous teeth, one larger, several with secondary spines, many setae proximally. Epipod of approximately 50 broad, lightly chitinous very pinnate setae.

Sixth limb.- Crescent shaped, terminus of essentially four lobes, anterior three small, each with a lateral seta, anteriormost with three terminal pinnate setae, middle with seven, posterior with about eight; posterior lobe very broad, lined with about 22 broad heavily pinnate setae.

Seventh limb.- Typical of superfamily, vermiform, segmented. Terminus with opposing rows of short setae which have a short oblique branch short of terminus (Skogsberg, 1920, fig. 72, no. 14), four or five typical terminal setae with typical cone-in-cone distal portions, four to six more proximally.

Furca.- Ten claws distally increasing in length, larger with secondary spines along concave margin; margin hirsute.

Frontal organ.- Unsegmented, comparatively long, thin, straight, end rounded.

Eye.- Very reduced or absent in females.

Habitat.- Taken from 405 feet of water, salinity approximately 35 °/oo. September.

Size and types.- Hypotype UMMP no. 48781, female: length 1.74 mm, height 1.62 mm.

Remarks.- The checkered pattern of the shell has not been reported for this species, but has for P. rotunda Skogsberg (1920, p. 414, pl. 75, fig. 2) and P. interpuncta Baird (in Mueller, 1894, p. 210, pl. 3, figs. 2 & 38).

This species differs from its closest affinity P. interpuncta Baird (1850b), by the absence of a rostral beak, different setation of antennules and maxillae, and the absence of stout setae between the furcal claws. P. interpuncta was so incompletely described by Baird as to leave some question as to assignment. P. levis Mueller (1894), may not be a valid species, internally the differences do not appear to be of greater magnitude than individual variations in P. lilljeborgi reported by Skogsberg; the shell is somewhat different in the shape of the rostrum, but not moreso than in specimens of P. lilljeborgi reported by Sars (1922, p. 14-15, pl. 8).

The broken antennal natatory setae probably indicate the female is a mature specimen, even if somewhat shorter than others described, and had completed a planktonic phase of the sexual cycle (see Skogsberg, 1920, p. 348-368). Skogsberg's proposal that colder water might be causal in the loss of setae, rather than as a part of a sexual cycle, would be doubtful in the case of present occurrence.

Discussion.- What appear to be developing eggs were seen inside the animal. Remains of a diatom and a Globigerina type foraminifer were in the stomach. The adductor muscle scar pattern was obscured since the chitinous shell broke at the attachment point upon dissection.

Genus Pseudophilomedes Mueller, 1894

Pseudophilomedes ferulana Kornicker (emended herein)

Pl. 11, figs. 1-9; pl. 1, 12, figs. 1-8

Pseudophilomedes ferulana Kornicker, 1958, p. 235, figs. 46, 1a,b, 2a, b; 56, a-d.

Carapace.- Female: weakly or irregularly calcareous, ovoid, a blunt non-downcurved rostrum overhanging a slight incisure, four or five long setae on inner face. A blunt broad caudal process slightly ventral to mid-line. Greatest height central. Shell very tumid. Margins somewhat nodose, with long setae in several rows. Surface reticulate, a sulcus slightly anterior to mid-line extends dorsally from mid shell. Surface sparsely covered by inter-reticulate setae. About six nodes along the contact margin of both valves slightly dorsal to caudal process.

Radial pore canals appear straight. Adductor muscle scar pattern indistinct, anterior to sulcus.

Antennule.- Six segments; basal podomere longest, articulated distally, four or five very small spines on the ventral margin; second podomere with one dorsal sensory spine, a few very small spines on both margins; third podomere short, nearly fused to second, a dorsodistal sensory spine with a few secondary setae and a similar ventrodistal spine, both margins bearing a few very small spines; fourth podomere with one dorsodistal sensory spine bearing secondary setae, two similar ventrodistal sensory spines, both extending well beyond terminus, ventral margin bearing a few very small spines; fifth podomere distally

articulated, bearing a short dorsodistal spine; sixth (terminal) podomere with seven long and one medium spine, two of long spines smooth and flattened and more finely segmented than others which have sparse secondary spines and forked tips.

Antenna.- Protopod large, no setae. Endopod a verruciform process bearing two lateral spines and a distinctive long terminal spine with secondary setae distally. Exopod of nine segments; basal podomere nearly as long as succeeding ones, no setae; second through eighth podomeres each bearing a long heavily pinnate natatory seta proximally spinose on one margin; ninth (terminal) podomere bearing two long and one medium very pinnate setae, no marginal spines.

Mandible.- Basal podomere of protopod with a large distinctive forked masticatory process dorsally off distal end, each fork with three or four spines along margin; second podomere with two ventral setae, one proximal, one comparatively large heavily pinnate distal, and 3 large setae dorsally. Exopod reduced to two sparsely pinnate setae off a comparatively large basal ramus, and several small lateral spines. Endopod of three segments; basal podomere with two ventrodistal pinnate setae; second podomere long, narrow, apparently a fusion of two segments, three large dorsal setae, one proximally, two at mid-point, and several small marginal setae and spines; third (terminal) podomere with about six terminal spines, one longer, more clawlike with distal subsetae.

Terminal portion protrudes from shell just beneath rostrum.

Maxilla.- With three principal rami, the proximal with three heavy spines bearing subspines and a sensory pinnate seta, easily broken off, middle ramus with two heavy spines bearing subspines and three setae;

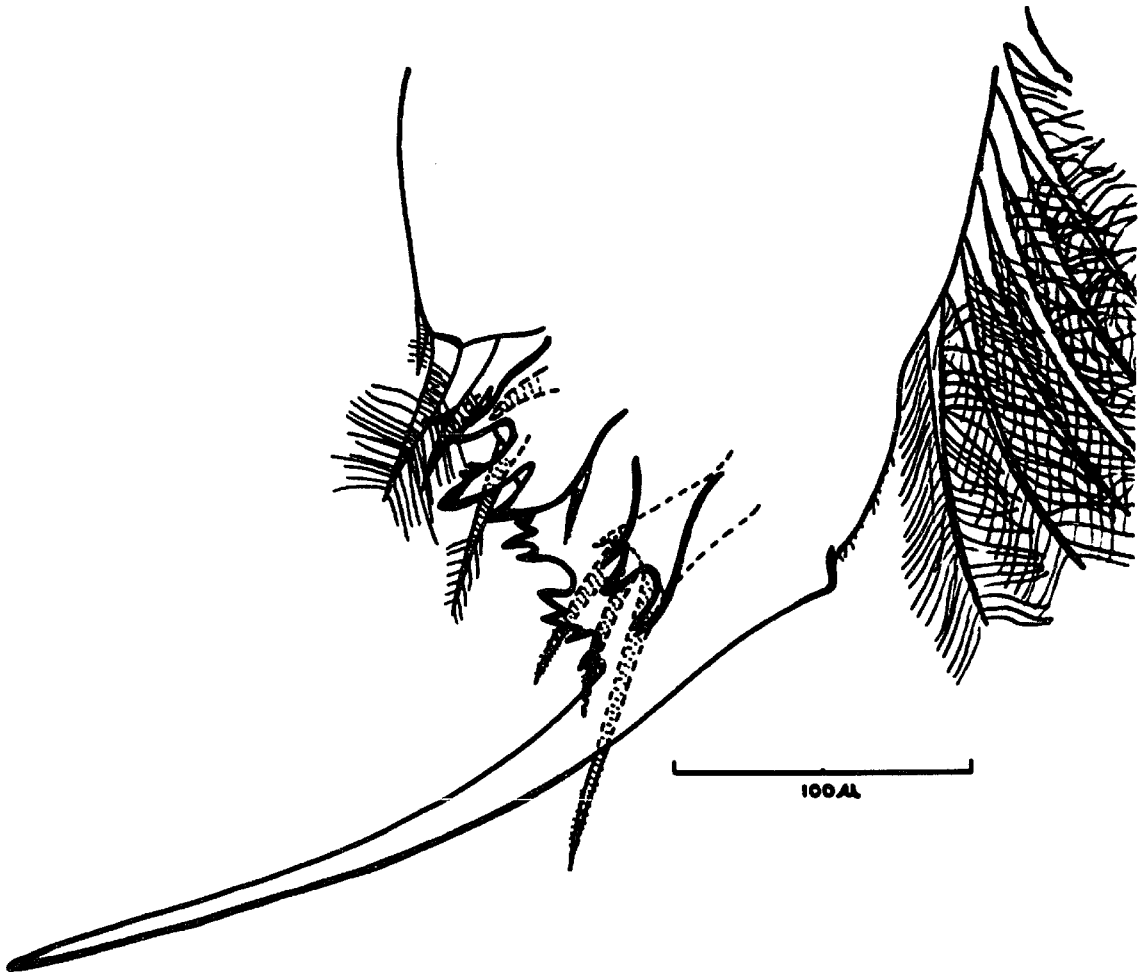
distal ramus with about seven pinnate basal setae of varying lengths, about four more distal pinnate setae and a large blunt distally segmented terminal process with sensory (?) granules on distal margin, curved forward. Dorsal margin of appendage hirsute.

Fifth limb.- Distinct for genus. Terminated in a long claw anteriorly directed; proximal margin of claw's base with three or four pronged elements, generally many spinose elements at base of claw (text-fig. 10). Epipod with about 45 long very pinnate setae.

Sixth limb.- Essentially four lobed, anterior small, bearing one or two pinnate setae; second with two smaller pinnate setae and two long pinnate setae; third lobe with three or four smaller and two larger pinnate setae; posterior lobe relatively wide bearing five to seven typically pinnate setae along the margin and two posteriorly directed extremely pinnate setae, latter not striated normal to length, also with very fine secondary setae covering entire rounded surface rather than being in two rows as on others. A small posterior seta on the margin of basal podomere.

Seventh limb.- Typical of superfamily, vermiform, segmented; six setae of various lengths on terminal segment, five or six more proximally, generally shorter. The terminus typical opposing rows of very small setae.

Furca.- Terminated in seven to ten claws followed by a short broad spine (more an outgrowth of border chitin than with a distinct attachment as have claws). Distal claw with a secondary claw sagittally off the mid portion, not easily observed laterally. All claws with distinct



TEXT-FIGURE 10

Drawing of fifth limb of Pseudophilomedes ferulana

secondary spines along exsagittal edge, larger proximally. Fourth claw broader and more blunt than others relative to length, this typical of genus. Number of claws not always equal on both sides.

Frontal organ.- Long, arising from a more-or-less bifid frontal ganglion; proximal half segmented; mid portion expanded; distal half smooth except for occasional small sensory hairs, tip sharply pointed and covered with sensory hairs.

Eye.- Paired; situated near base of antennule - antenna. Appear to have three or four large lenses separated around the central area of nerve tissue. Other globules attached to outside of anterior portion of ocular membrane, of unknown function. Tissue more granular than in large lenses.

Egg.- Not separate within posterior portion of shell, but encased within a transparent membrane, four to ten observed.

Habitat.- Taken from 141 to 429 feet of water, offshore, salinity approximately 35 °/oo.

Types.- Hypotypes UMMP nos. 48785, 1.404 mm long, 0.975 mm high; 48782, 1.404 mm long, 0.936 mm high; 48783, 1.52 mm long, 0.97 mm high; 48784; all females.

Remarks.- The specimen figured by Kornicker differs slightly in regards to the setae of the maxilla. The furca as drawn shows no secondary spines on the claws, nor the large secondary claw of the largest distal claw. This latter is difficult to see in lateral view. The furca has eight claws, and this is mentioned as a specific guide, however, in

the specimens from the Sapelo Island area the number of claws is variable. The principal likeness is the blunt sensory distal process of the maxilla. There is no detailed description of shell features or soft parts given.

Three species of this genus have previously been described: P. foveolata Mueller (1894); P. angulata Mueller (1894); P. inflata (Brady & Norman, 1896) (= Paramekodon inflatus Brady & Norman). Males have been described only for P. foveolata (Philomedes foveolata, Brady & Norman, 1896), they were taken by net tows rather than from bottom samples; the planktonic occurrence may be connected with the sexual cycle as is known in species of Asterope and Philomedes. The males do not have the large distal claw on the fifth limb, although the fourth claw on the furca is enlarged as in the case of the female. Some species of Philomedes e.g. P. interpuncta Baird, as well as species of Cypridina and Sarsiella also exhibit the enlargement of the fourth furcal claw.

The two flattened antennular setae and the forked terminus of the other antennular setae are not exclusive generic characters, occurring in Philomedes and Sarsiella. The large claw of the fifth limb of the female is the most distinguishing generic character; the unusual distal maxillary process of P. ferulana is probably, as Kornicker states, of subgeneric value.

Discussion.- There is a pair of very pinnate long setae extending downward to the shell's edge from the vicinity of the base of the fifth limb, I was unable to ascertain the point of articulation.

The eggs were cellular clusters and showed no recognizable development at the date of capture.

The muscle scar pattern was not distinct on the nearly non-calcareous specimens found; it appears to consist of three rows, the two posterior ones curved convexly toward the rear; the posterior row is of about five scars, the middle and anterior of about three. The lack of calcium carbonate in most of the shell prohibited mounting the specimens dry, and the removal of the body tends to tear the inner chitinous layer where the adductors attach. There is still enough calcium carbonate present to prevent mounting in CMC-S, an acid medium, so the whole mounts must be decalcified in 5 percent acetic acid.

Family RUTIDERMATIDAE Brady & Norman, 1896

The family is characterized by the presence of an articulating pincher (chela) on the mandible.

Genus Rutiderma Brady & Norman, 1896

Rutiderma dinochelata Kornicker (emended herein)

Pl. 13, figs. 1-9; pl. 14, figs. 1-7

Rutiderma dinochelata Kornicker, 1958, p. 236, figs. 46, 8a,b; 57, a-f; 58, a-d; 86, b,f,j.

Carapace.- Female: calcareous or noncalcareous, oval in lateral outline with a nodose margin. Posterior truncate with a caudal process. Rostrum downcurved, not overhanging incisure. Surface coarsely punctate, two prominent longitudinal ribs joined by a posterior vertical rib; faint radial ribs anteroventrally. Anterior and ventral margins with two sets of setae, one long emerging from thin radial pore canals, other a margin

of very thin setae, so close as to form a nearly solid chitinous border extending outward about one-half the length of the major setae.

Interior of caudal process with an unusual hirsute, setiferous flange. Flange with a set of radial pore canals. A "reverse vestibule" exists beneath the flange. No portion of the main body mass of the animal extends into this area.

Adductor muscles form an anteroventral circular group of about 12 well spaced ovoid scars.

Antennule.- Five segments; basal podomere largest, no setae; second podomere with a dorsomedian seta, a distolateral seta; third podomere with two dorsoproximal setae, one dorsodistal seta, a ventroproximal seta, and two ventrodistal setae (one medium, other long) extending nearly as far as setae off terminal podomere; fourth podomere with one long ventrodistal seta; fifth (terminal) podomere very short, with five long setae with occasional secondary setae, three or four short setae.

Antenna.- Protopod large, ovoid. Endopod reduced to three or four short setae on a node (verruca). Exopod of nine segments; basal podomere with no setae; second through fifth podomeres each with a non-pinnate long seta with faint dorsal dentition; sixth through eighth podomeres each with a long pinnate natatory seta, ninth (terminal) podomere with four heavily pinnate setae.

Mandible.- Protopod of two segments; basal shortest with a small forked process off distal end; second podomere with four proximal setae, one median seta, and three distal setae. Endopod (?) of two segments, the distal podomere equipped with a very heavily chitinized pair of articulated claws. Claws with dentition along inner margins, a large

spine in between claws, five or six short setae off distal podomere.

Maxilla.- Two principal endites, the proximal shortest, distally equipped with many spines, some with heavy subspines; second endite larger, of two segments; basal with two distal setae curving around terminus; second podomere short, distally equipped with about five short pinnate setae and two stout spines with sub-spines. Related in form to Sarsiella.

Fifth limb.- Distal portion of protopod equipped with about six heavily chitinized broad spines with broad multi-forked tips; a small lobe posterior to distal end of protopod (endopod ?) with about eight distal seta; a large "branchial" plate (exopod ?) with about 42 large pinnate setae.

Sixth limb.- Reduced. Platelike, lightly chitinized. Each plate of about four lobes, all with distal setae, the posterior lobe largest with about seven setae, the posterior setae becoming shorter and very hirsute.

Seventh limb.- Vermiform, segmented, bearing six terminal setae, four more proximally, all with typical cone-in-cone structure distally.

Furca.- Bearing four claws followed by two spines, hirsute proximally. Secondary spines on claws prominent, occurring in a series of alternating lengths.

Frontal organ.- Long, an expanded area at about mid-point.

Eye.- Only one seen. Four lenses, some bifid.

Habitat.- Taken from depths of 57 to 441 feet, offshore, salinities of 25 to 35 °/oo. June through September.

Types.- Hypotypes UMMP nos. 48786, 48787, 48788, 48789, 48790; all females.

Remarks.- Although these animals differ somewhat from the photographs, drawings and descriptions of Kornicker, I have placed them in his species. The specimens from the vicinity of Sapelo Island have a stronger caudal process, the margin is more nodose, and the inner dentition of the mandibular chelae differs, note the proximal tooth and the spines (pl. 13, fig. 9); this particular dentition of the chela is the same in all specimens captured and is the same for both the right and left.

Kornicker uses the furcal claws as a specific character, stating (1958, p. 236): "The caudal furca bears three strong claws which show distinct demarcation lines at their bases, followed by two weak claws." Yet his drawing (fig. 57a) shows four strong claws followed by two weak ones. All specimens from near Sapelo Island have four strong and two weak claws.

Any variances between the populations at Bimini and Sapelo Island appear to be subspecific.

Discussion.- All specimens taken were bearing four eggs, each approximately 200 microns in diameter.

The stomach contents showed the remains of annelids, diatoms, and nearly whole large copepods, attesting to the use to which the mandibular chelae are put.

Rutiderma mollita, n. sp.

Pl. 15, figs. 1, 2

Carapace.- Female: weakly or noncalcareous, nodose margins, reduced rostrum and caudal process; longitudinal ribs faint. Surface lightly punctate, radial pore canals very thick and prominent, many branching. Flange on interior of caudal process much reduced.

Internal morphology.- The same as for R. dinochelata Kornicker, herein, except furca which has three strong claws followed by three reduced spines.

Habitat.- Taken from 65 feet of water of about 30 °/oo salinity, offshore. August.

Size and types.- Holotype UMMP 48791, female, length 1.44 mm, height 1.02 mm; paratype UMMP 48792, female, length 1.45 mm, height 1.05 mm.

Remarks.- Differs from R. compressa Brady & Norman (1896) in the nodose margin, the configuration of the ribs, the dentition of the mandibular chelae, and the secondary spines of the furca.

The morphology of the appendages is strikingly similar to R. dinochelata, even down to the position of individual setae. The character of the dentition on the claw of the mandibular chelae is the same, as well as the number and position of setae on the seventh limb. Only the furca differs.

Discussion.- Both females were bearing four eggs each.

Genus Asteropteron Skogsberg, 1920

Asteropteron oculitristis, n. sp.

Pl. 15, figs. 3-7; pl. 16, figs. 1-8

Carapace.- Male: weakly and irregularly calcareous; elliptical in outline, greatest height nearly at mid-point. Large rostrum directed ventrally, overhanging incisure. Principal sculpture a ridge paralleling margin, anterodorsally narrow and low, posterodorsally and ventrally becoming wide, high, steep with heavy irregular nodes which may project over margin. Distinctly incurved around rostral region. Surface essentially smooth with slightly raised porous (?) areas of irregular size, generally larger posteriorly, the pores (?) appear as irregular squarish patterns within the raised areas.

Anterior and ventral margins lined with setae, other rows on inner face of rostrum, along posterior contact margin.

Vestibule present. Radial pore canals thin, straight. Adductor muscle pattern circular, about 15 closely spaced scars slightly antero-ventral to mid-point.

Antennule.- Six segments; basal podomere largest, no setae; second podomere articulated with basal, three or four setae along dorsal margin, distal two pinnate, margin hirsute; third podomere very short, fused at both ends, one ventrolateral seta, three comparatively large pinnate dorsal setae; fourth podomere with one dorsodistal pinnate seta, one ventrodistal pinnate seta, the latter projecting well beyond terminus of appendage; fifth podomere with one very long ventrodistal seta with striae ceasing at about mid-point, seta becoming smooth and forking, the forks also dividing; sixth (terminal) podomere with six long setae, two

thinner and blunt, four larger and segmented, with numerous subsetae and a short heavy blunt spine, slightly curved dorsally.

Antenna.- Protopod large, ovoid. Endopod of three segments; basal podomere with four or five proximal setae; second podomere elongate with two small laterodistal setae; third (terminal) podomere elongate, narrow, terminus bluntly rounded, a comparatively long thin seta off the proximal portion. Exopod of nine segments; basal podomere about as long as succeeding, one proximal seta; second through eighth podomeres each with a long heavily pinnate natatory seta, occasionally spinose along margin; ninth (terminal) podomere with two long natatory setae as preceding, one medium length pinnate seta, one short pinnate seta. All setae striated normal to length.

Mandible.- Protopod with nine distally pinnate ventral setae, four very short proximal setae not projecting beyond margin, four short dorsoproximal setae, three or four dorsodistal setae (one or two short, two long and pinnate). Exopod reduced, dorsally directed, two long setae off distal portion, tip pointed, hirsute. Endopod of three segments; basal with five ventral pinnate setae increasing in length proximally; second podomere with two or three ventrodistal setae and about 12 to 15 dorsal setae, generally increasing in length distally; third (terminal) podomere short, three or four short or medium setae and two long heavy nonpinnate setae. All setae striated normal to length.

Maxilla.- Protopod with six or more ventroproximal setae, two or three short setae ventrodistally, entire ventral margin lined with long distally flattened "baleen" bristles, two dorsoproximal setae, three

dorsodistal setae (two short, one long). Endopod (?) with two to three short dorsal setae, terminus with five long pinnate setae and one short nonpinnate seta.

Fifth limb.- Highly modified. Comb ventrally lined with distally pinnate setae; a large pinnate seta (exopod ?) pointing forward from the mid-lateral area of comb. Epipod curved, ventral margin lined with very pinnate setae, broader and longer than those of comb.

Sixth limb.- Highly modified, flat, axe-shaped; rounded anteriorly, two endites, one with thin pinnate setae and other with heavier pinnate setae continuing along curved margin toward posterior which is pointed and hirsute with no terminal setae.

Seventh limb.- Vermiform, segmented, with about 20 typical setae, with distal cone-in-cone structure.

Furca.- Three principal claws increasing in size distally, all with spines of cyclical size along concave margin, hirsute on convex; followed by four pinnate setae decreasing in size proximally.

Gills.- Seven pairs.

Frontal organ.- Gently tapering distally to a rounded, slightly expanded tip. Central ganglion essentially bi-lobed.

Eye.- Paired, stalked, very strongly pigmented central area. Multi-faceted, marginal lenses of variable size, the larger being directed ventrally toward substrate.

Habitat.- Taken from 59 feet of water, offshore, of salinity of

about 25 °/oo. August.

Size and types.- Holotype UMMP 48793, male, length 1.74 mm, height 1.08 mm, width 1.02 mm; paratype UMMP 48794, male, dimensions as holotype.

Remarks.- Both sexes were described for A. fuscum (Mueller, 1890a) and A. agassizii (F. Mueller, 1870); in both, the antennal endopod of the male differs from that of the female, and strongly resembles that of the species herein. Only the female of A. monambon Kornicker is known. For the first two species there is no mention of sexual dimorphism in the shell, hence the species herein stands little chance of being the male of A. monambon, since it is readily distinguished from that and the other two species by the sculpture of the shell.

The unusual, but very functional, distribution of marginal lenses of the eyes has been noticed for A. agassizii (F. Mueller, 1870, pl. 9, figs. 15,16,20) in both sexes. Only the downward pointing larger lenses are drawn in these figures by Mueller. No eyes were found in A. fuscum; eyes are present, but not described in the case of A. monambon.

Genus Cyclasterope Brady, 1897

Cyclasterope biminiensis (Kornicker) (emended herein)

Pl. 17, figs. 1-8; pl. 18, figs. 1-7; pl. 19, figs. 1,2

Cycloberis (misprint for Cycloleberis) biminiensis, Kornicker, 1958, p. 243, figs. 67a-d; 68a-f; 85a-e.

(?) Cyclasterope brevis (Mueller), Brady, 1902, p. 183, pl. 24, figs. 16-22, non Asterope brevis Mueller, 1890a, p. 239, pl. 25, fig. 10; pl.

26, fig. 7; pl. 27, figs. 7-10, 15, 16.

Carapace.- Male: slightly and irregularly calcareous; smooth, translucent, subcircular, rostrum downcurved over incisure. Margin of shell lined on inner edge with relatively widely spaced setae; two inner marginal rows, one approximately along edge of inner lamella, other in between in anterior portion - dorsally more or less merging with outer row. Probable line of concrescence close to outer margin posteriorly; radial pore canals straight, unbranched, profuse. Adductor muscle scar pattern of many (30-40) elongate scars arranged in a near-spiral pattern, typical of genus.

Antennule.- Six segments; basal podomere largest, comparatively wide, no setae; second podomere articulated with basal, no setae, slightly hirsute on borders; third podomere short with five or six dorsal setae, one very small ventrodistal seta; fourth podomere short, one dorsodistal seta and a long thin ventrodistal seta extending beyond end of appendage; fifth podomere longer, with three to five prominent dorsal nodes and a ventrodistal heavy distally branching seta; sixth (terminal) podomere very short, with a dorsodistal heavy curved claw, generally seven additional distal setae, some of which branch distally or along their margin into relatively large secondary setae which in turn terminate in smaller short setae.

Antenna.- Large protopod. Endopod reduced, three segments, generally three setae near base; second podomere with none or one seta; third (terminal) podomere bluntly rounded with a short curved seta at tip, a long smooth seta originating about half way back on segment (exception in largest specimen, four setae on basal podomere, no short

terminal seta, long seta off tip; possibly a secondary sexual character, see remarks). Exopod of nine segments; basal podomere approximately the length of the succeeding eight, overlapping the second with a lateral toothlike process; second through eighth podomeres each with a marginal slightly curved blunt toothlike spine distally directed, the ninth occasionally with two. Second podomere with a segmented pinnate curved seta; third through eighth each with long segmented grossly pinnate natatory setae proximally bearing marginal spines; ninth (terminal) podomere usually with four pinnate setae, in adult two are long and toothed as in third through eighth podomeres.

Dimorphism.- See remarks.

Mandible.- Protopod with "scythe-shaped" process proximally directed off basal podomere (Skogsberg, 1920, p. 452); second podomere with a proximally directed process set with setae, some of which are distally pinnate, ventral margin with six to eight distally pinnate setae. Exopod reduced, non-muscular, dorsally directed, with two major distal setae. Endopod of three segments; first podomere with about five posterior setae; second podomere with about ten anterior setae and three posterodistal setae; third (terminal) podomere with two small setae, one long thin seta, and three long heavy setae-spines.

Maxilla.- Two endites on protopod with approximately five setae each. Exopod (?) dorsal, non-muscular, reduced, non-segmented; basal endite elongated generally bearing over 100 flattened, pinnate, long bristles ("baleen") distally along ventral margin, some secondary bristles ventrally and dorsally. Endopod with about five lightly pinnate distal setae.

Fifth limb.- Highly modified, comb ventrally lined with marginal pinnate setae, a large pinnate seta (exopod ?) pointing forward from mid area of comb; epipod curved, margin lined with thick very pinnate setae.

Sixth limb.- Highly modified, flat, axe-shaped, rounded anteriorly, pointed posteriorly; ventral margin rowed with short thick pinnate setae.

Seventh limb.- Vermiform, dorsally directed, segmented, distally equipped with varying numbers of setae, generally increasing in number with size of animal, distally with cone-in-cone structure; terminus surrounded by opposing rows of short blunt setae.

Furca.- Carried tucked up under body; four main pairs of curved claws with one or more rows of teeth along concave borders; a pinnate seta usually between third and fourth claw; fourth claw followed by three to six pinnate setae, depending on size of animal; margins of furcae hirsute.

Frontal organ.- Long, thin, probably unsegmented, non-muscular; base the so-called median eye (here no pigment seen).

Gills.- Seven pairs, posterodorsal.

Eye.- Stalked, oval, multifaceted, outer facets unpigmented. Covered with thin membrane.

Habitat.- Taken from 53 to 121 feet of water, offshore, salinity about 35 °/oo. May and August.

Size and types.- Length of six specimens 1.59 - 3.20 mm; hypotypes

UMMP nos. 48795, 48796, 48797, 48798, 48799, and 48800.

Remarks.- Mueller (1890a, p. 240) in a discussion of Cyclasterope (Asterope) brevis states that the differences of the endopod of the antennae are secondary sexual characteristics. He believed those with a distal short seta, or none, and a long seta emerging further back on the terminal podomere indicate the male, and that the long seta originating at the tip indicates a female. He was, however, unable to describe or figure the sex organs "(Ich zweifle nicht daran, dass es sich hier um secondäre Geschlechtsmerkmale handelt, obwohl ich mir über die Beschaffenheit der Geschlechtsorgane wegen mangelfafter Conservirung kein Urteil bilden konnte.)" C. brevis (Mueller) and C. biminiensis (Kornicker) are very similar, and the form of the antennal endopod indicates this is the male. This relationship appears to be the same in other genera of the family, Asteropteron and Cylindroleberis. In the case of the species of Cylindroleberis described on the following pages, the vaginae could be seen on the specimen with the typical female antennal endopod.

Brady (1902, p. 183) describes ostracods from the West Indies, referring them to Cyclasterope brevis. He erred in stating that Mueller erected the species from a female specimen from off the South American coast. Brady undoubtedly got this idea from the stated source of C. americana, on the same page. Mueller had 16 specimens of C. brevis from off Enosima, Japan, which he divided, as just discussed, into male and female. Further complicating this is the fact that C. americana has five nodes on the fifth podomere of the antennule - as does the species Brady considered conspecific with C. brevis. C. americana has three furcal claws and Brady states the West Indies' specimens have four, there-

fore it is probable that he misread the source of Mueller's material, rather than the species name, and had no intention of assigning material to C. americana.

Mueller stated that C. brevis, from off Japan, has one node on the fifth podomere of the antennule; he does not figure this but says: "Erste Antenne mit einem stumpfen Zahn an dem fünften Glied (vergl. Fig. 9, Taf. xxvi, von A. dentata, wo 5 derartige Zähne vorhanden)." Mentally concerned with teeth, he called the figured antennule of C. (Asterope) americana "A. dentata," since this is the referred to figure; no such species as A. dentata exists.

C. biminiensis differs from C. brevis in the presence of three to five nodes on the margin of the fifth podomere of the antennule, the presence of distal clawlike setae on the mandible, and probably in other ways since Mueller's description of the maxilla is incomplete, and the first and second thoracic legs are not mentioned. The setae arrangement on the seventh limb is too variable with growth to be a specific feature between these two species.

Discussion.- All specimens but the largest have an irregularly calcareous shell. They are, without exception, partially covered with calcareous spots. Mueller, 1890a, p. 239, also mentions this on the Japan specimens: " ..., besteht aus derbem Chitin mit geringer Kalkablagerung."

Genus Cylindroleberis Brady, 1868b

Cylindroleberis psitticina, n. sp.

Pl. 19, figs. 5, 6; pl. 20, figs. 1-9

Carapace.- Oblong, rostrum curved downward overhanging narrow, comparatively deep, incisure. Surface smooth, no ornamentation. Short setae line interior of rostrum and inner side of anterior and ventral margins. Inner lamella wide anteriorly and posteriorly. Adductor muscle scar pattern apparently about ten round scars in circular area slightly anteroventrally of mid-point.

Dimorphism. The female is longer in relation to height.

Antennule.- Female: six segments, basal podomere with no setae; second podomere with a long dorsodistal pinnate seta, a very short ventrodistal seta, a short laterodistal seta; third podomere with seven dorsal pinnate setae, two shorter ventrodistal setae; fourth podomere with a large ventrodistal seta distally divided into about six bare sensory setae; fifth podomere with one laterodistal seta; sixth (terminal) podomere with a chitinous claw curved upward, five long setae, four with heavy subsetae.

Dimorphism. Male with six rather than seven dorsal pinnate setae on third podomere.

Antenna.- Female: protopod large, ovoid. Endopod of three weakly developed segments; a long seta off tip. Exopod of nine segments; basal podomere nearly as long as succeeding eight, no setae; second podomere with a comparatively short pinnate seta; third through eighth podomeres each with a long pinnate natatory seta, occasionally slightly spinose

along proximal margin; ninth (terminal) podomere with one natatory seta, two shorter setae. Inner distal margin (margin opposite natatory setae) of each podomere with a very small spine.

Dimorphism. Male antenna heavier; third podomere of endopod with pointed tip, a long seta proximally off inner margin; ninth podomere (terminal) of exopod with four setae, two natatory, rather than three setae, one natatory, as in female.

Mandible.- Female: protopodite large, about seven ventral pinnate setae directed proximally, two long dorsodistal setae. Exopod reduced, tip hirsute with one small forked seta. Endopod of three segments; basal podomere with three long pinnate ventroproximal setae; second podomere with six long and three short dorsal setae, one long and two medium ventrodistal setae; third (terminal) podomere with a nearly straight chitinous claw, one or two stout setae, two shorter, thinner setae.

Dimorphism. Male mandible heavier, but essentially non-dimorphic. This individual has one more distal stout seta on terminus of endopod.

Maxilla.- Female: protopod with approximately six ventroproximal larger setae, one ventrodistal seta, two dorsoproximal seta and one dorsodistal seta, entire ventral margin lined with long distally flattened "baleen" bristles. Endopod (?) with one long proximal seta, terminus with two setae. Exopod (?) dorsal, reduced, unsegmented, pointed.

Dimorphism. Male with only one terminal seta on endopod (?).

Fifth limb.- Highly modified, comb ventrally lined with distally pinnate setae, a long forward directed lateral seta at mid-point (exopod ?).

Epipod curved, margin lined with many (45-50) long very pinnate setae.

No dimorphism observed.

Sixth limb.- Female: highly modified, axe shaped, flat, rounded anteriorly, tipped with approximately six short setae, one lateral and one dorsal setae proximally; ventral margin lined on posterior half with short pinnate setae; posterior not seen.

Dimorphism. Male's not seen.

Seventh limb.- Female: vermiform, segmented, six setae on distal segments, six others proximally, all distally with cone-in-cone structure. Terminus with opposing rows of short blunt setae.

Dimorphism. Male with setae as in female, terminus appears "closed" rather than two opposing rows of short setae.

Furca.- Female. Six pairs of claws decreasing in size proximally, the larger with secondary spines along concave margin; a short seta follows claws. Claws easily broken out of sockets.

Dimorphism. Distal three claws of male more distinct in size from following, which are more spinelike.

Frontal organ.- Comparatively long and straight, simple, terminus rounded; a slight constriction proximal to mid-point. Male's possibly slightly shorter and thicker.

Gills.- Seven pairs (cf. Cyclasterope biminiensis, pl. 19, fig. 3).

Eye.- Female: absent or very reduced.

Dimorphism. Very prominent in male. About 20 separate lenses, some bifid, the larger marginal ones directed downward toward substrate. Stalked.

Habitat.- Taken from 45 to 405 feet of water, offshore, salinity about 25 to 35 °/oo. September.

Size and types.- Holotype UMMP no. 48801, female, length 1.80 mm, height 0.57 mm; Paratype UMMP no. 48802, male, length 1.29 mm, height 0.59 mm.

Remarks.- The species may be differentiated from others whose shell shape is similar by the following: C. setisparsa (Kornicker, 1958, p. 239) possesses two short spines on the mid portion of the male antennal endopod (fig. 63b), the anterior of the seventh limb bears long setae, and the ventral margin has only one seta; only three long dorsal setae are on the second endopodal segment of the mandible. Although Kornicker states that the male of this species is unknown, he figures a male antennal endopod. Other figures of this same specimen are of the mandible, seventh limb, antennule, and an outline drawing of the shell. This latter figure shows the eyes. Since the absence of eyes in the female of this genus is so evident due to their prominence in the male, it is unlikely Kornicker would miss this dimorphism were it present. The female of C. oblonga as figured by Mueller (1894, pl. 8, fig. 4) (= C. mariae [Baird] 1850b, p. 257) also shows eyes. It is therefore probable that not all species of the genus exhibit this ocular sexual dimorphism.

The species herein differs from C. oblonga in the lack of eyes in the female, in the lack of two extremely long terminal setae on the antennule of the male, and the non-grasping form of the male antennal endopod.

C. elliptica (Philippi, 1840, p. 186) has a less elongate shell and

different setation on the antennule.

C. grimaldi (Skogsberg, 1920, p. 510) has posterior setae on the shell of the male, and an antennal exopod with basal spines on the distal podomeres.

Discussion.- The female carried nine eggs within the shell.

Family Sarsiellidae Brady & Norman, 1896

Genus Sarsiella Norman, 1869

Characteristics of genus.- Carapace noncalcareous to strongly calcareous, heavily ornamented to nearly smooth; circular or subcircular in outline, with pronounced caudal process, rostrum generally present in males, generally absent in females (pl. 22, fig. 1, 2; pl. 25, fig. 3).

Antennule generally of five podomeres, possibly four in some species (pl. 21, fig. 2); male with sensory hairs off third podomere (pl. 25, fig. 4).

Antenna with large protopod, heavily muscled for use in locomotion. Endopod in female reduced to a small verruca (node) with or without spines, in male less reduced, may be altered for grasping. Exopod of nine podomeres, distal eight with pinnate natatory setae (pl. 31, figs. 3, 4; pl. 25, fig. 7).

Mandible distinctive; basal podomere of protopod with a heavy internal chitinous support rod; last three podomeres (endopod ?) each usually with a distinctive curved claw off distal portion (pl. 24, fig. 4).

Maxilla distinctive; terminal podomere of endopod with five stout

spines, usually with secondary spines, these are articulated to move as a unit sagittally, functioning as a feeding "hand"; penultimate podomere with two long setae curving around terminus (pl. 24, fig. 5; pl. 23, fig. 4).

Fifth and sixth limbs distinctive (pl. 31, figs. 5,7).

Seventh limb vermiform in female, absent or reduced in male (pl. 30, fig. 5).

Frontal organ simple, blunt, club-shaped (pl. 21, fig. 1).

Eye paired, generally with five separated usually bifid lenses; male possibly dimorphic, up to ten lenses (pl. 21, fig. 1).

Habitat benthonic-nektonic, littoral.

Sarsiella nodimarginis, n. sp.

Pl. 21, figs. 1-8; pl. 22, figs. 1, 2

Carapace.- Female: calcareous. Circular with a prominent caudal process and a very nodose margin. An alar extension begins slightly anterior to mid-line, the anterior portion is rounded and enlarged, affording the base for adductor muscles. Ala widens posteriorly and is nodose on its margin; posterior portion abruptly truncated. Surface smooth, free margin lined with setae. Inner lamella narrow, radial pore canals thickened, apparently simple.

Antennule.- Five segments; basal podomere with no setae; second podomere with one dorsal seta; third podomere with one dorsoproximal seta, one ventroproximal seta, one dorsodistal seta, and three ventrodistal setae; fourth podomere with one short distal seta; fifth (terminal) podomere with six long setae, one medium seta and one short seta,

all nonpinnate, long setae tipped with a very small spine. All setae striated normal to length.

Antenna.- Protopod large, ovoid. Endopod a verruca with two lateral setae and a very small central seta. Exopod of nine segments; basal podomere long, no setae; second through eighth podomeres each with a long very pinnate natatory seta, some becoming proximally spinose along one margin; ninth (terminal) podomere with one long natatory seta as preceding plus a second shorter nonpinnate seta.

Mandible.- Typical of genus. Protopod with two segments; basal podomere elongate with a strong chitinous support rod; second podomere short, rounded, with four setae on inner margin, one seta on median outer margin, two distal setae on outer margin; last three podomeres (endopod ?) each with a long claw and two very small proximal setae on outer margin.

Maxilla.- Typical of genus. Terminus of endopod bearing five short blunt spines bearing secondary spines; three short setae more proximally on posterior portion; penultimate podomere with two long marginal setae curved around terminus. Coxa, pre-coxa essentially bilobate, larger lobe with about 10 spines, smaller with about six.

Fifth limb.- Typical of genus. Essentially asymmetrically bilobed, larger lobe with about eight setae, smaller with two; epipod with about 35 long thick very pinnate "branchial" setae.

Sixth limb.- Typical of genus. Terminal lobe with 15 to 26 faintly pinnate setae; posteriorly two long wide very pinnate setae.

Seventh limb.- Vermiform, segmented; terminus opposing rows of very

short setae; terminal segment bearing six setae of varying lengths, four more setae 11 to 15 segments proximally - all with distal cone-in-cone structure.

Furca.- Five, occasionally four, major claws, larger with secondary spines along concave margin, claws followed by three or four minor spines. Gradation from major to minor claws is fairly constant, upon further growth animal might have more major ones.

Frontal organ.- Simple, comparatively short, club-shaped.

Eye.- Paired, medially situated, each with five bifid lenses; whole covered by a membrane.

Habitat.- Taken from 99 to 373 feet of water, offshore, of salinities from 25 to 35 °/oo. August, September.

Size and types.- Holotype UMMP 48803, female, length 1.68 mm, height 1.44 mm; paratype UMMP 48804, female.

Remarks.- The species is readily distinguished by its shell characteristics.

Discussion.- The specimens each bore ten eggs of about 230 microns.

Sarsiella sculpta Brady (emended herein)

Pl. 22, figs. 3-8; Pl. 23, fig. 1

Sarsiella sculpta Brady, 1890, p. 516, pl. 1, figs. 17,18 non 19,20;
Kornicker, 1958, p. 252, figs. 47 - 6a,b, 82d,e, 88d,k,e,o,s; (?)
Brady, 1897, p. 93, pl. 17, figs. 12, 13.

Carapace.- Female: weakly and irregularly calcareous; subcircular, a broad caudal process posteroventrally. Contact margin slightly crenulate, occasionally with small secondary crenulations. Anterior and ventral margins with long setae which disappear posteriorly, except on caudal process. Highest point posterior of mid-line, wider posteriorly, abruptly sloped dorsally - posterodorsally. A distinct depression beginning anterior of mid-point, elongated toward caudal process. Surface coarsely and irregularly reticulate. Adductor muscle scar pattern slightly anterior to mid-line, consisting of about 12 circular or elongate scars which may be divided, spacing irregular. Radial pore canals straight.

Antennule.- Typical of genus. Five segments; basal podomere largest, distally articulated, no setae; second podomere with one dorsal seta; third podomere with one dorsoproximal seta, one dorsodistal seta, one ventroproximal seta, and three ventrodistal setae (two longest extending past terminal podomere); fourth podomere with one short distal seta; fifth (terminal)podomere very short, one short and six long setae. All setae striated normal to length.

Antenna.- Protopod large, ovoid. Endopod verruciform, one seta near base, directed toward base of exopod. Exopod of nine segments; basal podomere nearly as long as succeeding podomeres, no setae; second through eighth podomeres each with a long pinnate natatory seta, occasionally marginally spinose proximally; ninth (terminal) podomere with one long natatory seta as preceding and one short very finely pinnate seta. All setae striated normal to length.

Mandible.- Typical of genus. Protopod with two segments, basal

large with heavy chitin support rod; second podomere with three or four spines on inner margin, one on outer; last three segments (endopod ?) each with a strong curved claw and a small distal spine on outer side.

Maxilla.- Typical of genus. Terminus of endopod with five short blunt very stout spines, each with two rows of secondary spines; two short setae proximally on posterior half of podomere; penultimate podomere with two long marginal slightly pinnate setae curving around terminus. Coxa, pre-coxa rounded, bearing about 15 spines, some with secondary spines.

Fifth limb.- Typical of genus. Terminal segment with three lobes, anterior bearing two spines distally; middle bearing three distal and one posterolateral spine; posterior division bearing two distal and one very short proximal spine. Epipod with about 35 long very pinnate "branchial" setae.

Sixth limb.- Typical of genus. Short, rounded, terminus bearing about 12 spines ventrally directed; two long pinnate posterior setae.

Seventh limb.- Vermiform, segmented, with six terminal setae of variable length, four more proximally, all with distal cone-in-cone structure. Terminus with opposing rows of very short setae.

Furca.- Five major claws with secondary spines along concave margin, a small spine at posterior base of fourth and fifth claws; the two plates of the furcae somewhat more separated than usual.

Frontal organ.- Simple, club-shaped, the basal ganglion comparatively large.

Eye.- Paired, each with about five separated bifid lenses; whole covered by a membrane.

Habitat.- Taken from 121 feet of water, offshore, of salinity of about 34 °/oo. July.

Size and types.- Holotype UMMP 48805, female, length 1.20 mm, height 0.96 mm.

Remarks.- The shell is less calcareous than other specimens reported by Brady and by Kornicker. It also has a less prominent caudal process, possibly due to the lack of $CaCO_3$. Since only one specimen was found, and it is very like descriptions of S. sculpta, I have tentatively placed the specimen found off Sapelo Island in that species.

The original description by Brady (1890) was only of the shell, and what appear to be two species were figured; I consider the first two drawings only as of S. sculpta. The original was taken in water of two to four fathoms in the South Seas (Noumea, etc.). Subsequently (1897) Brady figured a seventh limb and furca of a specimen from Flinder's Passage (off northeastern Australia ?), but did not figure the shell; hence there is no way of knowing which of the two sets of figures of the original description, 17-18 or 19-20, this specimen resembled. Kornicker figures these same two parts from a specimen from the Bahama Islands. The specimen from off Sapelo Island has less setae on the seventh limb than that of Kornicker, and the furca does not have proximal short spines following the major claws as do the specimens of both other authors.

Discussion.- Six eggs were found inside the specimen. Some were

very near to hatching, but still within a membrane. No calcium carbonate was formed (the adult was only weakly calcified). The marginal setae of the shell and, remarkably, nearly all the appendages were well-developed. Only the sixth and seventh limbs were not seen, either because they had not been formed, or, in the case of the seventh limb, because they were males. The appendages did not stain well, since there was little muscle development; I noted that the antenna had all of its segments and setae. This is important in the identification of young instars, since in most species of the genus the young have antennae similar to those of the adult. The antennules have six long setae extending beyond the terminus, as does the adult, but they appear to originate within more proximal segments. Segmentation is difficult to ascertain in the antennules, but all appear to be there, although not in the precise form of tha adult. The epipod of the fifth limb was noticed on several unborn specimens.

The chitinous outer lining of the vaginae were unusual in that the left one was only 42 microns in diameter while the right was 68 microns.

Sarsiella pilipollicis, n. sp.

Pl. 23, figs. 2-9

Carapace.- Female: slightly and irregularly calcareous. Elliptical outline, a very prominent posteroventral caudal process, ventrally directed. Shell prominently nodose. Nodes form three prominent lateral rows, dorsal row with additional nodes posteriorly, margin nodose. Nodes bear many sensory setae, generally one more prominent. Surface reticulate, small sensory hairs border reticules. Anterior and ventral

margins with long setae, entire margin and submargin with short setae. Radial pore canals straight, thin, profuse. Adductor muscles attach anteroventrally of central area, seven to ten scars, some bifid, no distinct pattern.

Antennule.- Five segments; basal podomere longest, no setae; second podomere articulated with basal, one dorsodistal seta; third podomere fused to second, one dorsodistal seta, one dorsoproximal seta, one ventroproximal seta, and two ventrodistal setae extending beyond terminus of appendage; fourth podomere articulated with third, three or four short distal setae; fifth (terminal) podomere with six long terminal seta, four pointed, rarely with secondary setae, and two blunt. All setae striated normal to length.

Antenna.- Protopod large, ovoid. Endopod a verruca bearing two lateral spines directed toward base of exopod. Exopod of nine segments; basal podomere about as long as succeeding, no setae; second through eighth podomeres each bearing a long pinnate natatory seta; ninth (terminal) podomere with one long natatory seta as preceding and one short nonpinnate seta.

Mandible.- Typical of genus. Basal segment of protopod large, elongate, with a heavy chitinous support rod; second podomere with about four short spines on inner margin. Last three podomeres (endopod ?) each with a large curved terminal claw and a very short spine on the outer distal edge of each podomere.

Maxilla.- Typical of genus. Terminus of endopod with five stout spines, each with heavy secondary spines, the anterior one curved dis-

tally toward posterior, more pointed; two short spines more proximally on posterior inner portion; penultimate podomere with two long marginal spines curving around terminus; coxa, pre-coxa bilobate with about 12 spines.

Fifth limb.- Typical of genus. Terminus rounded, asymmetrically bilobed, larger lobe with approximately nine setae, smaller, anterior, lobe with two setae; a short seta more proximally off anterior portion; epipod with about 33 long very pinnate broad "branchial" setae.

Sixth limb.- Typical of genus. Terminus broadly rounded, very asymmetrically bilobed, smaller anterior lobe bearing three short setae, larger bearing about 12 finely pinnate setae ventrally directed; posteriorly with two broad, less chitinous, very pinnate setae.

Seventh limb.- Vermiform, segmented, terminus with opposing rows of very small setae; six terminal setae, some very reduced, two other setae about ten segments proximally, all with distal cone-in-cone structure.

Furca.- Five major claws, distal one very large, distal three with secondary spines along concave margin; followed by three or four small marginal spines.

Frontal organ.- Short, club-shaped, off an essentially bilobed ganglion.

Eye.- Not observed.

Habitat.- Taken from 373 feet of water, offshore, of salinity of about 35 °/oo. September.

Size and types.- Holotype UMMP 48806, female, length 1.37 mm, height 1.17 mm.

Remarks.- The species is easily distinguished from others of the genus by the setiferous nodes on the shell.

Discussion.- The specimen bore ten eggs. It had portions of several copepods in its stomach, one about one-third the body size of the ostracod, and relatively complete!

Sarsiella radiicosta, n. sp.

Pl. 24, figs. 1-11; pl. 25, fig. 1

Carapace.- Female: calcareous, subcircular, a blunt caudal process posteroventrally; caudal process with interior vestibule. Anterior and ventral margins very slightly crenulated. Two principal positive areas, one slightly ventral of mid-point, other posterodorsal of mid-point. Anteroventral region marked by faint radial ribs originating from a more ventral positive area. Entire surface slightly punctate. Setae approximately 30 microns long along anterior and ventral margins.

Radial pore canals not evident.

Adductor muscle pattern a group of about 12 circular comparatively widely spaced scars.

Antennule.- Five (?) segments; setation variable with age; basal podomere largest, no setae; second podomere with a dorsomedian seta; third podomere with one long and one short ventrodistal setae, one short ventroproximal seta, one dorsodistal seta, and one dorsoproximal seta; fourth podomere with two short distal setae; fifth (?) (terminal) podo-

mere very short, indistinctly separated, possibly not a real podomere, seven terminal setae, two medium, five large and nonpinnate. All setae striated normal to length.

Antenna.- Protopod large, ovoid. Endopod verruciform, no setae observed. Exopod with nine segments; basal nearly as long as succeeding podomeres, no setae; second through eighth podomeres each with a long very pinnate natatory seta, subsetae becoming spinose along proximal margin. Ninth (terminal) podomere with two setae, one as preceding, other short and apparently nonpinnate.

Mandible.- Typical of genus. Basal podomere elongate, large, with a heavy chitinous support; second podomere short with a small dorsodistal seta, a small ventrodistal seta. Last three podomeres (endopod ?) each with a long terminal claw, distal longest, each with a short distal seta off outer margin.

Maxilla.- Typical of genus. Terminus of endopod with five stout claws, each with heavy secondary spines, the anterior one curved distally toward posterior, and two short spines more proximally on posterior inner margin; penultimate podomere with two long marginal setae curving around terminus; coxa, pre-coxa essentially bilobate with about 15 spines.

Fifth limb.- Typical of genus. Terminus rounded with about five spines distally; epipod with over 30 large very pinnate "branchial" setae.

Sixth limb.- Typical of genus. Terminus broadly rounded, asymmetrically bilobed, larger lobe bearing about ten ventrally directed setae,

smaller lobe with about four short setae; posteriorly with two broad, less chitinous very pinnate setae.

Seventh limb.- Vermiform, segmented, generally four setae near terminus, four others eight to twelve segments proximally, all somewhat blunt and stout, with typical cone-in-cone distal structure. Terminus with opposing rows of very short setae.

Furca.- Five curved principal claws, larger with irregularly sized secondary spines along concave margin; none to two very small spines proximally follow claws.

Eye.- Paired, not generally visible through shell, appear red under reflected light, six separated lenses.

Habitat.- Taken from 81 feet of water, offshore, of a salinity of about 25 °/oo. April, May.

Size and types.- Holotype UMMP 48807, female, length 0.975 mm, height 0.775 mm; paratypes UMMP nos. 48808, female; 48809, female.

Frontal organ.- Comparatively thick, medium length, simple, rounded terminus.

Remarks.- The most diagnostic features of this species are the shape of the shell, the length and position of the anteroventral ribs, and the lack of setae on the antennal endopod. The species is closely allied to both S. capsula Norman (1869) and S. costata Kornicker (1958), but does not have the long dorsal ridge of either; when viewed dorsally the species herein shows two positive areas, not a lateral ridge.

Sarsiella georgiana, n. sp.

Pl. 25, figs. 2-9

Carapace.- Male: chitinous, ovoid, a blunt rostrum and large caudal process. Ventral margin nodose, anteriormost node largest. Ventral margin and inner margin of inner lamella lined with large setae. Three posterior marginal nodes, two prominent, one at mid-line, other dorsal, third much reduced, posteroventral. Each tipped with a long sensory seta. Surface essentially smooth. Ornamentation consists of a three part lateral extension, central juncture slightly posteroventral to mid-point; one extension directed anteriorly, one posteroventrally, and a third posterodorsally, latter expanded into a dorsally directed ala with a process terminally bearing a long sensory seta.

Radial pore canals not easily observed, apparently straight.

Adductor muscles attach within central portion of lateral ornamentation, scars therefore spread over a curved surface, not prominent.

Antennule.- Five segments; basal podomere with no setae; second podomere with one dorsodistal seta; third podomere with one dorsoproximal seta, one dorsodistal seta and two ventrodistal units - one a very long non-pinnate seta extending as far as terminal setae of appendage, other, typical in males of the genus, a mass of hundreds of sensory hairs depending like medusoid tentacles; fourth podomere with a short distal seta; fifth (terminal) podomere with two short, one medium, and five long nonpinnate setae with secondary setae along their length. All setae striated normal to length.

Antenna.- Protopod typically large, ovoid. Endopod with three seg-

ments; basal podomere with two very short lateral spines; second podomere with three comparatively large stout spines; third (terminal) podomere curved as a clasping organ and tipped with a small spine. Exopod of nine segments; basal nearly as long as succeeding eight, no setae; second through eighth podomeres each with a long pinnate natatory seta, proximal secondary setae being somewhat spinose on one margin of second podomere's seta; ninth (terminal) podomere with two setae, one as preceding, other much shorter and nonpinnate.

Mandible.- Typical of genus. Three terminal segments (endopod ?) each with a stout claw. Comparatively smaller than in female. A stout seta on convex margin of penultimate podomere, a small seta on concave margin of terminal podomere.

Maxilla.- None seen.

Fifth limb.- Only epipod seen; typical of genus, with about 35 very pinnate "branchial" setae.

Sixth limb.- Typical of genus. Subcircular ventrally, about ten long and eight shorter very pinnate setae on margin in two rows; two typical long very pinnate setae extended posteriorly.

Seventh limb.- Not present on male.

Copulatory appendage.- Paired, highly modified, terminated by one large and one smaller chitinous claw, both curved anteriorly; a small spine between them. A tubule and some glandular tissue visible just proximal to claws. A large muscle along anterior margin.

Furca.- Five major claws with secondary spines of cyclical size

along concave margin; claws followed by a few very small marginal spines.

Frontal organ.- Short, simple, club-shaped.

Eye.- Paired, each with about ten bifid lenses of different sizes, generally not in contact and forming no distinct pattern. Whole covered by a thin membrane

Habitat.- Taken from 81 feet of water, offshore, salinity about 25 °/oo. July.

Size and types.- Holotype UMMP 48810, male, length 1.09 mm; height 0.62 mm.

Remarks.- Only a male was found. The specimen did not bear any seventh appendage that could be seen. As Skogsberg (1920, p. 88) has stated: " ... we know that in the males of this genus [Sarsiella] the 7th limb is quite absent". Mueller (1894, p. 72) commented that the seventh appendage is rudimentary to the point of uselessness for cleaning, and the posterior portion of the shell and the appendages become fouled.

I was unable to observe even vestigial traces of a male seventh appendage.

Kornicker (1958, p. 286, fig. 75c) figured a seventh appendage of a male of S. carinata Scott (1905) which is very typical of the female seventh appendage except for the absence of the terminal opposing rows of very short spines. There is no doubt of it being a male, since a penis is also figured. Unfortunately Kornicker did not describe or figure the internal anatomy of the male of his new species, S. gigacantha, although he found three and the line drawing of the shell shows

close affinities with the species herein. Kornicker may have been unaware that males have, to my knowledge, never been found with a developed seventh limb, and does not comment upon his finding one.

S. gigacantha Kornicker has a less nodose ventral margin, and the juncture point of the lateral ornamentation is somewhat anterodorsal to the mid-point, whereas it is posteroventral in the species herein. Kornicker did not describe the maxilla of his species, nor can I; it is probably very reduced.

The male differs principally from S. carinata Scott in having a complex antennal endopod as compared with the simple one of that species, in having three mandibular claws rather than two, and in having a non-segmented frontal organ.

The posterior nodes and the nodose margin separate this species from S. zostericola Cushman (1906) although the appendages are quite similar.

Sarsiella rousei, n. sp.

Pl. 25, figs. 10-12; pl. 26, figs. 1-3

Carapace.- Female: subcircular, rounded caudal process posteroventrally. A very slight anterior rostrum, more evident on left valve, presence atypical of female of genus. Tumid, steeply sloped posteriorly. Surface reticulate, interstices covered with raised hollow tubercules. Margin hispid, ventrally bordered with long setae. Radial pore canals straight, apparently unbranched. Adductor muscle scar pattern not seen.

Antennule.- Five segments; basal podomere with no setae; second podomere articulated with basal, with one dorsal seta; third podomere

with one dorsoproximal seta, one dorsodistal seta, one ventroproximal seta, and two or three long ventrodistal setae extending past terminus; fourth podomere articulated with third, two dorsal setae; fifth (terminal) podomere short, with six long setae, two blunt (sensory ?), four pointed. All setae striated normal to length.

Antenna.- Protopod large, ovoid. Endopod verruciform, a comparatively long finely pinnate seta distally, two short lateral setae directed toward base of exopod. Exopod of nine segments; basal podomere nearly as long as succeeding podomeres, no setae; second through eighth podomeres each with a long pinnate natatory seta which is proximally spinose along one margin; ninth (terminal) podomere with two terminal setae, one long pinnate natatory and one short nonpinnate.

Mandible.- Typical of genus. Basal podomere elongate, large, with a heavy chitinous support; second podomere with about three short setae off inner margin; last three podomeres (endopod ?) each terminated with a long claw, each with a short distal seta off outer margin.

Maxilla.- Typical of genus. Terminus of endopod with five stout claws, each with heavy secondary spines, the anterior one curved distally toward posterior and more pointed, two short spines more proximally on posterior inner margin; penultimate podomere with two long marginal setae curving around terminus; coxa, pre-coxa essentially bilobate with about 12 spines.

Fifth limb.- Typical of genus. Terminus rounded, asymmetrically bilobed, the larger with five setae, smaller with two; a short spine more proximally off anterior portion; epipod with about 30 very pinnate

broad "branchial" setae.

Sixth limb.- Typical of genus. Terminus broadly rounded, asymmetrically bilobed, larger bearing about ten ventrally directed setae, smaller with about three short setae; posteriorly with two broad, less chitinous, very pinnate setae.

Seventh limb.- Vermiform, segmented; terminus opposing rows of very small spines, six terminal setae of varying lengths, two more about seven segments proximally, all with distal cone-in-cone structure.

Furca.- Five principal claws decreasing in size proximally, each bearing small spines along concave margin, followed by about three very small marginal spines.

Frontal organ.- Short, club-shaped, off a subspherical somewhat bilobed ganglion.

Eye.- Paired, each with five separate lenses, all somewhat bifid. Whole encompassed by a membrane. Comparatively large.

Habitat.- Taken from 77 to 96 feet of water, offshore, salinity of about 32 °/oo. July and August.

Size and types.- Holotype UMMP 48811, female, length 1.26 mm, height 0.96 mm, width 0.78 mm maximum; paratype UMMP 48812, female, length 1.13 mm, height 0.94 mm.

Remarks.- The species is easily differentiated from other known species of the genus by the structure and hispid nature of the shell. The presence of a slight rostral incisure, probably not providing any

permanent opening in the shell in this species, is atypical of females of the genus. The female is often generically described as having no antennal sinus or rostrum (e.g. Treatise, 1961, p. Q403) although Scott (1905, p. 368, pl. 1, fig. 3) described and figured a female, S. gracilis, with a small, but distinct, rostrum.

Discussion.- The holotype had four eggs inside the posterior of the carapace.

The species is named for Mr. James Rouse, Captain, R. V. KIT JONES.

Sarsiella angusta, n. sp.

Pl. 26, figs. 4-6

Carapace.- Female: chitinous, elliptical in outline, very thin. A posteroventral caudal process. Surface smooth, sole ornamentation a ridge just inside and parallel to margin. Margin finely nodose. Long setae along anterior and ventral margin. Adductor muscle scars indistinct, apparently eight or more circular, occasionally bifid or trifid scars in irregular pattern.

Antennule.- Five segments; basal podomere largest, no setae; second podomere articulated with basal, with one dorsodistal seta, three or four very small dorsal marginal spines; third podomere fused to second, with two dorsal setae, one proximal - one distal, two ventrodistal setae extending beyond terminus; fourth podomere articulated with third, with two distal setae; fifth (terminal) podomere very short, with six long setae, four pointed, two blunt. All setae striated normal to length.

Antenna.- Protopod large, ovoid. Endopod verruciform with two

lateral setae directed toward base of exopod. Exopod of nine segments; basal approximately as long as succeeding, no setae; second through eighth podomeres each with a long pinnate natatory seta; ninth (terminal) podomere with two setae, one long natatory as preceding, one short, non-pinnate.

Mandible.- Typical of genus. Basal podomere large, elongate with a heavy chitinous support; second podomere with about four short setae off inner margin, two off outer margin. Last three podomeres (endopod ?) each terminated with a long claw, each with a short distal seta on the outer margin.

Maxilla.- Typical of genus. Terminus of endopod with five stout claws, each with heavy secondary spines, two short spines more proximally off posterior inner surface; penultimate podomere with two long marginal setae curving around terminus; coxa, pre-coxa essentially bilobate with about 12 spines.

Fifth limb.- Terminus rounded, asymmetrically bilobed, the smaller, anterior, with two terminal setae, the larger with seven setae; a short seta more proximally off anterior portion; epipod with over 20 long very pinnate broad "branchial" setae.

Sixth limb.- Terminus broadly rounded, very asymmetrically bilobed, the smaller anterior lobe bearing three short setae, larger bearing about seven finely pinnate setae ventrally directed; posterior with two broad, less chitinous, very pinnate setae.

Seventh limb.- Vermiform, segmented, terminus with two opposing series of short spines, six terminal setae of varying lengths, four more

setae seven to ten segments proximally, all with distal cone-in-cone structure.

Furca.- Five curved claws increasing in size distally, each with secondary spines along concave margin.

Frontal organ.- Short, club-shaped, off an essentially bilobed ganglion.

Eye.- Paired. Five separate lenses, whole encased by a membrane.

Habitat.- Taken from 41 feet of water, offshore, salinity about 25 °/oo. September.

Size and types.- Holotype UMMP no. 48813, female, length 1.44 mm, height 1.08 mm, width 0.45 mm maximum.

Remarks.- The thinness and simplicity of the shell suffices to differentiate this from other known species.

Sarsiella greyi, n. sp.

Pl. 27, figs. 1-10; pl. 28, figs. 1-7

Carapace.- Weakly or irregularly calcareous. Subcircular, somewhat flattened along hinge line; a comparatively long caudal process posteroventrally. Anterior and ventral margins somewhat nodose, occasionally nodes on posterior. Surface smooth to slightly reticulate; gently sloped laterally, expanded posterodorsally into a hollow "wing," the interior acting as a brood pouch. Free margin lined with numerous long setae, occasional setae on lateral surface. Adductor muscle scar pattern

central, apparently seven or eight rounded subdivided scars in irregular pattern.

Dimorphism. Alar extension (brood pouch) reduced in male (?).

Antennule.- Five segments; basal podomere longest, no setae; second podomere with one dorsal seta; third podomere with one dorsoproximal seta, one dorsodistal seta; one small ventroproximal seta, and two ventrodistal setae; fourth podomere with two distal setae; fifth (terminal) podomere with six long nonpinnate setae with occasional secondary setae, four pointed and two blunt. All setae striated normal to length.

No dimorphism observed.

Antenna.- Female: protopod large, ovoid. Endopod a verruciform process terminated by a small spine, two lateral setae directed toward base of exopod. Exopod of nine segments; basal podomere nearly as long as succeeding, no setae; second through eighth podomeres each with a long pinnate natatory seta, proximally becoming spinose along margin; ninth (terminal) podomere with one natatory seta as preceding, one short nonpinnate seta.

Dimorphism. Endopod of male (?) a verruciform process as in female, also with two lateral setae. Terminus a node with two setae, right and left alike, apparently not fitted for grasping.

Mandible.- Typical of genus. Basal podomere of protopod large, with heavy chitinous support rod, a hirsute bulge posterodistally; second podomere with four short and one large setae along inner margin, two short setae on outer distal edge. Last three podomeres (endopod ?) each terminated with a large claw, each with a small spine on outer distal edge.

No dimorphism observed.

Maxilla.- Typical of genus. Terminus of endopod with five stout spines with heavy secondary spines, proximally two setae off posterior half; penultimate podomere with two long marginal setae curving around terminus; coxa, pre-coxa of about three nodes, each very spinose, some with secondary spines.

No dimorphism observed.

Fifth limb.- Typical of genus. Terminal podomere bilobate, posterior lobe with five setae, anterior with three; penultimate podomere directed anteriorly, terminated with two long setae; epipod with about 35 broad very pinnate "branchial" setae.

No dimorphism observed.

Sixth limb.- Typical of genus. Terminus rounded with about 14 setae in two longitudinal rows; posteriorly two broad, less chitinous, very pinnate setae.

No dimorphism observed.

Seventh limb.- Female: vermiform, segmented; terminal segment with six setae of varying length, two to four more ten to fifteen segments proximally, all with distal cone-in-cone structure. Terminus with opposing rows of very short setae. In central portion of distal third of appendage are chitinous vertebraelike supports.

Dimorphism. Appendage not observed in male (?).

Furca.- Five major claws, larger with secondary spines along concave margin followed by three to five marginal spines.

No dimorphism observed.

Frontal organ.- Short, club-shaped, off a somewhat bifid basal ganglion.

No dimorphism observed.

Eye.- Female: paired, each with five separated distinctly bifid lenses. Whole covered by a membrane.

Dimorphism. Male (?) has non-bifid lenses.

Habitat.- Taken from 81 feet of water, offshore, salinity of about 25 °/oo. July.

Size and types.- Holotype UMMP 48814, female, length 1.14 mm, height 1.02 mm; paratypes UMMP 48816, male (?) length 1.09 mm, height 0.936 mm; UMMP 48815, female, length 0.90 mm, height 0.84 mm.

Remarks.- The structure of the carapace serves to differentiate this from other known species.

Discussion.- The male, if it is the male, is quite unusual for the genus. There is no rostrum and no setiferous process on the antennule which are characters of all previously described Sarsiella males known to the author. Neither antennal endopod is formed for clasping. The only masculine features are the absence of a seventh limb and the possession of what appear to be near-vestigial copulatory appendages. Conceivably, the latter could be the posterior portion of a parasitic degenerative isopod, similar to one described by Sars (1889, pl. 97, fig. 5). The growth of the seventh limbs would have been inhibited by the parasite.

Both females were bearing eggs, the larger holotype had eight in

each brood pouch, the smaller paratype had four in each; the size difference in these mature adults may indicate post-maturation molting.

The species is named for Mr. Milton S. Grey, who collected and gave it to the author.

Sarsiella tubipora, n. sp.

Pl. 29, figs. 1-11

Carapace.- Female: irregularly calcareous; subcircular in outline, somewhat flattened along hinge line; a distinct posteroventral caudal process. Central portion of valve essentially flat, posteriorly steeply sloping to margin, otherwise gently sloped. Surface very reticulate. Inter-reticulate area covered with large pores which are raised above the surface as tubes with a distal expansion. Margin edged with tube-pores and with large setae anteriorly extending ventrally and disappearing posteriorly except at caudal process. Adductor muscles attached anteroventral to mid-point, appear to be below reticules, about 12 ovoid, occasionally divided, scars in irregular pattern.

Antennule.- Five segments; basal podomere largest, no setae; second podomere with one dorsal seta; third podomere with one dorsodistal seta, one dorsoproximal seta, one ventroproximal seta, and two ventrodistal long setae extending beyond terminus of appendage; fourth podomere with one distal seta; fifth (terminal) podomere short, with six long terminal setae, one shorter on right appendage, two shorter on left. All setae striated normal to length.

Antenna.- Protopod large, ovoid. Endopod verruciform, two short

spines near base directed toward base of exopod, a comparatively long very finely pinnate spine off the terminus. Exopod of nine segments; basal podomere nearly as long as succeeding, no setae; second through eighth podomeres each with a long pinnate proximally spinose natatory seta; ninth (terminal) podomere with one long and one short pinnate setae.

Mandible.- Typical of genus. Large ovoid basal segment of protopod with heavy chitinous support rod; second podomere with two medial spines on posterior margin and one distal spine on posterior margin; last three podomeres (endopod ?) each with a long curved distal claw and a small distal spine on outer margin.

Maxilla.- Typical of genus. Terminal podomere of endopod with five broad blunt spines bearing two rows of strong secondary spines, distal portion of anteriormost spine thinner and finely pinnate; two more proximal setae on posterior portion. Penultimate podomere with two long finely pinnate setae curving around terminus.

Fifth limb.- Typical of genus. Terminus rounded, lobate. A small anterior lobe off penultimate podomere with a short terminal seta; a larger anterior lobe off terminus with two setae, principal lobe with four distal setae, one proximal. Epipod with more than 20 long broad, weakly chitinous very pinnate "branchial" setae.

Sixth limb.- Typical of genus. Rounded, lobate; small anterior lobe with one to three setae, large terminal lobe with about 12 smooth to finely pinnate setae extending downward; two broad, less chitinous very pinnate setae posteriorly. Posterior margin hirsute.

Seventh limb.- Vermiform, segmented; distal segment with six setae, two other setae about eight segments proximally, all with cone-in-cone structure distally. Terminus with opposing rows of very small setae.

Furca.- Five major claws with secondary spines along concave margin, followed on left plate by about eight smaller spines; on right three smaller spines between claws three and four, about five follow fifth claw.

Frontal organ.- Simple, club-shaped.

Eye.- Paired, with five separated bifid lenses. Whole covered by a membrane.

Habitat.- Taken from 121 feet of water, offshore, of salinity of about 30 °/co. July.

Size and types.- Holotype UMMP 48817, female, length 1.55 mm, height 0.98 mm.

Remarks.- The species is easily recognized by its unusual pores.

Discussion.- The specimen bore a cluster of six eggs, mutually attached, one in center bounded by five others.

Sarsiella disparalis, n. sp.

Pl. 30, figs. 1-7; pl. 31, figs. 1-8

Carapace.- Female: very weakly calcareous. Subcircular, anterior and ventral margins slightly crenulate. A posteroventral caudal process. Surface comparatively smooth. Ornamentation of valves extremely variable

in degree, not so much in morphology; consists of a large median horizontal ridge with anterior and posterior alar projections, a shorter dorsal ridge also with anterior and posterior extensions, and a ventral ridge with an extension at about mid-point. A median posterior node usually occurs at margin. Dorsal and ventral marginal ridges may be lacking and median ridge reduced to a low elongate mound. This may occur on only one valve of a specimen. Some specimens fairly symmetrical; on very asymmetrical ones, lack of ornamentation was on left valve. Anterior and ventral margins bear setae. Inner lamella slightly spinose posteriorly. Radial pore canals simple, unbranching. Adductor muscles attach in hollow of anterior alar portion of median ridge, difficult to distinguish scar pattern; apparently a small central cluster of about seven closely spaced scars with about eight more, some bifid, around these.

Antennule.- Five (?) segments; basal longest, no setae; second podomere with one dorsal seta; third podomere with one dorsoproximal seta, one dorsodistal seta, and two ventrodistal long setae extending past terminus of appendage; fourth podomere with one short distal seta; fifth (terminal) podomere very short, indistinctly separated, possibly not a true podomere, usually four long pointed setae, two shorter blunt setae, and two short setae. All setae striated normal to length.

Antenna.- Protopod large, ovoid. Endopod a verruciform process with two short lateral setae pointing toward base of exopod, a very short seta on terminus. Exopod of nine segments; basal podomere nearly as long as succeeding, no setae; second through eighth podomeres each with a long pinnate natatory seta; ninth (terminal) podomere with two

terminal setae, one as preceding, other shorter, only slightly pinnate. all setae striated normal to length.

Mandible.- Typical of genus. Basal podomere of protopod large, with a heavy chitinous support rod; second podomere with two or three setae on outer margin, three or four on inner. Last three podomeres (endopod ?) each with a long distal claw and a short distal spine on outer margin.

Maxilla.- Typical of genus. Terminal podomere with five heavy blunt spines with coarse secondary spines, two smaller setae proximally off posterior half; penultimate podomere with two finely pinnate marginal setae curving around terminus; coxa, pre-coxa rounded terminally with a total of about 15 spines.

Fifth limb.- Typical of genus. Terminus asymmetrically bilobed, smaller lobe with two long setae, larger with about five. Epipod with about 40 long very pinnate "branchial" setae.

Sixth limb.- Typical of genus. Terminus asymmetrically bilobed, rounded, distally bearing about 12 faintly pinnate stout setae, posteriorly bearing two large less chitinous pinnate setae.

Seventh limb.- Vermiform, segmented; six terminal setae, four proximally at intervals, all with distal cone-in-cone structure. Terminus with opposing rows of very short setae.

Furca.- Five major claws with secondary spines along concave margin, followed by about two very minute spines.

Frontal organ.- Simple, club-shaped, basal ganglion large with pig-

mented tissue.

Eye.- Paired, each with five separated bifid lenses. Whole covered by a membrane.

Habitat.- Taken from 41 to 61 feet of water, offshore, of salinities of about 25 °/oo. August, September.

Size and types.- Holotype UMMP 48819, female, length 1.50 mm, height 1.26 mm; paratypes UMMP 48818, female, length 1.44 mm, height 1.20 mm; 48820. Five specimens found.

Remarks.- The unusual features of shell morphology serve to differentiate this from other known species.

Discussion.- Both females dissected bore six eggs which appeared to be in various stages of development. About five more eggs were still within the body mass.

Superfamily Halocypridacea Dana, 1852

Family Halocyprididae Dana, 1852

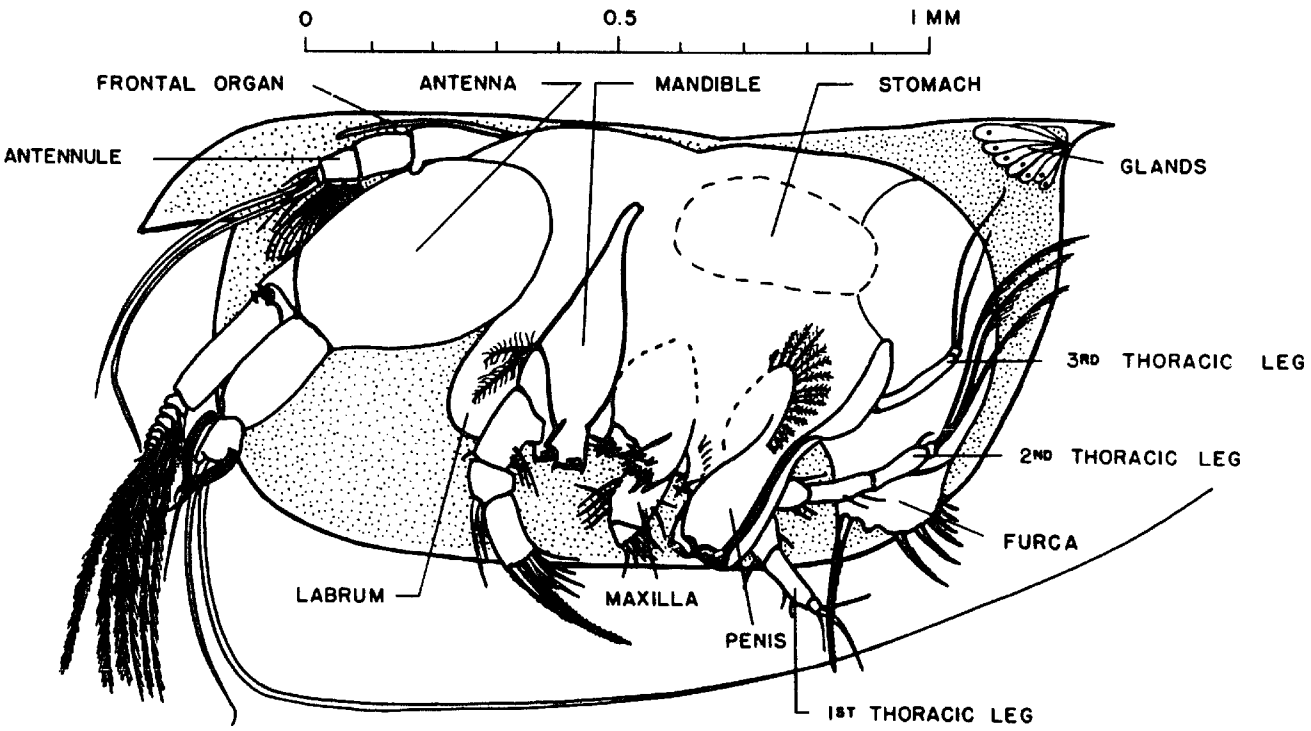
Genus Euconchoecia Mueller, 1890b

Euconchoecia chierchiae Mueller

Pl. 32, figs. 1-9; pl. 33, figs. 1-9

Euconchoecia chierchiae Mueller, 1890b, p. 277, pl. 28, figs. 1-10;
Skogsberg, 1920, p. 740, figs. 148-151.

Carapace.- Noncalcareous. Rostrum pointed, deeply incised, female with spine on tip of left rostrum. Right posterior spine on both sexes.



TEXT-FIGURE 11

Drawing of planktonic species Euconchoecia chierchiae; penis is unpaired in this group.

Posterior gland openings symmetrical, slightly ventral to posterior corner. Dorsal area depressed near mid-line, possibly due to adductor muscle tension on noncalcareous shell. Normal pore canals evident upon staining, unaltered test appears smooth.

Internal morphology.- See Skogsberg (1920) for complete description; Iles (1961) gives functions of appendages of a halocyprid.

Habitat.- Planktonic. Occurrences variabl , all offshore, popu-

lation generally increasing further from shore, maximum number taken on edge of Gulf Stream, 75 miles from land; water of 20-26° C., salinities 25 to over 35 °/oo. Tows taken both day and night at three to five meters depth.

Size and types.- Length of adults 1.1 to 1.28 mm; height of males about one-half length, females slightly less. Hypotype UMMP nos. 48821, 48822, 48823, 48824, 48825, 48826, and 48827.

Remarks.- This genus differs from Conchoecia Dana (1848) in that the posterior glands (Drusengruppen of Mueller) open symmetrically near the posterodorsal corners of the shell, and, according to Skogsberg (1920, p. 738) by the distal node (verruca) on the second podomere of the male antenna. Mueller erected the genus and described the species on the basis of males found off the coast of Brazil; I found females predominant, from 60 to 80 percent of each sample; these were collected in May.

Discussion.- The setae of the fourth podomere of the antennule were seen to be used for rowing the animal through the water. All appendages were seen to be moved rapidly, even the furca, as the animal swam. The action is jerky, much like some copepods.

Upon placing a freshly killed specimen in distilled water, occasionally the inner and outer chitin layers of the shell would expand apart as osmotic transfer of water occurred. It is possible that some degree of regulation of fluid between these two layers may aid the animal in buoyancy maintainance.

The eggs of the living female have a greenish blue cast; nearly all females were bearing eggs.

The stomach contents revealed diatoms as the major food source, and what appeared to be portions of arthropod appendages were also seen.

REFERENCES CITED

ALEXANDER, W. B., SOUTHGATE, B. A., & BASSINDALE, R., 1932, The Salinity of the Water Retained in the Muddy Foreshore of an Estuary: Mar. Biol. Ass. Jour., N.S. 18, p. 297-298.

ANDERSON, F. W., 1964, The Law of Ostracod Growth: Palaeontology, vol. 7, pt. 1, p. 85-104, 1 text-fig., 28 tabs.

BENSON, R. H., & COLEMAN, G. L., 1963, Recent Marine Ostracodes from the Eastern Gulf of Mexico: Univ. Kansas Paleontol. Contrib., Arthropoda, Art. 2, 52 p., 8 pls., 33 figs.

BAIRD, WILLIAM, 1850a, The Natural History of the British Entomostraca: Ray Society, London, p. i-viii + 364, 36 pls.

BAIRD, WILLIAM, 1850b, Description of Several New Species of Entomostraca: Proceedings Zool. Soc. London, part 18, p. 254-257, 2 pls.

BRADY, G. S., 1866, On New or Imperfectly Known Species of Marine Ostracoda: Trans. Zool. Society, London, vol. 5, p. 359-394, 6 pls.

BRADY, G. S., 1867-1871, in Les Fonds de la Mer, Folin, L. de and Perier, L., vol. 1, Paris, Savy.

BRADY, G. S., 1868a, A Synopsis of the Recent British Ostracoda: Intell. Observer, vol. 12, p. 110-130, 2 pls.

BRADY, G. S., 1869a, Contributions to the study of Entomostraca. IV, Ostracoda from the river Scheldt and the Grecian Archipelago: Ann. Mag. Nat. History, ser. 4, vol. 3, p. 45-50, 2 pls.

BRADY, G. S., 1880, Report on the Ostracoda Dredged by H.M.S. Challenger During the Years 1873-1876: Report Sci. Results Voyage H.M.S. Challenger, Zoology, pt. 3, 184 p., 44 pls.

BRADY, G. S., 1890, On Ostracoda Collected by H. B. Brady, Esq., LL.D, F.R.S., in the South Sea Islands: Trans. Roy. Soc. Edinburgh, vol. 35, part 2, p. 489-526, 4 pls.

BRADY, G. S., 1897, A Supplementary Report on the Crustaceans of the Group Myodocopa Obtained During the Challenger Expedition, with Notes on Other New or Imperfectly Known Species: Trans. Zool. Soc. London, vol. 14, no. 7, p. 85-100, 3 pls.

BRADY, G. S., 1902, On New or Imperfectly Known Ostracoda, Chiefly from a Collection in the Zoological Museum, Copenhagen: Trans. Zool. Soc. London, vol. 16, pt. 4, no. 1, p. 179-210, 5 pls.

BRADY, G. S. & NORMAN, A. M., 1896, A Monograph of the Marine and Fresh-water Ostracoda of the North Atlantic and of North-Western Europe - Part 2, Sections 2 to 4: Myococopa, Cladocopa, and Platycopa: Sci. Trans. Royal Dublin Society, vol. 5, ser. 2, p. 621-784, 28 pls.

CUSHMAN, J. A., 1906, Marine Ostracoda of Vineyard Sound and Adjacent Waters: Proc. Boston Soc. Nat. History, vol. 32, no. 10, p. 359-386, 12 pls.

DANA, J. D., 1848, Conspectus Crustaceorum quae Orbis Terrarum Circumnavigatione, Carolo Wilkes e Classe Reipublicae Foederatae Duce, Lexit et Descripsit, Pars 2: Proc. Amer. Academy of Arts and Science, 1852, vol. 2, p. 9-61.

DARBY, D. G., & HOYT, J. H., 1964, An Upper Miocene Fauna Dredged from Tidal Channels of Coastal Georgia; Jour. Paleontology, vol. 38, no. 1, p. 67-73, 2 pls., 2 text-figs.

EDWARDS, RICHARD A., 1944, Ostracoda from the Duplin marl (Upper Miocene) of North Carolina: Jour. Paleontology, vol. 18, no. 6, p. 505-528, 4 pls.

GRABAU, A. W., 1913, Principles of Stratigraphy, 1185 p., 264 figs., A. G. Seiler & Co., New York, N. Y.

HIRSCHMANN, NIKOLAJ, 1909, Beitrag zur Kenntnis der Ostracodenfauna des Finnischen Meerbusens: Societas pro Fauna et Flora Fennica, Meddelanden, vol. 35, p. 282-296, 1 pl., 12 figs.

HOWE, H. V., 1961, Systematic Descriptions, in Treat. Invertebrate Paleontology, part Q, Arthropoda 3, Ostracoda, i-xxiii + 442 p., 334 figs.

HOWE, H. V., et al., 1935, Ostracoda of the Arca Zone of the Choctawhatchee Miocene of Florida: Fla. Geol. Survey, Geol. Bull. 13, 47 p., 4 pls.

ILES, E. J., 1961, The Appendages of the Halocyprididae: Discovery Reports, vol. 31, p. 299-326, 14 figs.

JONES, T. R., 1856, A Monograph of the Tertiary Entomostraca of England: Palaentographical Soc. of London, 68 p., 6 pls.

KESLING, R. V., 1951, Mechanical Solution of Formulas for Growth Rates: Contrib. Mus. Paleontology Univ. Mich., vol. 8, no. 10, p. 231-237, 3 figs.

KORNICKER, L. S., 1958, Ecology and Taxonomy of Recent Marine Ostracodes in the Bimini Area, Great Bahama Bank: Publ. of the Institute of Marine Science, Univ. Texas, vol. 5, p. 194-300, 89 figs.

LILJEBORG, W., 1853, De Crustaces ex Ordinibus Tribus: Cladocera, Ostracoda, et Copepoda, in Scania Occurrentibus. Om de Inom Skane Forekommande Crustaeer af Ordiningere Cladocera, Ostracoda och Copepoda; Lund, xvi + 222 p., 27 pls.

MALKIN, D. S., 1953, Biostratigraphic Study of Miocene Ostracoda of New Jersey, Maryland, and Virginia: Jour. Paleontology, vol. 27, no. 6, p. 761-799, 5 pls., 14 figs.

MINCHER, ALBERT R., 1941, The fauna of the Pascagoula Formation: Jour. Paleontology, vol. 15, no. 4, p. 337-348, 2 pls., 4 figs., 1 tab.

MUELLER, FRITZ, 1870, Bemerkungen uber Cypridina: Jenaische Zeitschrift für Medicin und Naturwissenschaft, band 5, p. 255-276, 2 pls.

MUELLER, G. W., 1890a, Neue Cypridiniden: Zoologische Jahrbucher, Abtheil. für Syst., Geog. und Biol. der Thiere, band 5 (1891), p. 211-252, 3 pls.

MUELLER, G. W., 1890b, Ueber Halocypriden, Zoologische Jahrbucher, Abtheil. für Syst., Geog. und Biol. der Thiere, band 5 (1891), p. 253-280, 3 pls.

MUELLER, G. W., 1894, Die Ostracoden des Golfes von Neapel und der Angrenzenden Meeres-Abschnitte: Fauna und Flora des Golfes von Neapel, Zool. Sta. Neapel, mono. 21, p. i-viii + 404, 40 pls.

MUELLER, G. W., 1908, Die Ostracoden der Deutschen Sudpolar Expedition, 1901-1903: Deutsche Sudpolar Expedition, band 10, zool. band 2, p. 51-181, 16 pls., 45 text-figs.

NORMAN, A. M., 1869, Shetland Final Dredging Report - Part 2. On the Crustacea, Tunicata, Polyzoa, Echinodermata, Actinozoa, Hydrozoa, and Porifera: Report of 38th Meeting Brit. Assoc. Adv. Science (1868), p. 247-336 (Ostracoda, p. 289-295).

PHILIPPI, A., Zoologische Bemerkungen, III, Asterope, ein neues Genus der Ostracopoden: Archiv. für Naturgeschte, Jahrgang 6, band 1, p. 186-188, 1 pl.

POULSEN, E. M., 1962, Ostracoda - Myodocopa, part 1, Cypridiniformes-Cypridinidae: Dana Report 57, The Carlsberg Foundation's Oceanographical Expedition Round the World 1928-30, vol. 10, 414 p., 181 figs., 26 tabs.

PURI, H. S., 1953, Contribution to the Study of the Miocene of the Florida Panhandle: Fla. Geol. Survey, Geol. Bull. 36, 345 p., 17 pls., 14 text-figs., 12 tabs.

PURI, H. S., 1960, Recent Ostracoda from the West Coast of Florida: Trans. Gulf Coast Geol. Societies, vol. 10, p. 107-149, 6 pls., 46 text-figs., 1 fig.

PURI, H. A., & HULINGS, N. C., 1957, Recent Ostracode Facies from Panama City to Florida Bay Area: Trans. Gulf Coast Assoc. Geol. Societies, vol. 7, p. 167-190, 11 figs.

SARS, G. O., 1866, Oversigt af Norges Marine Ostracoder: Videnskabs-

Selskabet, I Christiana, Forhandlinger, p. 1-130.

SARS, G. O., 1889, An Account of the Crustacea of Norway, vol. 2, Isopoda, parts 1-14, 270 p., 104 pls.

SARS, G. O., 1922-1928, An Account of the Crustacea of Norway, vols. 1-9, Ostracoda, 277 p., 119 pls.

SCHAEFER, H. W., 1953, Uber Meeres- und Brackwasser- Ostracoden aus dem Deutschen Kustengebeit: Hydrobiologia, vol. 5, no. 4, p. 351-389, 15 figs.

SCOTT, ANDREW, 1905, Report on the Ostracoda Collected by Professor Herdman, at Ceylon, in 1902: Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Mannaar, Part 3, Supplementary Report 12, p. 365-384, 2 pls.

SKOGSBERG, TAGE, 1920, Studies on Marine Ostracods, part 1, Cypridinids, Halocyprids and Polycopids: Uppsala Universitat, Zoologiska Bidrag från Uppsala, Suppl. band 1, 784 p., 153 figs.

STEPHENSON, M. B., 1938, Miocene and Pliocene Ostracoda of the Genus Cytheridea from Florida: Jour. Paleontology, vol. 12, no. 2, p. 127-148, 2 pls., 20 text-figs.

SWAIN, F. W., 1951, Ostracoda from Wells in North Carolina, part 1, Cenozoic Ostracoda: U.S. Geol. Survey Prof. Paper 234-A i-ii + 58, 7 pls., 3 figs.

SWAIN, F. M., 1955, Ostracoda of San Antonio Bay, Texas: Jour. Paleontology, vol. 29, no. 4, p. 561-646, 6 pls., 39 text-figs.

TEAL, J. M., & KANWISHER, JOHN, 1961, Gas Exchange in a Georgia Salt Marsh: Limnology and Oceanography, vol. 6, no. 4, p. 388-399, 5 figs., 3 tabs.

TREATISE ON INVERTEBRATE PALEONTOLOGY, 1961, R. C. Moore Ed., part Q, Arthropoda 3, Crustacea, Ostracoda, 442 p., 334 figs., Univ. Kansas Press.

TRIEBEL, ERICH, 1960, Die taxionomische Stellung und die Gattungen der Unterfamilie Macrocypridinae (Ostracoda): Senckenbergiana Biol., vol. 41, no. 1/2, p. 109-124, 8 pls.

TRESSLER, W. L., 1949, Marine Ostracoda from Tortugas, Florida: Jour. Wash. Acad. Sciences, vol. 39, no. 10, p. 335-343, 25 figs., 1 tab.

U. S. Coast and Geodetic Survey, 1964, Tidal Current Tables, Atlantic Coast of North America.

VAN DEN BOLD, W. A., 1946, Contribution to the Study of Ostracoda with Special Reference to the Tertiary and Cretaceous Microfauna of the Caribbean Region: Amsterdam, 167 p., 18 pls. text-figs.

VAN DEN BOLD, W. A., 1950, Miocene Ostracoda from Venezuela: Jour. Paleontology, vol. 24, no. 1, p. 76-88, 2 pls., 4 figs.

WAGNER, C. W., 1957, Sur les Ostracodes du Quaternaire Récent des Pays-Bas et leur Utilization dans L'Étude Géologique des Dépôts Holocènes, 158 p., 50 pls., 26 figs.; Mouton & Co., The Hague, Netherlands.

PLATE 1

Figs. 1-12 *Cytheromorpha curta* Edwards

1,3-5 UMMP 48754, female; 1, left valve exterior, X87; 3, right valve interior, X87; 4, left valve interior, X87; 5, dorsal view of teeth, AL anterior left, AR anterior right, PL posterior left, PR posterior right, X435.

2,11 UMMP 48755, male; 2, left valve exterior showing more reticulate pattern and smaller size, X87; 11, internal morphology, penes on left, X105.

6,12 UMMP 48756, female; 6, right valve, transmitted light showing adult lack of reticulation, dark spots are normal pores, X87; 12, internal morphology, dark spots in upper right are eyes, X105.

7 UMMP 48757, male; right valve, transmitted light showing reticulations and smaller size of adult, X87.

8 UMMP 48758, immature specimen, transmitted light showing reticulate pattern, X87.

9 UMMP 48759, adductor muscle scars, exterior left valve, anterior to right, X435.

10 UMMP 48760, anterior of left valve from inside - showing radial pore canals and vestibule, X435.

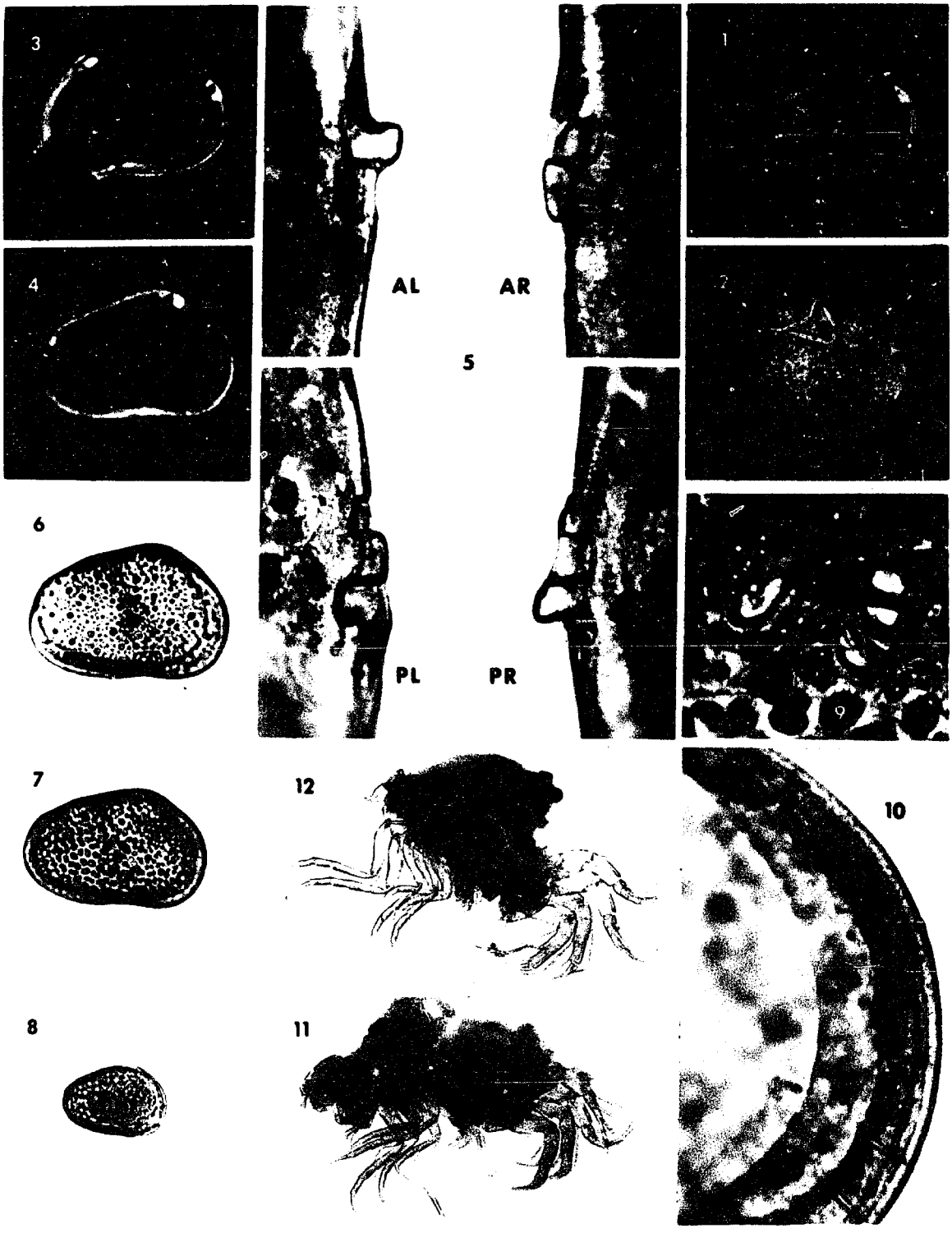


PLATE 1

PLATE 2

Figs. 1-6 Cytheromorpha curta Edwards

1 UMMP 48755, male, showing penes, X260.

2,6 UMMP 48761, male; 2, mandible, X260; 6, antenna, exopod the dorsal rod, X260.

3 UMMP 48762, female, antenmule, X260.

4 UMMP 48754, female, normal sieve type pores, X1050.

5 UMMP 48760, female, maxilla (exopod with branchial setae out of focal plane), X260.

Figs. 7-10 Cytheromorpha warneri Howe & Spurgeon

7,8 UMMP 48763, female; 7, dorsal view of teeth, AL anterior left, AR anterior right, PL posterior left, PR posterior right, X435; 8, left valve exterior, X87.

9 UMMP 48764, left valve exterior, X87.

10 UMMP 48765, male, sensory distal seta of antennule, X1130.

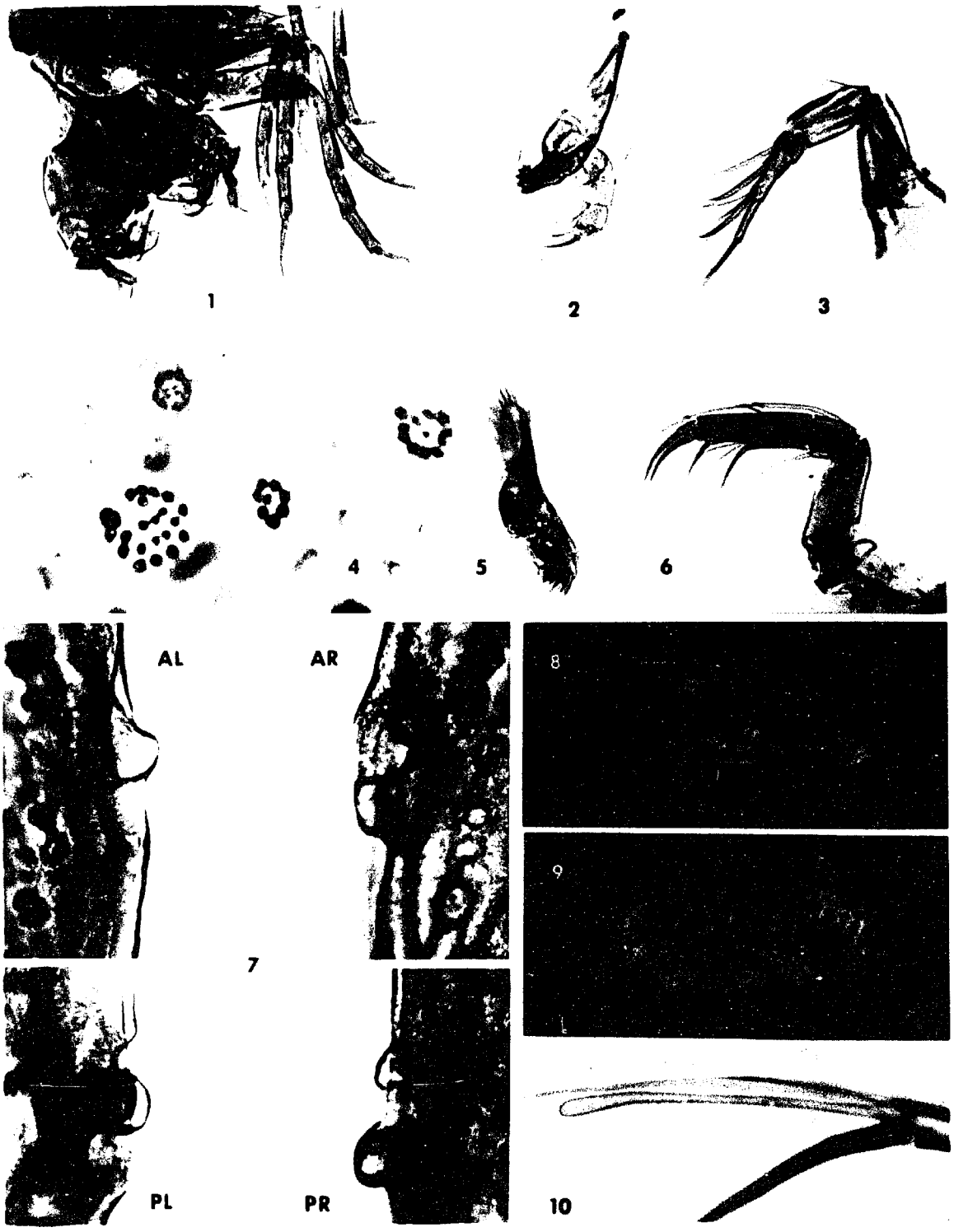


PLATE 2

PLATE 3

Figs. 1-10 Leptocythere paracastanea Swain

1,3-6,8 UMMP 48766, male; 1, left valve interior, X87; 3, left valve exterior, X87; 4, left valve, dorsal view, tipped outward to show teeth, anterior toward top, X175; 5, right valve, dorsal view, anterior toward top, X175; 6, dorsal view of teeth, AL anterior left, AR anterior right, PL posterior left, PR posterior right, X435; 8, left valve, posterior portion of median hinge element, dorsal view, posterior to left, X435.

2,7, UMMP 48767, female; 2, left valve exterior, X87; 6, dorsal view of teeth, Al anterior left, AR anterior right, X435.

9, UMMP 48768, female, internal morphology, dark posterior spot is vaginae, X130.

10, UMMP 48769, male, internal morphology, note diatoms in stomach, just above penes, X130.



PLATE 3

PLATE 4

Figs. 1-9 Leptocythere paracastanea Swain

1-4 UMMP 48770, female; 1, antenna, X350; 2, mandible, X350; 3, antennule, X350; 4, maxilla, X350.

5-7 UMMP 48767, female; 5, normal pore canals, exterior view, X870; 6, fifth, sixth and seventh limbs, anterior to right, X350; 7, gut with diatoms, X350.

8 UMMP 48766, male, anterior of right valve from inside showing polyfurcate radial pore canals, X435.

9 UMMP 48771, male, copulatory appendages, X435.



PLATE 4

PLATE 5

Figs. 1-8 Cyprideis floridana (Howe & Hough)

1,3-4,6 UMMP 48772, female; 1, left valve exterior, X87; 3, left valve interior, X87; 4, right valve interior, X87; 6, dorsal view of teeth, anterior toward top, X175.

2,5 UMMP 48773, male; 2, left valve exterior, X87; 5, dorsal view of teeth showing slight variation within species, anterior toward top; X175.

7 UMMP 48774, sieve type normal pores, note larger main pore in upper central region, X1050.

8 UMMP 48775, adductor muscle scars of left valve exterior, note distinctive angle of upper scar of row, dark area between upper scar of row and V-shaped scar is mandibular fulcral point, X435.

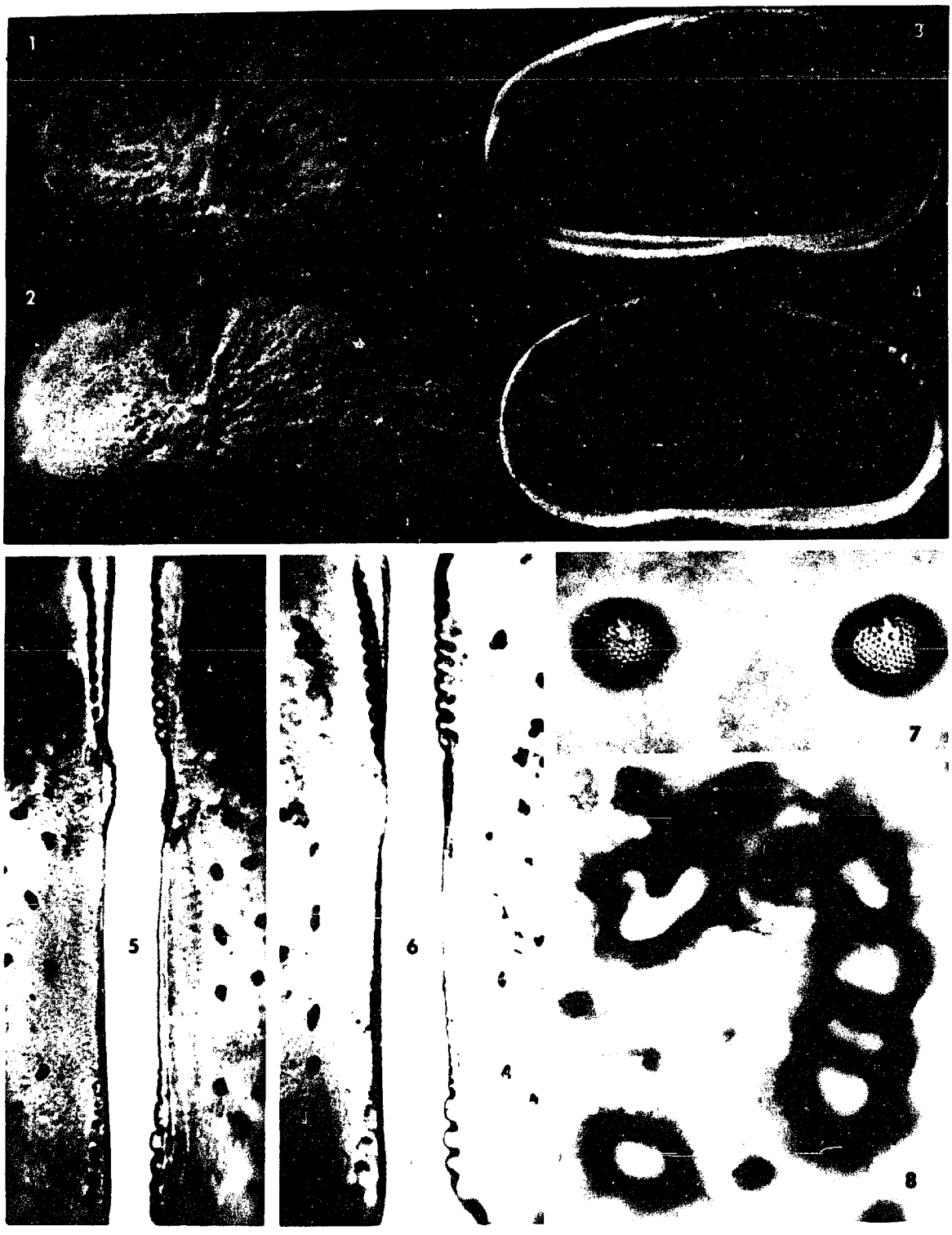


PLATE 5

PLATE 6

Figs. 1-8 Cyprideis floridana (Howe & Hough)

1,2,7 UMMP 48773, male; 1, antennule, X175; 2, antenna, X175; 7, radial pore canals, inside right valve, X435.

3-5 UMMP 48776, female; 3, maxilla, X175; 4, mandible, X175; 5, sixth limb, X175.

6,8 UMMP 48772, female; 6, genital region showing a vagina and tubules, X435; 8, whole mount showing arrangement of appendages, an antennule and antenna have been removed, furca at right angles to normal position, X87.



PLATE 6

PLATE 7

Figs. 1-12 Semicytherura elongata (Edwards)

1 UMMP 48777, female, dorsal view of valves, anterior to left, note overlap by left valve anteriorly, X87.

3,4 UMMP 48778, male; 3, dorsal view of valves, anterior to left, note overlap by left valve anteriorly, X87; 4, left valve exterior, X87.

2,5-12 UMMP 48779, female; 2, left valve exterior, X87; 5, right valve interior, X87; 6, left valve interior, X87; 7, dorsal view of teeth, AL anterior left, AR anterior right, PL posterior left, PR posterior right, X435; 8, posterior left tooth from inside, showing crenulations, X435; 9, anterior left tooth from inside showing crenulations, X435; 10, normal open type pore canal, area to left is not a sieve pore, X1050; 11, radial pore canals, X435; 12, whole mount showing internal morphology, X175.

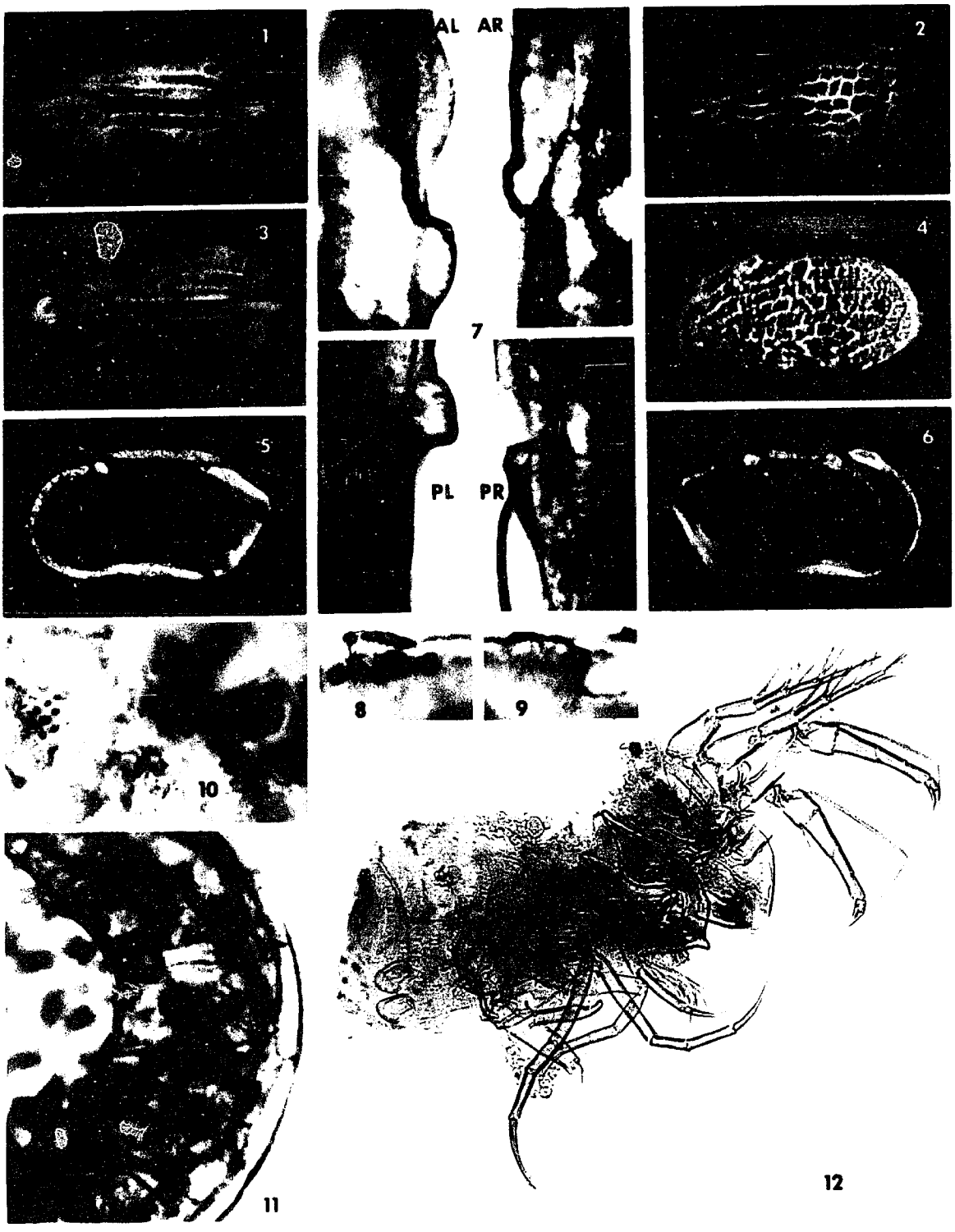


PLATE 7

PLATE 8

Figs. 1-9 Macrocypris sapeloensis, n. sp.

1-9 UMMP 48780, holotype, male; 1, left valve, exterior view, X52; 2, right valve external view, X52; 3, hinge elements, dorsal view, anterior is upward, X87; 4, antennule, X87; 5, antenna, X87; 6, adductor muscle scars, inside right valve, anterior to left, X175; 7, mandible, distal portion, X87; 8, posterior of right valve, external view, showing radial pore canals and vestibule, X175; 9, anterior of right valve, external view, showing radial pore canals and vestibule, X109.

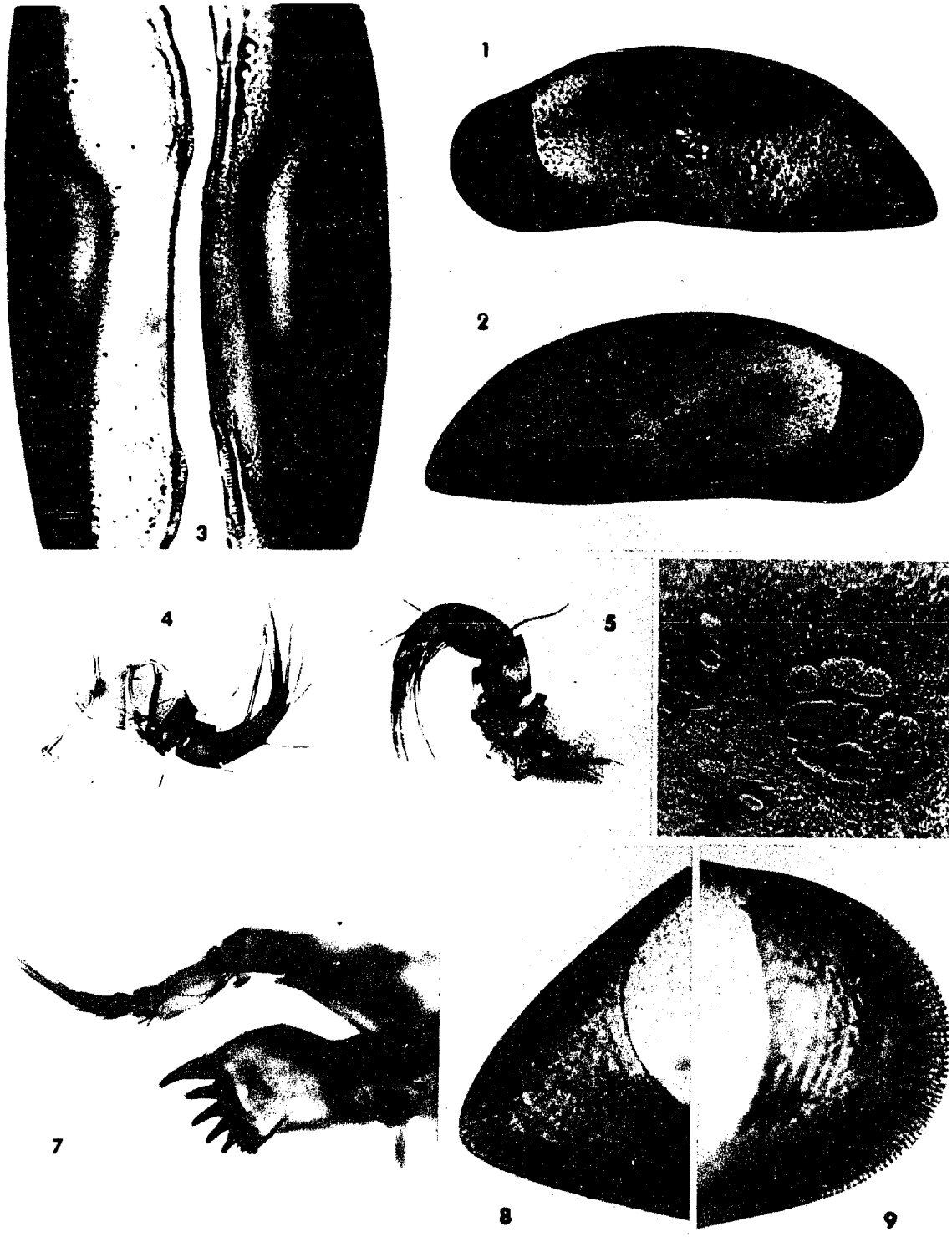


PLATE 8

PLATE 9

Figs. 1-9 Macrocypris sapeloensis, n. sp.

1-9 UMMP 48780, holotype, male; 1, distal portion of maxilla, X260; 2, sixth limb, X87; 3, seventh limb, X87; 4, labrum and fifth limbs, X175; 5, furca and copulatory organ, X87; 6, sperm, X87; 7, furca, X260; 8, distal seta of seventh limb, X520; 9, vas deferens (detached from ampullae at top of photomicrograph) and Zenker's organs, X87.



PLATE 9

PLATE 10

Figs. 1-11 Philomedes lilljeborgi (Sars)

1-11 UMMP 48781, female; 1, antennule, X87; 2, right valve exterior, X43; 3, mandible, X87; 4, maxilla, X87; 5, fifth limb, X87; 6, rostrum, internal view, X87; 7, sixth limb, X87; 8, furca, X87; 9, frontal organ, X87; 10, seventh limb, X87; 11, endopod of antenna, a distal seta is broken off, X130.

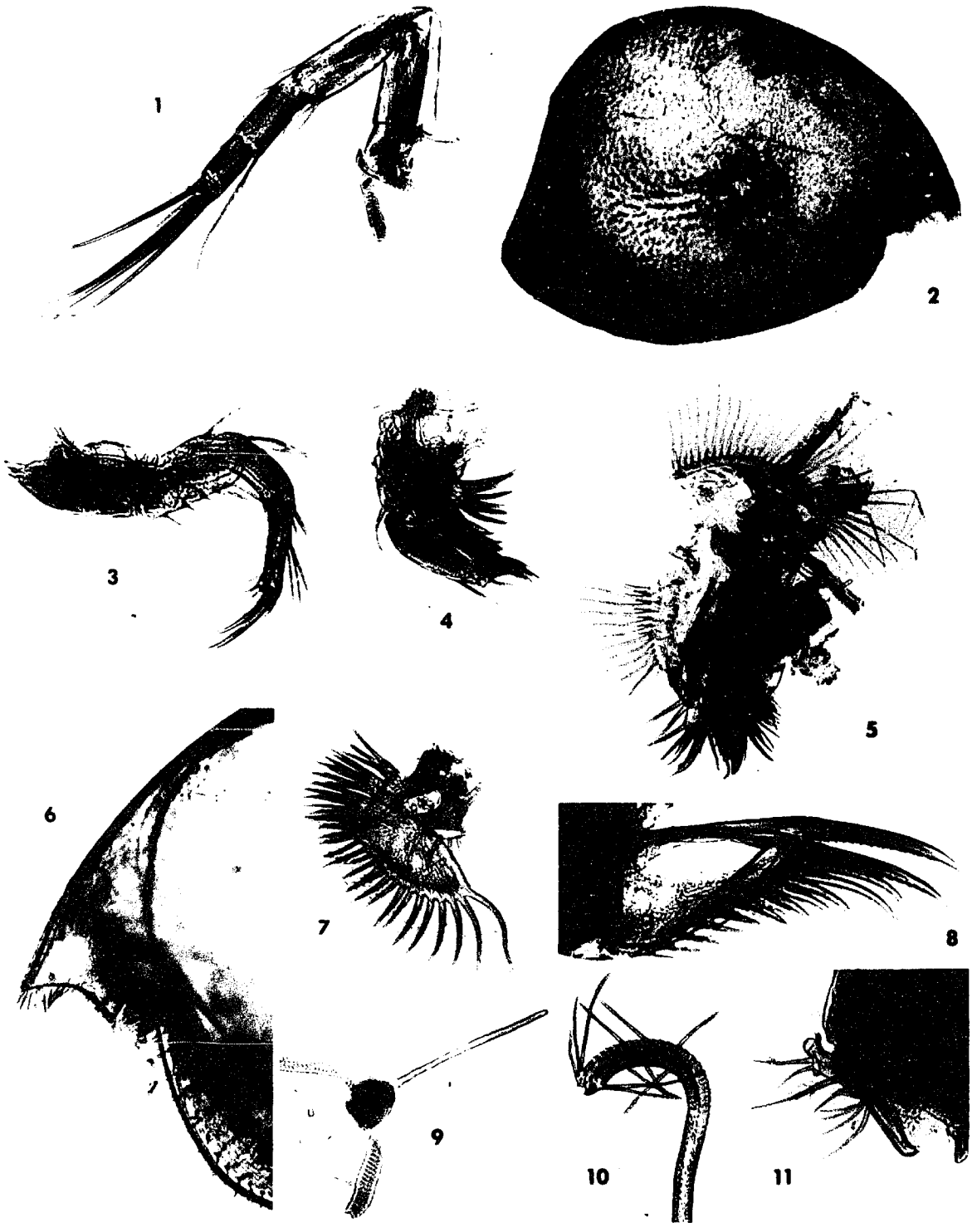


PLATE 10

PLATE 11

Figs. 1-9 Pseudophilomedes ferulana Kornicker

1,3,4,8 UMMP 48782, female; 1, dorsal view of furca, showing small lateral spines off principal claws, X87; 3, tip of distal process of maxilla, X870; 4, tip of distal seta of antennule, X870; 8, left valve from exterior, X43.

2,6,9 UMMP 48783, female; 2, distal portion of mandible showing palp, X175; 6, internal view of caudal process showing row of nodes, X130; 9, antenna, note verruciform endopod with terminal seta coming from behind basal podomere of exopod, X175.

5 UMMP 48784, female, furca, X87.

7 UMMP 48785, female, dorsal view of carapace showing sulci, X43.

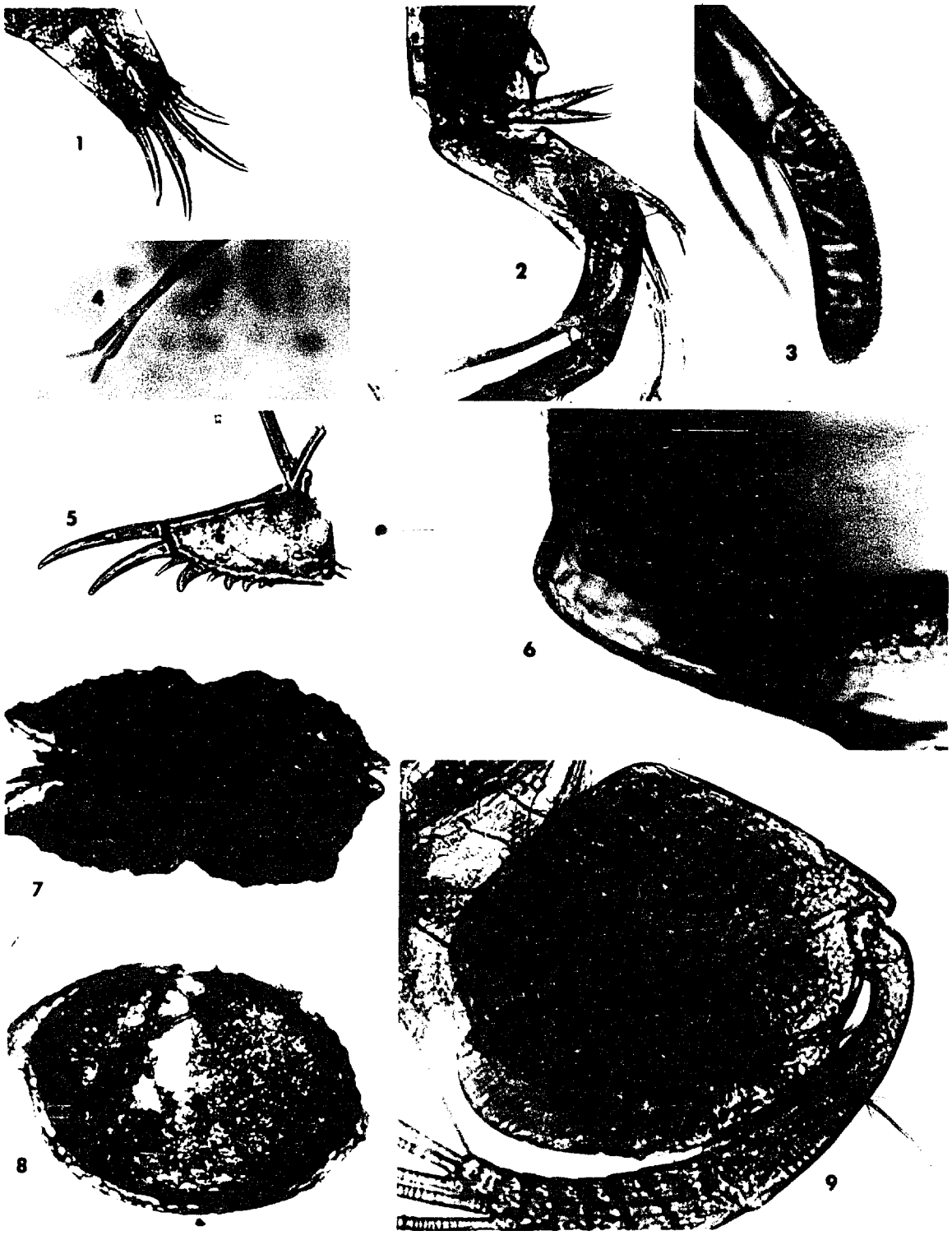


PLATE 11

PLATE 12

Figs. 1-8 Pseudophilomedes ferulana Kornicker

1,3,4,8 UMMP 48782, female; 1, antennule, dark spot near base is eye, X87; 3, maxilla, X87; 4, mandible, X87; 8, frontal organ, X87.

2,5-7 UMMP 48783, female; 2, antenna, X87; 5, fifth limb, X87; 6, sixth limb, X87; 7, seventh limb, X87.

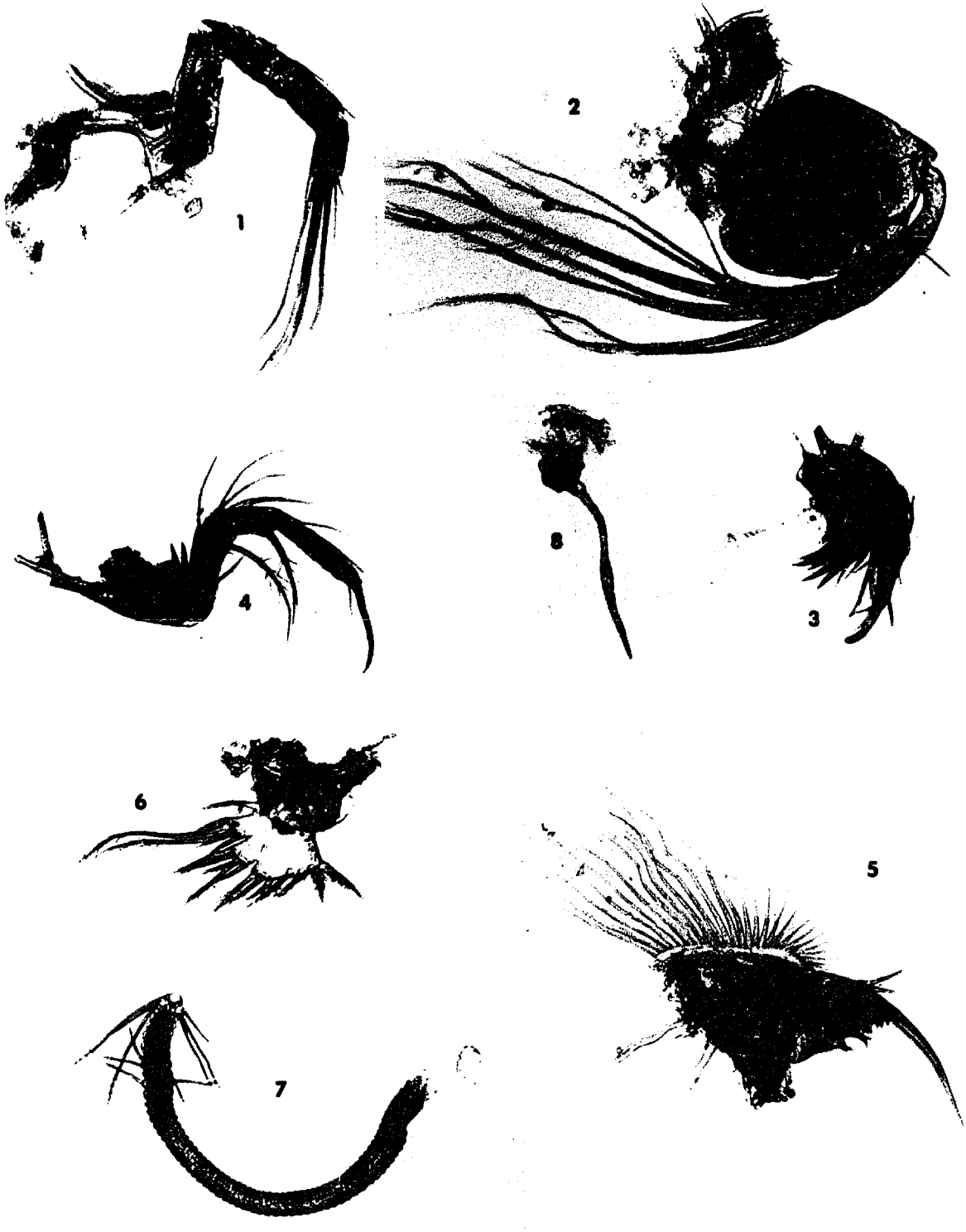


PLATE 12

PLATE 13

Figs. 1-9 Rutiderma dinochelata Kornicker

1-4,6-9 UMMP 48786, female; 1, antennule, X87; 2, antenna, X87; 3, mandible and maxilla, X87; 4, seventh limb, X87; 6, furcae, X87; 7, "toothed" portion of margin of antennal seta, X870; 8, frontal organ and eye, X175; 9, articulating chela, X435.

5 UMMP 48787, female; mandible, maxilla and fifth limb, X87.

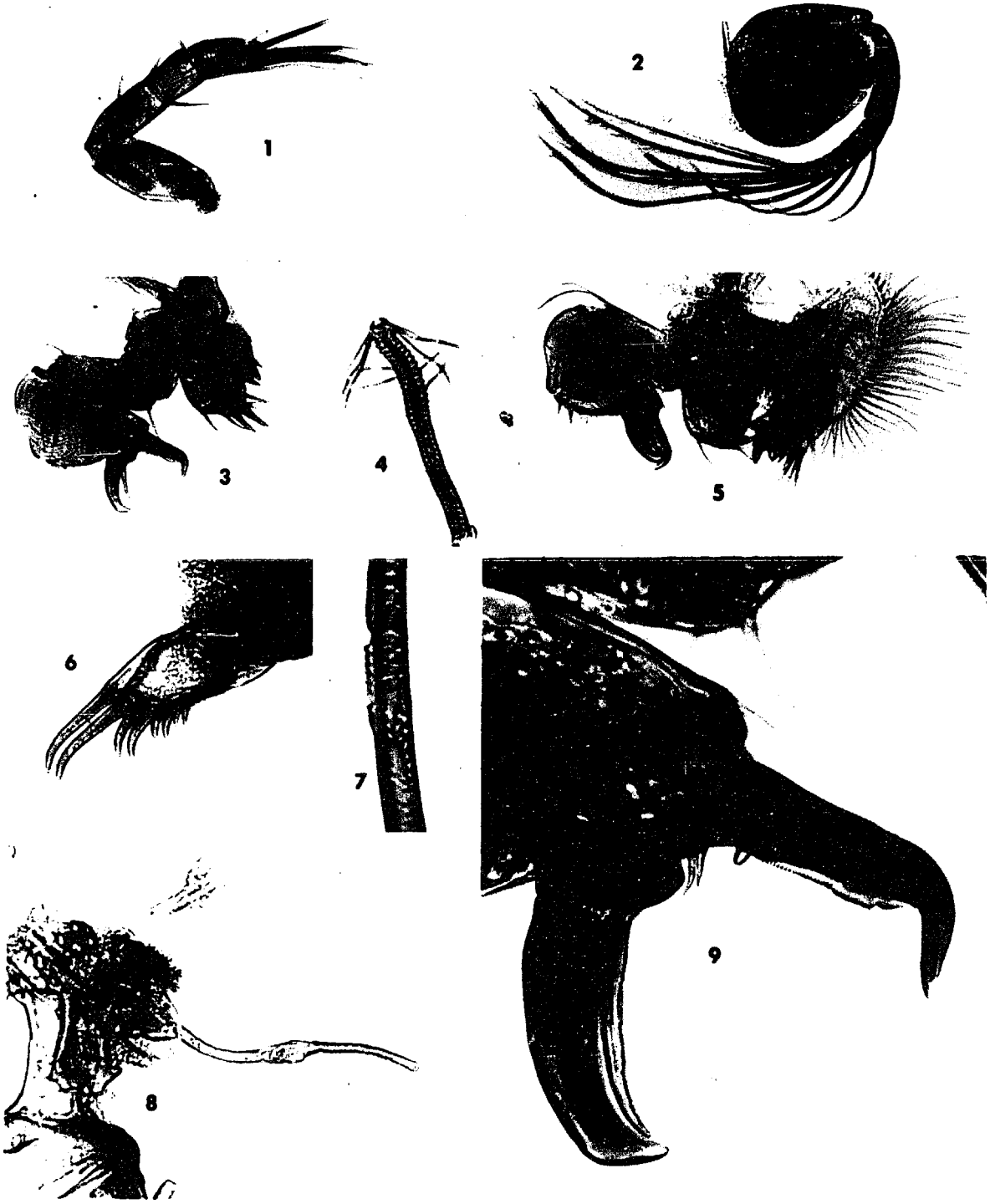


PLATE 13

PLATE 14

Figs. 1-7 Rutiderma dinochelata Kornicker

1 UMMP 48788, female, whole mount showing appendage orientation, note sixth limb by furcae, X87.

2 UMMP 48786, female, major claws of furcae showing secondary setation, X435.

3-5 UMMP 48789, female; 3, adductor muscle scar pattern, right valve exterior, X87; 4, adductor muscle scar pattern, left valve exterior, X87; 5, left valve exterior, X52.

6 UMMP 48790, female, copepod in stomach, X435.

7 UMMP 48787, female, inside view left caudal process showing setiferous flange, X435.



PLATE 14

PLATE 15

Figs. 1,2 Rutiderma mollita, n. sp.

1 UMMP 48791, female, holotype; right valve exterior, X52.

2 UMMP 48792, female, schematic of adductor muscle scar pattern, arrow indicates anterior.

Figs. 3-7 Asteropteron oculitristis, n. sp.

3, 5-7 UMMP 48793, male, holotype; 3, seventh limb, X87; 5, left valve exterior, X43; 6, adductor muscle scar pattern, inside left valve, anterior to right, X87; 7, raised pore cluster, X435.

4 UMMP 48794, male, paratype, furca, X52.



PLATE 15

PLATE 16

Figs. 1-8 Asteropteron oculitristis, n. sp.

1,2,5,7 UMMP 48794, male, paratype; 1, portion of antennule, X87; 2, antenna, note endopod on left, X87; 5, eye, note position of larger lenses - downward toward substrate, X175; 7, sixth limb, X87.

3,4,6,8 UMMP 48793, male, holotype; 3, maxilla, X87; 4, mandible, X87; 6, frontal organ, X87; 8, a pair of fifth limbs, X87.



PLATE 16

PLATE 17

Figs. 1-8 Cyclasterope biminiensis (Kornicker)

1 UMMP 48795, male, antennule, X65.

2,8 UMMP 48796, male; 2, antenna, X43; 8, showing form of endopod of male, note short basal spines (somewhat masked by natatory setae) of exopod podomeres, X175.

3 UMMP 48797, left valve exterior, showing irregular calcareous pattern, X30.

4,7 UMMP 48798, male; 4, frontal organ, note bilobation of basal ganglion, X87; 7, natatory setae of antenna, showing spinose pattern and subsetae, X435.

5,6 UMMP 48799, male; 5, eye lense pattern, X260; 6, inner view of rostrum, X435.

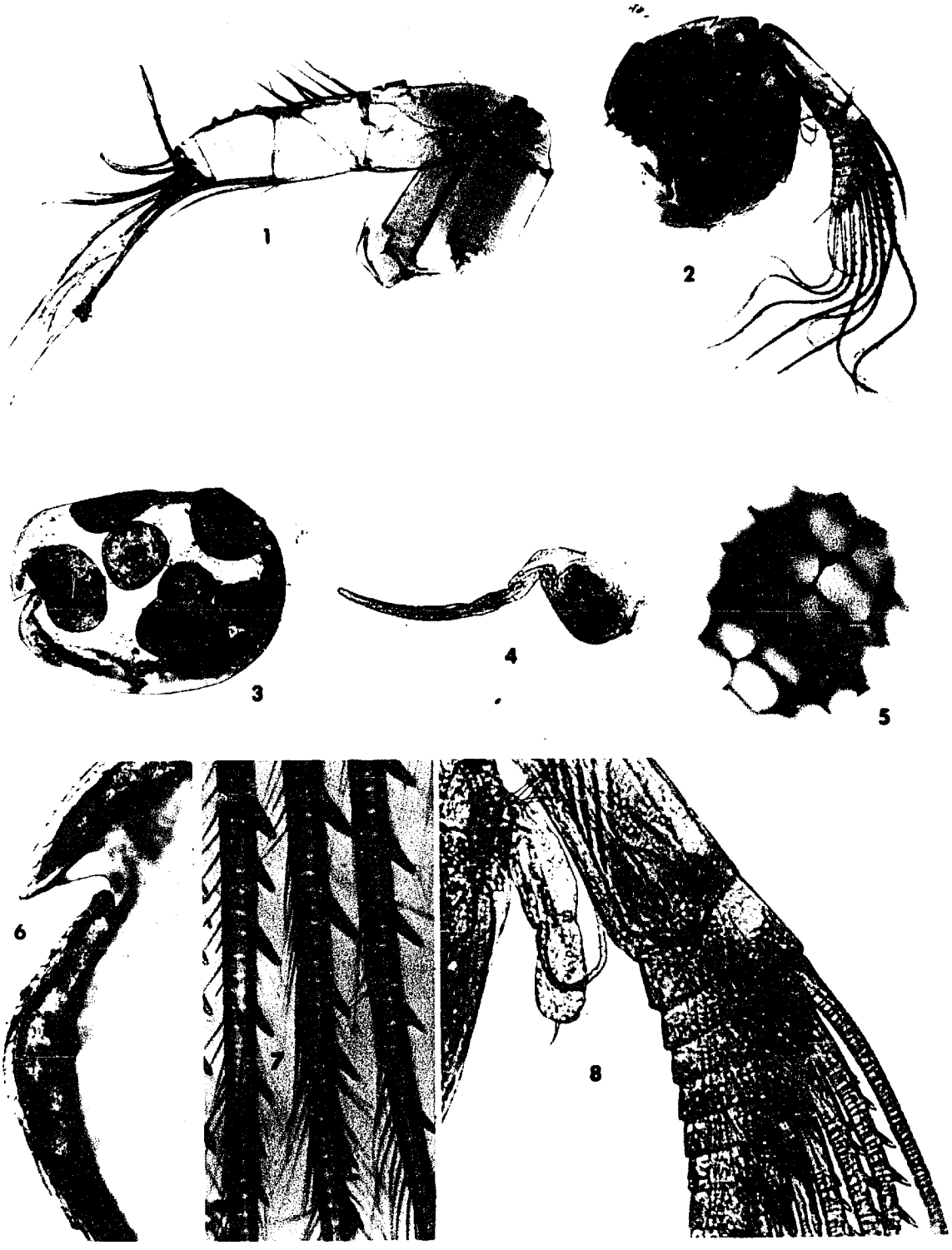


PLATE 17

PLATE 18

Figs. 1-7 Cyclasterope biminiensis (Kornicker)

1,5,6 UMMP 48798, male; 1, mandible, X87; 5, furcae, X87; 6, sixth limbs, X87.

2 UMMP 48795, male, maxilla, X87.

3 UMMP 48799, male, seventh limb, X87.

4 UMMP 48796, male, setae from ventral portion of second podomere of protopod of mandible, X435.

7 UMMP 48800, male, fifth limb, X65.

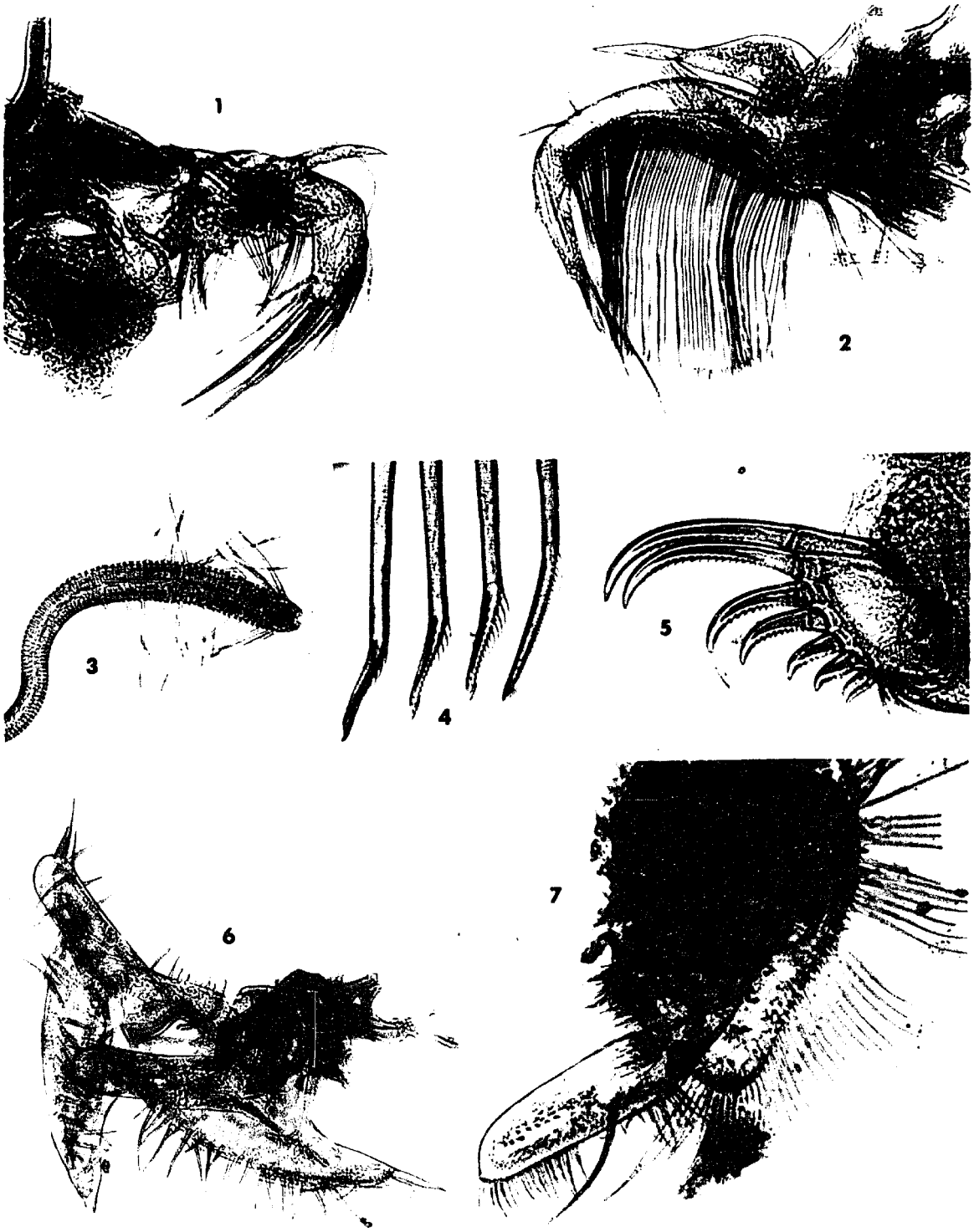


PLATE 18

PLATE 19

Figs. 1-4 Cyclasterope biminiensis (Kornicker)

1 UMMP 48795, male, setae of seventh limb showing calcareous algae growth, X435.

2 UMMP 48800, male, seventh limb, X87.

3 UMMP 48799, male, gills, anterior to right, X87.

4, schematic drawing of adductor muscles scar pattern, arrow indicates anterior.

Figs. 5,6 Cylindroleberis psitticina, n. sp.

5 UMMP 48802, male, antenna, X87.

6 UMMP 48801, female, holotype, left valve exterior, X52.

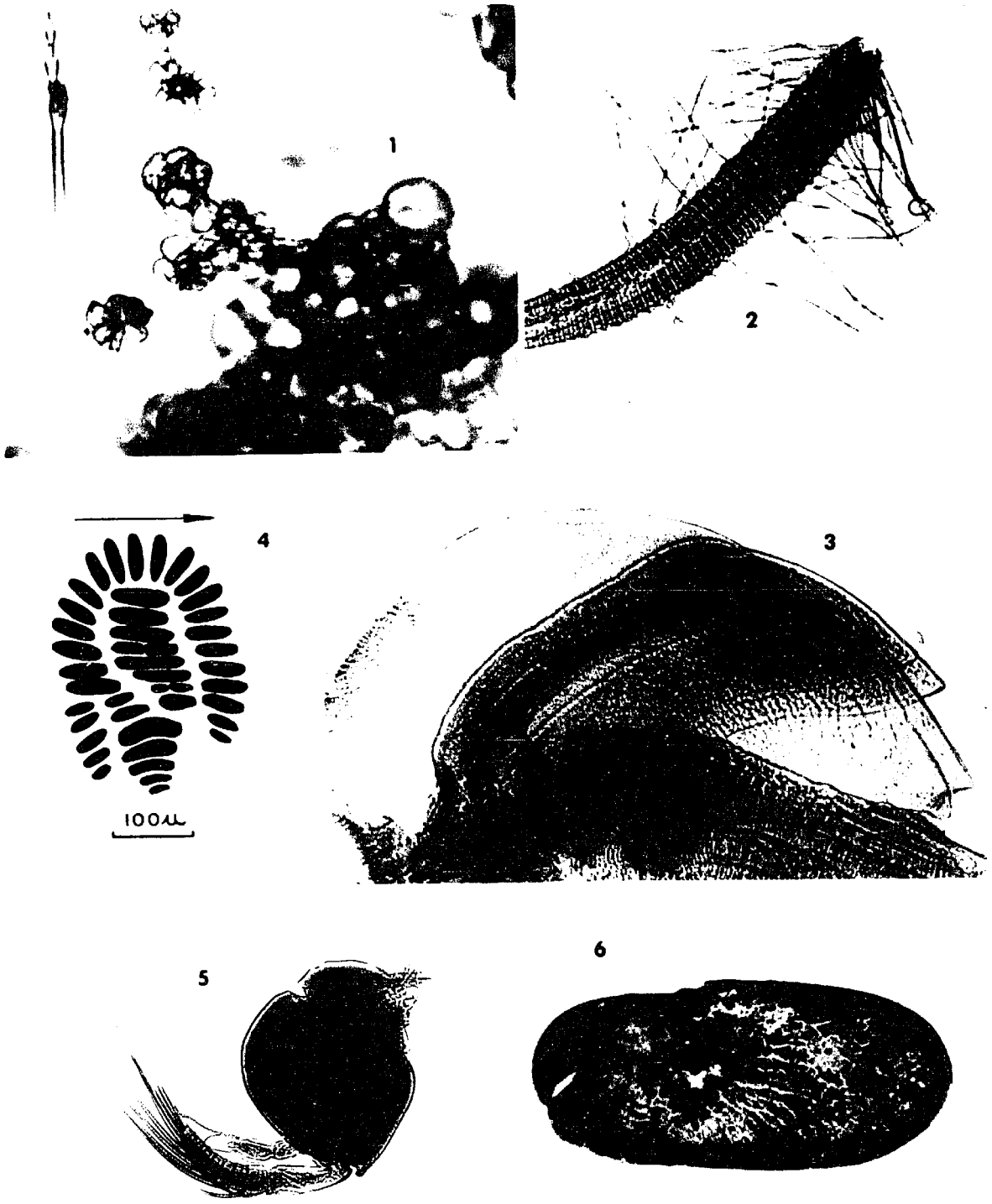


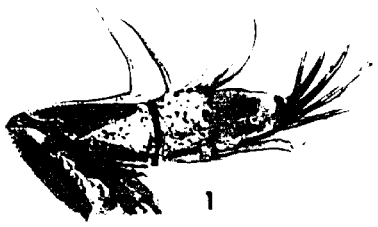
PLATE 19

PLATE 20

Figs. 1-9 Cylindroleberis psitticina, n. sp.

1,2,5,8 UMMP 48801, female, holotype; 1, antennule, X87; 2, mandible, X87; 5, frontal organ, X435; 8, furcae, largest distal pair of claws broken off at bases, X175.

3,4,6,7,9 UMMP 48802, male; 3, maxilla, X87; 4, frontal organ, X435; 6, fifth limb, X87; 7, eye, X435; 9, antennal endopod, X435.



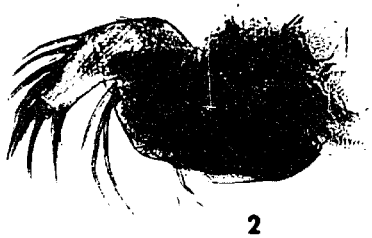
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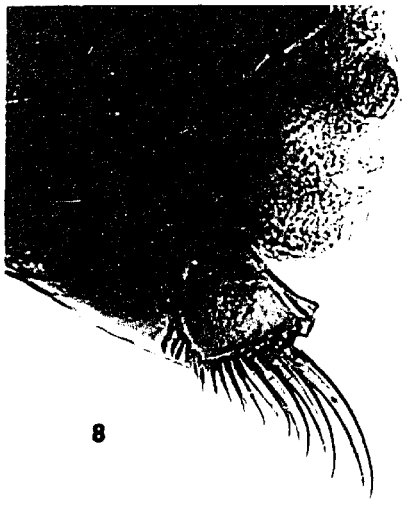




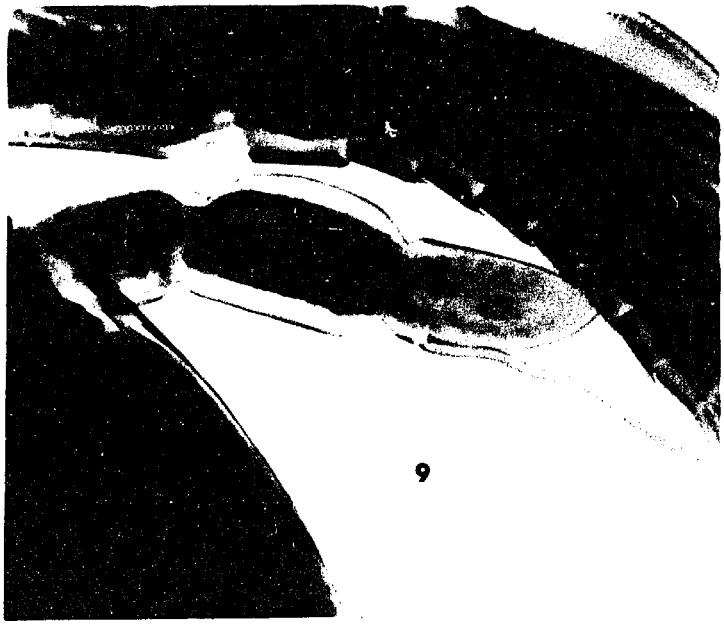
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PLATE 20

PLATE 21

Figs. 1-8 Sarsiella nodimarginis, n. sp.

1-8 UMMP 48803, female, holotype; 1, frontal organ and eye, X175; 2, antenna, X43; 3, antenmule, X87; 4, mandible, X87; 5, maxilla and sixth limb, X87; 6, furcae, X87; 7, fifth limb, X87; 8, antennal endopod, on left is elongate basal podomere of exopod, X435.



PLATE 21

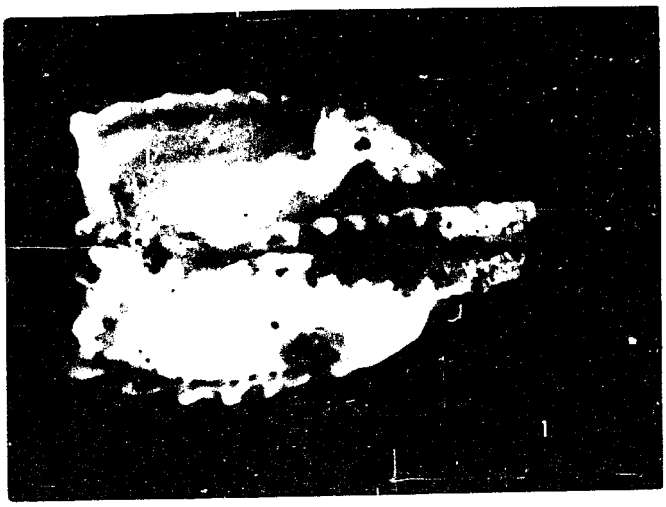
PLATE 22

Figs. 1,2 Sarsiella nodimarginis, n. sp.

1,2 UMMP 48804, female; 1, dorsal view of valves showing alae, X43; 2, right valve exterior, X43.

Figs. 3-8 Sarsiella sculpta Brady

3-8 UMMP 48805, female; 3, frontal organ, X87; 4, fifth limb, X87; 5, mandible, X87; 6, caudal process, X435; 7, left valve exterior, X43; 8, adductor muscle scars, anterior to left, X435.













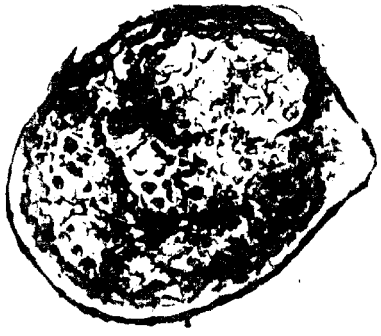




PLATE 22

PLATE 23

Fig. 1 Sarsiella sculpta Brady

1 UMMP 48805, newborn emerging from egg capsule, X87.

Figs. 2-9 Sarsiella pilipollicis, n. sp.

2-9 UMMP 48806, female, holotype; 2, end of seventh limb, X435; 3, antennule, X87; 4, maxilla, X87; 5, adductor muscle scars, right valve, anterior to right, X87; 6, furcae, note two vaginae at upper right, X87; 7, nodes, X175; 8, carapace surface, X435; 9, left valve exterior, X52.



PLATE 23

PLATE 24

Figs. 1-11 Sarsiella radiicosta, n. sp.

1,5 UMMP 48807, female, holotype; 1, whole mount showing appendage orientation, an antennule and antenna have been removed, note two eyes, seventh limbs projecting dorsally, X52; 5, two terminal podomeres of maxillary endopod, typical of genus, X435.

2-4,6,7,10,11 UMMP 48808, female; 2, antennule, X87; 3, antenna, X87; 4, mandible, X87; 6, left valve exterior, X52; 7, right valve exterior, X52; 10, maxilla and fifth limb, X87; 11, eye, X435.

8,9 UMMP 48809, female; 8, left valve exterior, X52; 9, right valve exterior, X52.



PLATE 24

PLATE 25

Fig. 1 Sarsiella radiicosta, n. sp.

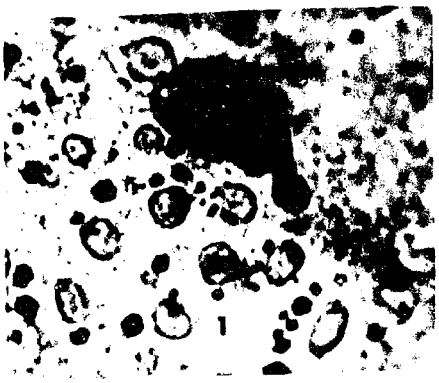
1 UMMP 48808, female, adductor muscle scars, left valve, anterior to left, X260.

Figs. 2-9 Sarsiella georgiana, n. sp.

2-9 UMMP 48810, male, holotype; 2, frontal organ, dark mass is an eye, X87; 3, left valve exterior, X52; 4, antennule, note bristles "baleen" off third podomere, typical of males of genus, X87; 5, endopod (?), X175; 6, antenna, X87; 7, antenna showing grasping form of endopod, X175; 8, sixth limb, X87; 9, furcae and penis, X87.

Figs. 10-12 Sarsiella rousei, n. sp.

10-12 UMMP 48811, female, holotype; 10, furcae, X87; 11, frontal organ, X87; 12, antennule, X87.

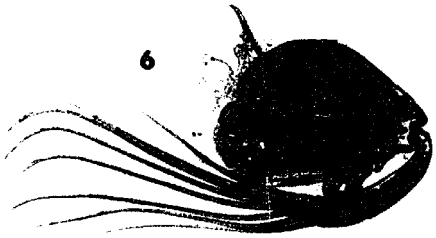

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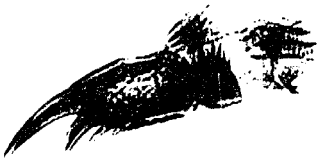

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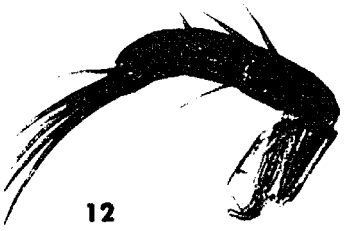

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PLATE 25

PLATE 26

Figs. 1-3 Sarsiella rousei, n. sp.

1-3 UMMP 48811, female, holotype; 1, left valve interior showing slight rostrum, atypical of female of genus, X87; 2, whole mount both antennae removed, note arthropod remains in gut, X87; 3, left valve exterior, X52.

Figs. 4-6 Sarsiella angusta, n. sp.

4-6 UMMP 48813, female, holotype; 4, left valve exterior X52; 5, antennule, X87; 6, seventh limb, X87.

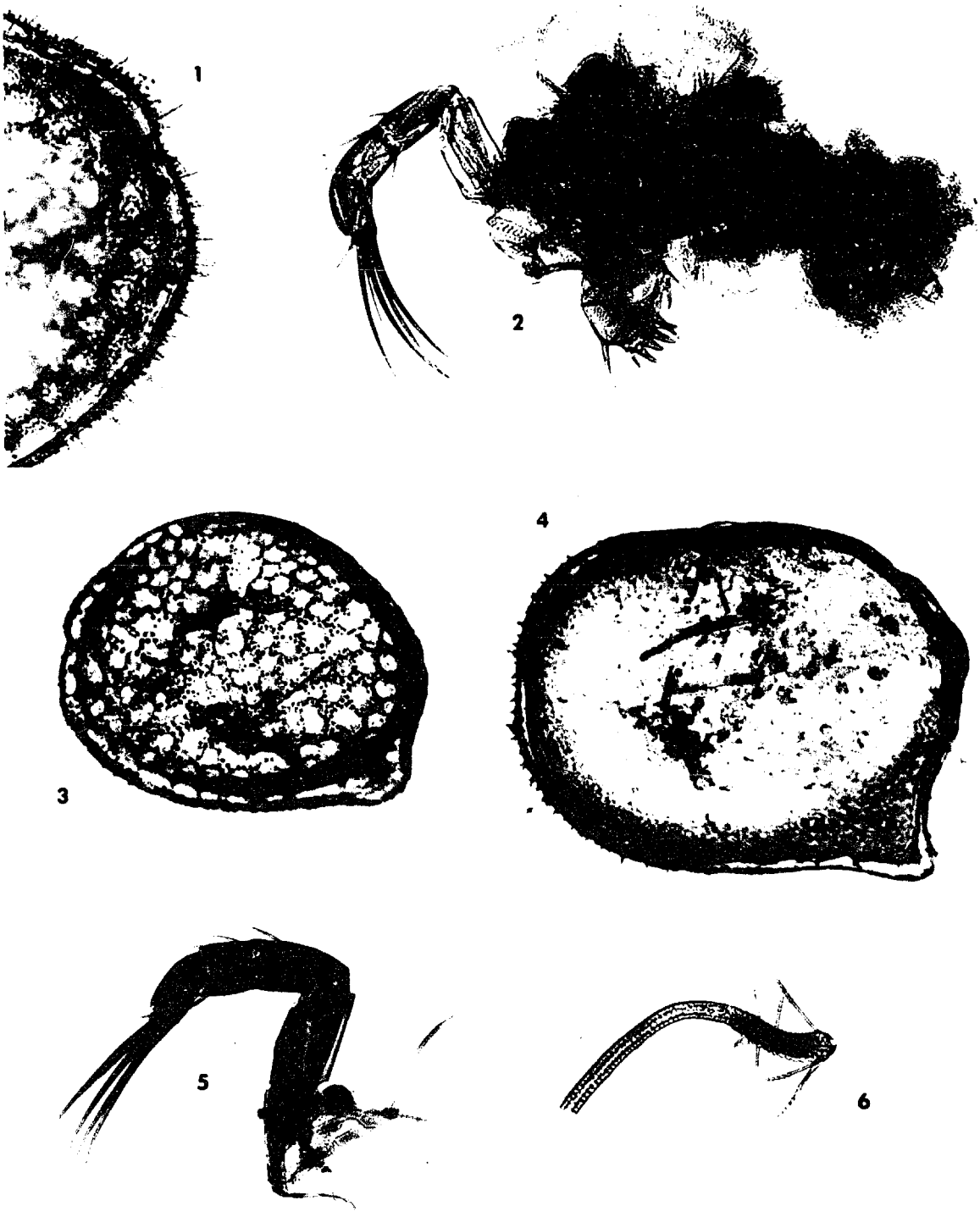


PLATE 26

PLATE 27

Figs. 1-19 Sarsiella greyi, n. sp.

1-9 UMMP 48814, female, holotype; 1, antennule, X87; 2, fifth limb, X87; 3, mandible, X87; 4, frontal organ, X87; 5, seventh limb, X87; 6, sixth limb, X87; 7, furcae, X87; 8, copepod in stomach, X175; 9, right valve exterior showing irregular growth of calcium carbonate, X43.

10 UMMP 48815, female, right valve exterior, noncalcareous specimen, note the posterodorsal outpouching serving as brood space, X43.



PLATE 27

PLATE 28

Figs. 1-7 Sarsiella greyi, n. sp.

1-7 UMMP 48816, male; 1, antennule, X87; 2, mandible, X87; 3, maxilla, X87; 4, left valve exterior, X43; 5, furca and what may be a reduced copulatory organ, X260; 6, antennal endopod, exopod has been removed, X260; 7, furcae and possible copulatory organ, reverse view of figure 5, X260.

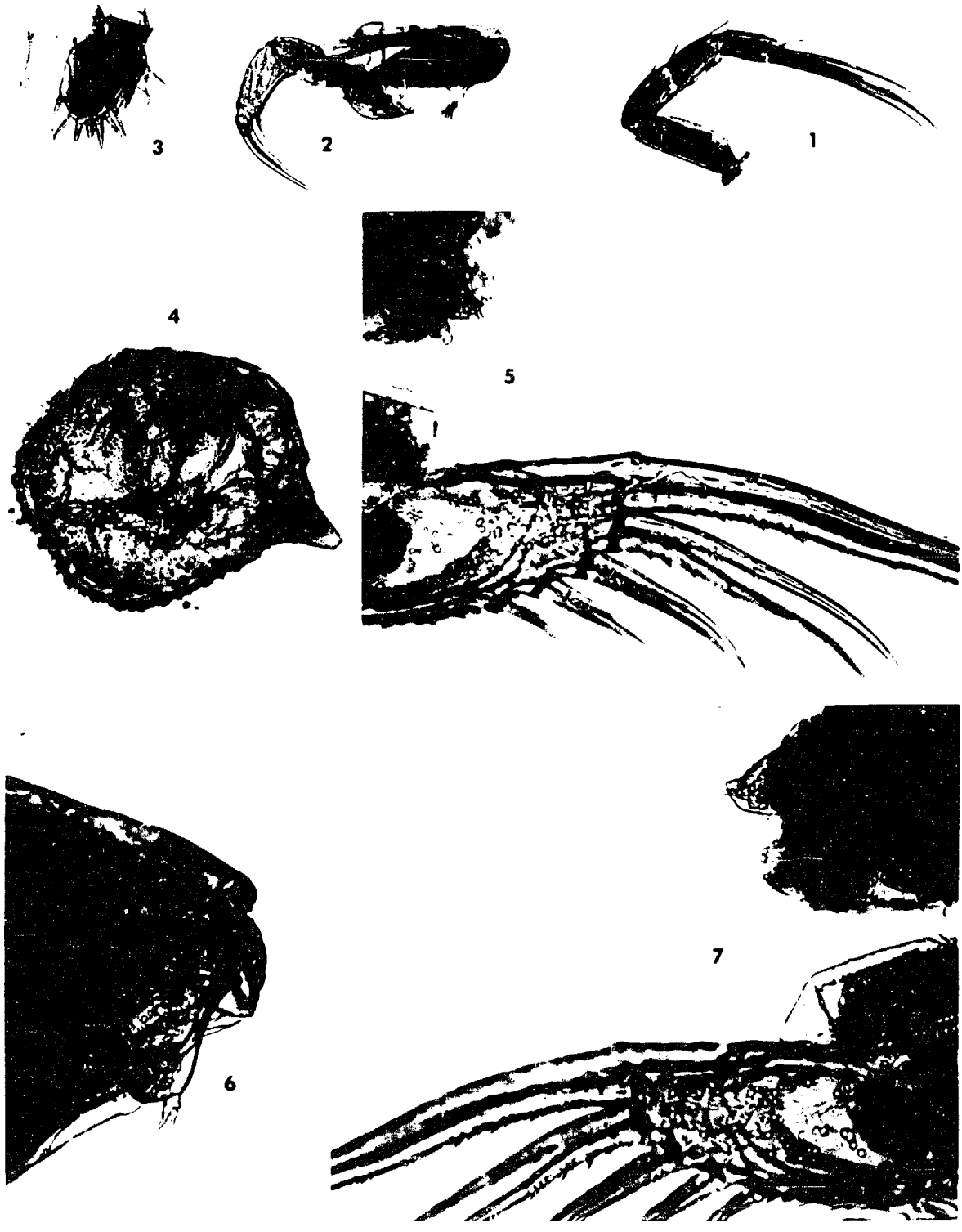


PLATE 28

PLATE 29

Figs. 1-11 Sarsiella tubipora, n. sp.

1-11 UMMP 48817, female, holotype; 1, antennule, X87; 2, mandible, X87; 3, antenna, X87; 4, maxilla, X87; 5, sixth limb, X87; 6, fifth limb, X87; 7, antennal setae, X435; 8, furcae, X175; 9, shell surface showing tube-pores surrounding reticules, X435; 10, edge of shell surface showing tube-pores, X435; 11, left valve exterior, X43.

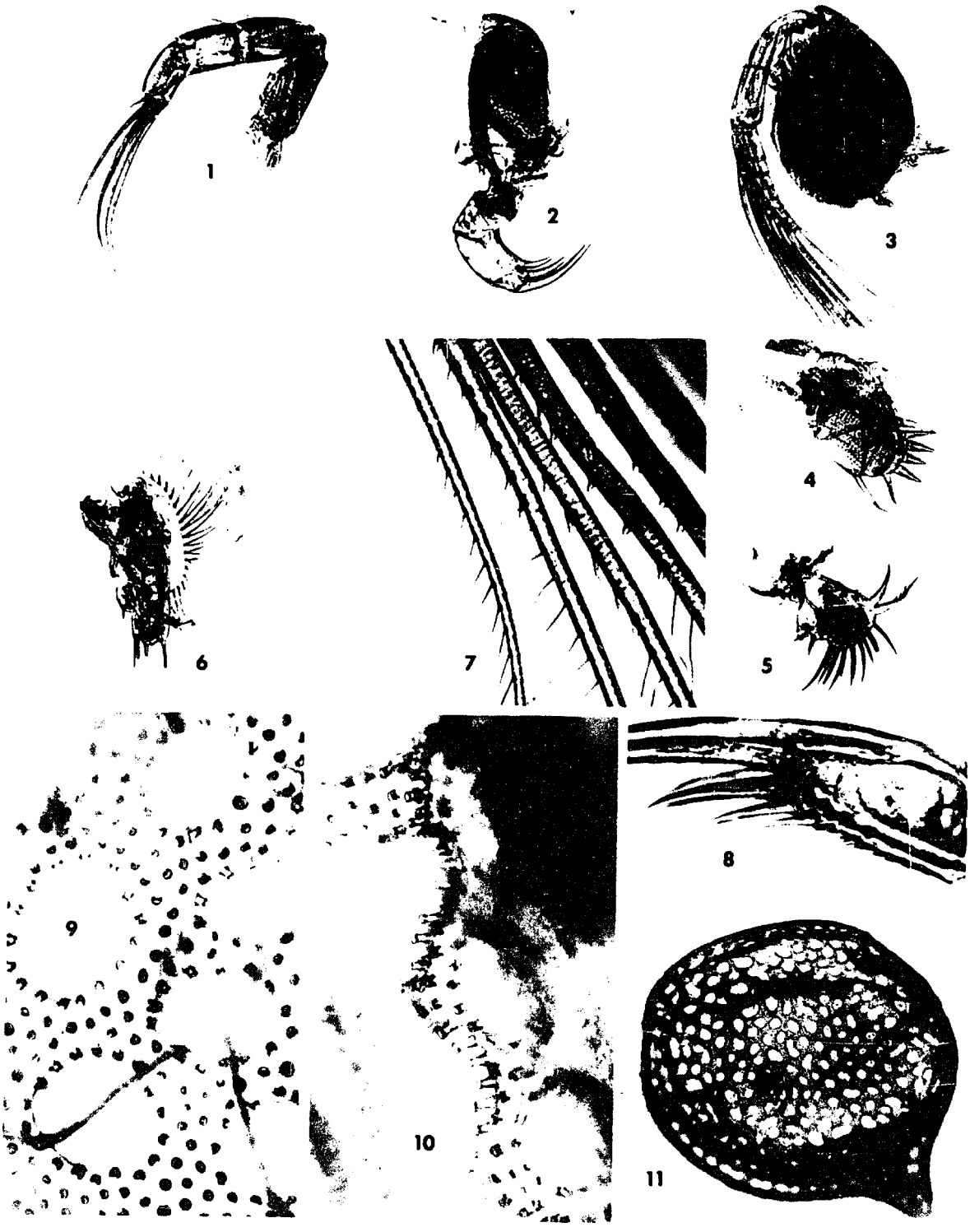


PLATE 29

PLATE 30

Figs. 1-7 Sarsiella disparalis, n. sp.

1 UMMP 48818, female, left valve exterior showing median lateral ridge, dorsal and ventral alar projections are present but do not stand out; X43.

2-6 UMMP 48819, female, holotype; 2, left valve exterior showing lack of ornamentation, cf. figure 2, plate 31, the right valve of this specimen has alae as does figure 1, this plate, X43; 3, egg with first instar emerging, note rudimentary antennule and antenna, X175; 4, frontal organ, X87; 5, seventh limb, X175; 6, vagina, X870.

7 UMMP 48820, female, glands in proximal portion of furca, X175.

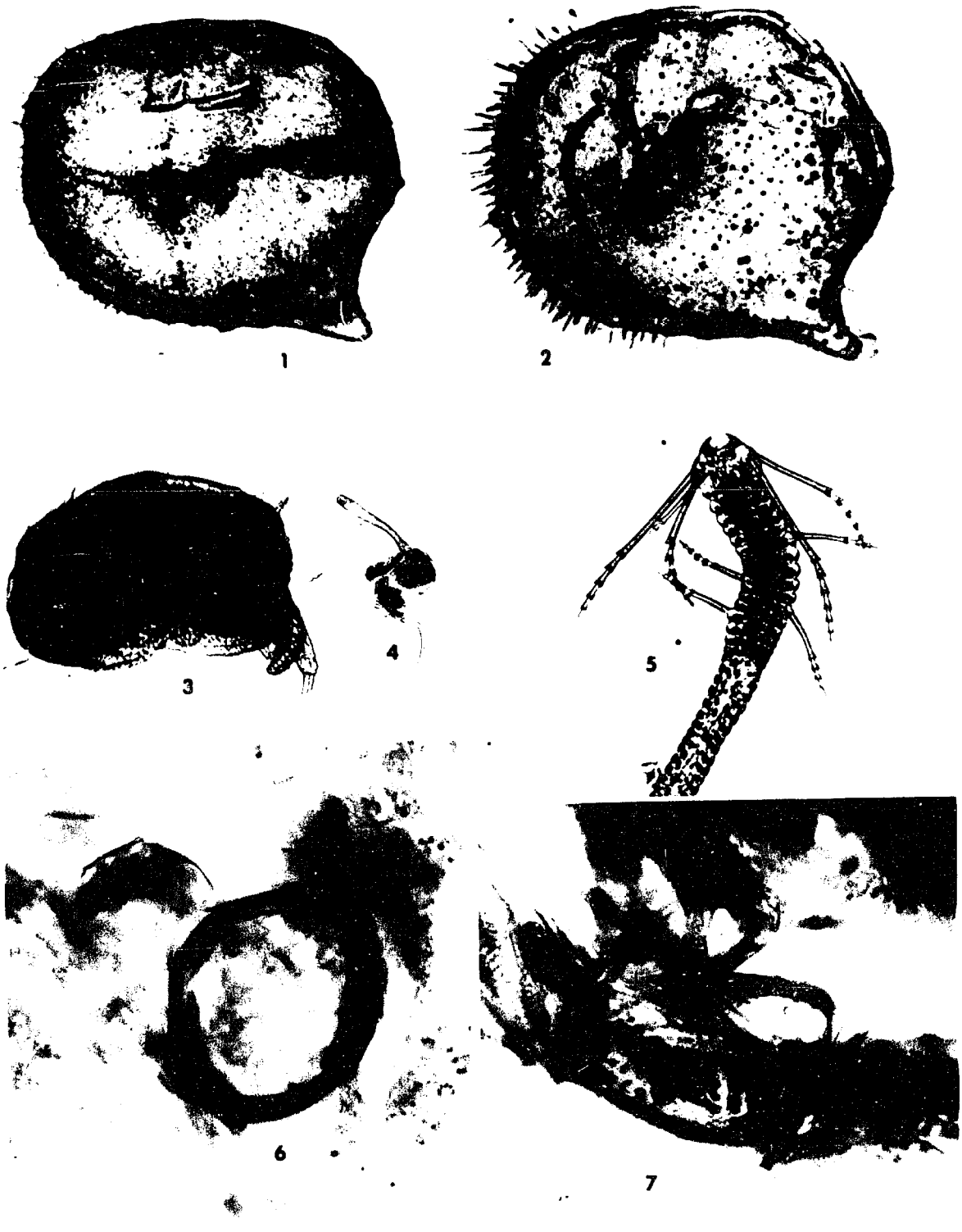


PLATE 30

PLATE 31

Figs. 1-8 Sarsiella disparalis, n. sp.

1,2,4-7 UMMP 48819, female, holotype; 1, antennule, X87; 2, silhouette, ventral view, of valves showing extreme asymmetrical ornamentation, X43; 4, antennal endopod, exopod broken off, X26; 5, sixth limb, X87; 6, furcae, X87; 7, fifth limb, X87.

3,8 UMMP 48818, female; 3, antenna, X87; 8, mandible, maxilla, portion of fifth limb, X87.



PLATE 31

PLATE 32

Figs. 1-9 Euconchoecia chierchiae Mueller

1,3,4,6,7 UMMP 48821, male; 1, antennule and labrum, X87; 3, fifth limb, X87; 4, mandible, X87; 5, sixth limb, X87; 6, maxilla, X87; 7, seventh limb, X87.

2 UMMP 48822, male, whole mount, an antennule and antenna have been removed, note long sexually distinctive antennal seta, dark mass in main body is stomach, X52.

8 UMMP 48823, male, grasping organ of right endopod of antenna, X435.

9 UMMP 48824, male, antenna, X87.

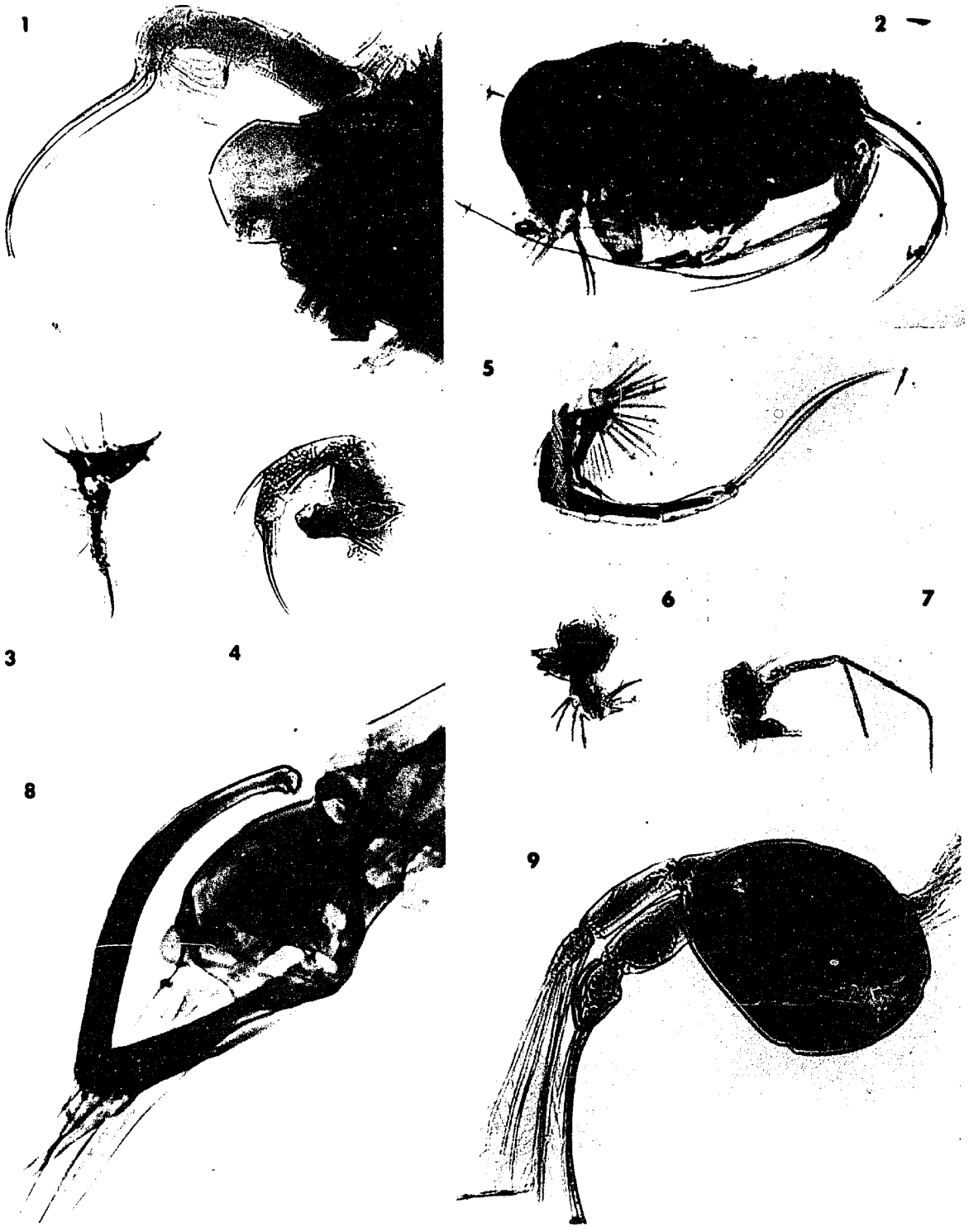


PLATE 32

PLATE 33

Figs. 1-9 Euconchoecia chierchiae Mueller

1 UMMP 48825, female, complete animal bearing eggs, X52.

2 UMMP 48826, female, diatom entering mouth, maxillae aiding, X435.

3 UMMP 48827, female, antennule, X87.

4,7-9 UMMP 48824, male; 4, dorsal view of posterior of valves showing glands and spine off right valve, X87; 7, adductor muscle scar of right valve, anterior toward top, dorsal to left, cf. fig. 6, X435; 8, adductor muscle scar of left valve, anterior toward top, dorsal to right, cf. fig. 6, X435; 9, external view of valves, central overlap caused by flattening the chitinous test, X52.

5 UMMP 48821, male, penis, X87.

6 UMMP 48822, male, adductor muscle scar of left valve, internal view, anterior toward top, dorsal to left, note variance with the more common type scars of figs. 7 & 8, X435.

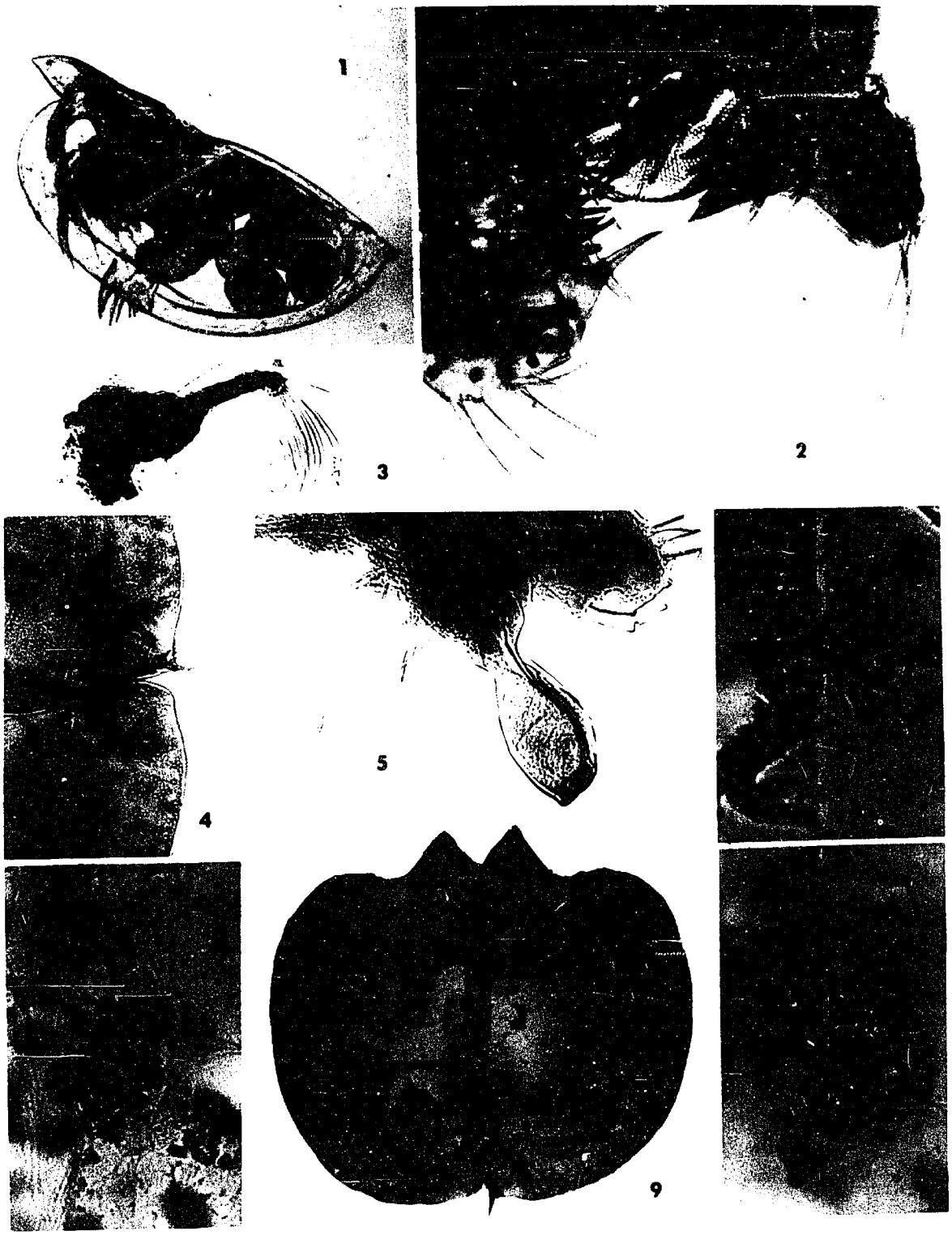


PLATE 33