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# ARTHROPODA

ARTICLE 5

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RECENT OSTRACODES OF KNYSNA ESTUARY,  
CAPE PROVINCE, UNION OF SOUTH AFRICA

By RICHARD H. BENSON and ROSALIE F. MADDOCKS



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## ABSTRACT

Seven sediment samples collected from the intertidal zone on the shores of Knysna Estuary, which is about 300 miles east of Cape Town, Union of South Africa, yielded specimens representing 17 species of Recent estuarine and lagoonal podocopid ostracodes. One new genus, *Sulcostocythere* and eight new species: *Paracypris westfordensis*, *Aglaiella railbridgensis*, *Perissocytheridea estuaria*, *Sulcostocythere knysnaensis* (designated type-species of *Sulcostocythere*), *Cytheretta knysnaensis*, *Loxococoncha parameridionalis*, *L. megapora*, and *Aurila dayii* are described; six additional new forms of hemicytherids and trachyleberids are described, but because of insufficient material these have not been named; one form with a definite affinity to a previously described species, *Cytherella* sp. aff. *C. punctata* BRADY, 1866, one species with a questionable identification, *Bairdia villosa?* BRADY, 1880, and one previously described species *Xestoleberis capensis* MÜLLER, 1908 are described.

The transition along the estuary from mesohaline to euhaline conditions is reflected by changes in the composition of the ostracode population. *Paracypris westfordensis*, the only ostracode species present at Westford Bridge (Sal. 16.5-21.7‰), is the predominant species at Ashford (Sal. 18-24‰), associated with *Perissocytheridea estuaria*, *Loxococoncha parameridionalis*, and *Sulcostocy-*

*there knysnaensis*. This assemblage is also found at Rail Bridge (Sal. 30-31‰), except that *Paracypris westfordensis* is replaced by *Aglaiella railbridgensis*. At Leisure Isle, where the salinity is near that of the open sea, all of the typical estuarine species except *Paracypris westfordensis* are represented. The predominant species of this rich ostracode fauna are *Aurila dayii* and *Cytheretta knysnaensis*.

At Rail Bridge four samples were obtained from different levels within the intertidal zone. Each sample contained a fauna represented by a characteristic predominant species. *Aglaiella railbridgensis* is predominant at low-water spring tide level; *Sulcostocythere knysnaensis* is predominant at low-water neap tide level; *Loxococoncha parameridionalis* is the most abundant member of the sparse fauna at mid-tide level; *Perissocytheridea estuaria* is abundant and the characteristic species present at high-water tide level. Each of these species is present at the other levels as well, but in reduced abundance.

Most of the species described from the Knysna fauna are not easily classified within the established European and North American generic categories; their assignments must be considered as temporary, awaiting further studies of relationships among Southern Hemisphere ostracodes.

## INTRODUCTION

Until recently the general estuarine and marine fauna of South Africa has been very poorly known. Since 1947 the Zoology Department of the University of Cape Town has been conducting a long-term detailed investigation of the composition and ecology of the fauna inhabiting the estuarine and coastal waters of the Union of South Africa. A detailed survey of conditions in Knysna Estuary was conducted and results published by DAY, MILLARD & HARRISON (1951). Studies so far have been confined mainly to the larger benthonic animals; most of the microscopic forms have not yet been identified. The purpose of the present study is to supplement this survey by the identification of the podocopid ostracode species and the discussion of their distribution within the estuary.

Knysna Estuary is well suited for the location of a preliminary investigation of South African ostracodes. It has the richest fauna of larger benthonic invertebrates, in numbers of species and of individuals, of any of the South African estuaries. It is also open to the sea throughout the year, unlike many of the eastern estuaries that are closed for part of the year. Thus, the fauna is fairly stable, and samples collected at a single time of the year are reasonably representative of the average conditions. The salinity of the seaward lagoon approaches normal marine, and

the ostracode population there contains representatives of the coastal fauna outside the estuary.

This study of Knysna Estuary constitutes the first part of a general survey of South African marine podocopid ostracodes. The second part will be a description of the marine Podocopa from the continental shelf near Knysna.

## PREVIOUS STUDIES

The investigations of South African estuaries conducted by the Zoology Department of the University of Cape Town have been published as a series of reports in the Transactions of the Royal Society of South Africa. Part III of this series, by J. H. DAY, N. A. H. MILLARD, and A. D. HARRISON (1951), summarizes the general physical and biological conditions of Knysna Estuary but includes no discussion of the ostracodes. G. O. SARS (1924) described the fresh-water ostracodes of Knysna Swamp; the brackish-water and marine ostracodes have never been described. The only known example of a terrestrial ostracode, *Mesocypris terrestris* HARDING, was described from Knysna Forest by HARDING (1953, 1955). G. S. BRADY (1880) described 12 new species of marine Podocopa collected by the *Challenger* Expedition from Simon's Bay (Fig. 1),

and two additional species were reported from Station 142 (150 fathoms), south of Cape of Good Hope. G. W. MÜLLER (1908) described six new species of marine Podocopida from the vicinity of Simonstown. The only fossil ostracodes known to date from the Union of South Africa were described by CHAPMAN (1904, 1923) from Cretaceous sediments of East Pondoland.

### COLLECTING LOCALITIES

Seven samples of bottom sediment were collected from the shores of Knysna Estuary between tide levels with a maximum range of six feet. Two of these samples are from the upper reaches of the estuary, at Ashford and at Westford Bridge, at low-water level of neap tide. Four samples were taken from the shore at Rail Bridge, about midway along the estuary. These samples were taken at four different levels within the intertidal zone: At low-water level of spring tide, at approximate low-water level of neap tide, at approximate mid-tide level, and at approximate high-water level of neap tide. A sample was taken in the euhaline environment at Leisure Isle near the mouth of the estuary, at low-water level of neap tide. The exact locations of these samples are shown in Figure 2 and Figure 3. These samples are identified as follows:

- KNY.216A-Z Knysna Estuary at Westford Bridge, low-water level of neap tide, 10/7/60
- KNY.217A-Z Knysna Estuary at Ashford, low-water level of neap tide, 8/7/60
- KNY.218A-Z Knysna Estuary at Leisure Isle, low-water level of neap tide, 7/7/60
- KNY.219A-Z Knysna Estuary at Rail Bridge, low-water level of spring tide, 29/12/60

### DESCRIPTION OF KNYSNA ESTUARY

Knysna Estuary is located (Fig. 1) on the South Coast of the Union of South Africa, more than 300 miles east of Cape Town and approximately 150 miles west of Port Elizabeth (lat. 34°4'S., long. 23°3'E.). The Knysna River, which originates about 40 miles to the north in the Outeniqua mountain range, forms the estuary. The estuarine portion, about 12 miles long, is a drowned river valley rapidly being filled in with sediment. The mouth of the estuary is a deep, permanently open channel constricted between the two rocky headlands of Knysna Heads. Behind the headlands the river widens into a shallow sound with a maximum width of more than two miles. The ocean swell breaks with great force on the rocky headlands and on the bay-mouth shoal, but the protected waters

KNY.220A-Z Knysna Estuary at Rail Bridge, approximate low-water level of neap tide, 29/12/60

KNY.221A-Z Knysna Estuary at Rail Bridge, approximate mid-tide level, 29/12/60

KNY.222A-Z Knysna Estuary at Rail Bridge, approximate high-water level of neap tide, 29/12/60

### LABORATORY METHODS

The specimens studied for this report were obtained from samples of bottom sediment sent to us from South Africa. In many cases the soft-parts of the recently dead animals were intact though not in workable condition. Particular attention was paid to the morphology of the carapace, as this could be most easily correlated with previously described species and genera with the large quantity of "fossil" material at hand. Dissections were undertaken on the soft-parts of the cyprid specimens whenever possible in order to confirm the generic designation based on carapace structures. Also the soft-parts of some of the cytheracean species were inspected to confirm the suspected presence of sexual dimorphism.

### ACKNOWLEDGMENTS

The sediment samples for this investigation were collected and given to us by Prof. J. H. DAY, Department of Zoology, University of Cape Town. Prof. DAY and his assistant Miss MULLINS supplied the geographic information concerning the collecting localities of these samples, as well as a summary of known distribution of ostracode species around southern Africa. Prof. DAY also provided a reprint of the 1951 study, from which the geographic and ecologic description of Knysna Estuary that follows has been summarized.

of the sound or lagoon are very quiet. The township of Knysna is located on the east shore of the sound, which is called "lagoon" by DAY, MILLARD, and HARRISON, 1951, but is doubtfully so in the commonly understood geologic sense. Two permanent islands exist within the sound: Paarden Island, which is low and marshy, and Leisure Isle, a sandy dune-covered island used as a pleasure resort. The sound narrows upstream to a winding channel bordered by mud flats. The upper limit of the estuary is at Charlesford Rapids, 12 miles by way of the channel from the mouth, where the bed of the river rises rapidly in elevation and Knysna River is no longer affected by tidal changes.

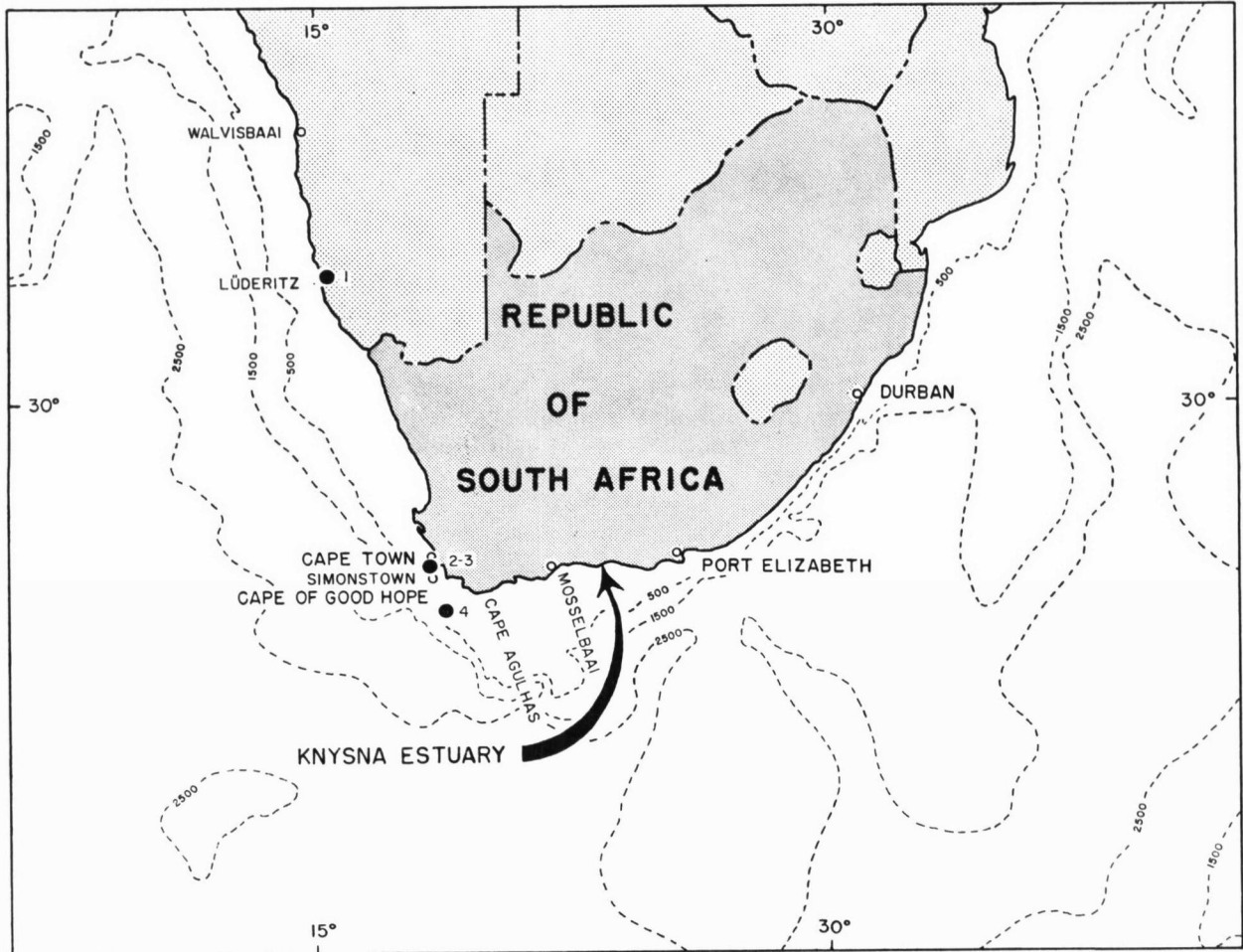


FIG. 1. Location of the study area in the Union of South Africa about 300 miles east of Cape Town. Previous study localities are indicated: 1, KLIE, 1940; 2, 4, BRADY, 1880; 3, MÜLLER, 1908.

### TEMPERATURE

The South Coast of Africa, as far west as Agulhas Banks, is influenced by the southeast-flowing, warm-water Agulhas Current. This current flows at a distance from shore, generating counter currents that are present closer to shore. The average sea temperature at Knysna Heads is  $16.8^{\circ}\text{C}$ ., varying from a low of  $13.5^{\circ}\text{C}$ . in August to a high of  $19.85^{\circ}\text{C}$ . in February (ISAAC, 1937). These temperatures are somewhat lower than those recorded on the East Coast but warmer than the water temperatures of the Cape Town area and the West Coast. Because the estuarine waters are affected by changes in air temperature, they are warmer than the sea in the summer, colder in winter. The most extreme temperatures are recorded in the upper part of the estuary, ranging from  $12^{\circ}\text{C}$ . to  $29^{\circ}\text{C}$ .

### SALINITY AND TIDAL CHANGES

The tidal range at Knysna Heads is about 6 feet. Because the mouth of the estuary is deep and open, this tidal range is maintained for a great distance up the estuary, as far as Westford Bridge. Beyond this point the effect of tides diminishes very rapidly.

The river discharge is relatively weak because of the small size of the drainage basin, but it is sufficiently strong to maintain a clearly marked salinity gradient from Charlesford Rapids to the sea. The river occupies a deep, well-defined channel flanked by broad tidal flats. For six miles from the mouth inland the estuary is a wide shallow sound, which has a relatively constant salinity very close to that of the open sea. Farther up the estuary the salinity decreases rapidly and fluctuates through a broad range. The salinity in the areas of the Westford Channels and

Charlesford Rapids is affected immediately by local rain-storms and drought conditions as well as by tidal changes. The variations in average salinity at high and low tide at the sample stations are as follows: Leisure Isle 33‰-35‰, Rail Bridge 31‰-30‰, Ashford 18‰-24‰, Westford Bridge 16.5‰-22‰.

### SEDIMENT

This section represents a summary of the observations by DAY, MILLARD and HARRISON, 1951. Between the Old Drift and Belvedere the channel and banks are of soft black mud. At Belvedere banks of muddy sand are present along the channel, but mud occupies the backwater areas. From the Point to Leisure Isle the substrate is dominantly muddy sand. The clean sands of Leisure Isle are replaced seaward by the rocky outcrops of Fountain Point and Knysna Heads.

### MAJOR DIVISIONS OF THE ESTUARY

DAY, MILLARD, and HARRISON (1951) distinguish the following broad divisions of Knysna Estuary (p. 382):

"I. *Knysna Heads*, including the rocky coast in the region of Fountain Point. Average salinity above 34.5‰, substratum rocky or clean sand, current strong, wave action fair, little variation in seasonal temperature, clear water, pH above 8.

"II. *The Lagoon* [herein called a "sound"], including Leisure Isle, Thesen's Wharf, the Rail Bridge and The Point. Average salinity above 28.4‰, substratum muddy sand, current fair, wave action nil, temperature higher than the sea in summer, slightly lower in winter, pH above 8.

"III. *The Westford Channels*, from Eastford, past Westford Bridge to the Old Drift. Salinity average variable, between 8.8‰ and 21.7‰, substratum soft mud, current weak, wave action nil, temperature higher than the sea in summer, slightly lower in winter, pH usually above 8.

"IV. *Charlesford Rapids*. Salinity very variable but except during droughts below 8‰, substratum pebbles and sand, current variable, wave action nil, temperature very seasonal, pH below 8."

### DISTRIBUTION OF OSTRACODE SPECIES

Ostracodes were found in all the samples, but by far the largest and most varied population was found in the Leisure Isle sample. The Westford Bridge and Ashford samples contained a very sparse fauna. No fresh-water ostracodes were present in any of the samples. The general distribution and variation in abundance of the estuarine species is shown in Figs. 3 and 4.

Only one species, *Paracypris westfordensis*, is restricted to the uppermost or Westford Channels division of the estuary. This species is the only ostracode present at Westford Bridge but is fairly abundant there; it also makes up 64 percent of the meager fauna at nearby Ashford. It is not present at Rail Bridge or at Leisure Isle.

Four species characterize the Rail Bridge fauna (KNY219 and KNY220): *Perissocytheridea estuaria*, *Sulcostocythere knysnaensis*, *Loxochoncha parameridionalis*, and *Aglaiella railbridgensis*. The first three of these are present also at Ashford; all four species occur at Leisure Isle. *Cytherella* sp. aff. *C. punctata* BRADY was found living in the low spring-tide level sample at Rail Bridge. A few other species typical of Leisure Isle were represented in the Rail Bridge low-tide level samples by single specimens.

*Cytheretta knysnaensis* and *Aurila dayii* are the predominant species (56%) of the varied Leisure Isle

fauna. The four species characteristic of the Rail Bridge locality constitute another 18 percent of the population. Other abundant forms found at Leisure Isle include *Xestoleberis capensis* MÜLLER (10%) and *Loxochoncha megapora* n. sp. (4%). Seven additional species, totaling 6 percent of the sample population, are rare at Leisure Isle and may be intruders from the coastal fauna outside the Heads. At least 10 other marine species were represented in the Leisure Isle sample by only one or two specimens each; these forms which were left undescribed because of inadequate representation, account for 4 percent of the sample population. Specimens in the Leisure Isle sample are very well preserved, but none contain soft parts.

### VERTICAL ZONATION OF SPECIES AT RAIL BRIDGE

Each of the four samples collected at different levels of the intertidal zone at Rail Bridge contained a distinctive ostracode fauna, with a different species predominant at each level. The low spring-tide level sample (KNY219) contained an abundant population composed of only two species, *Aglaiella railbridgensis* (58%) and *Sulcostocythere knysnaensis* (42%). At the low neap-tide level (KNY220) the predominant form is *Sulcostocythere* (76%), and *Aglaiella*



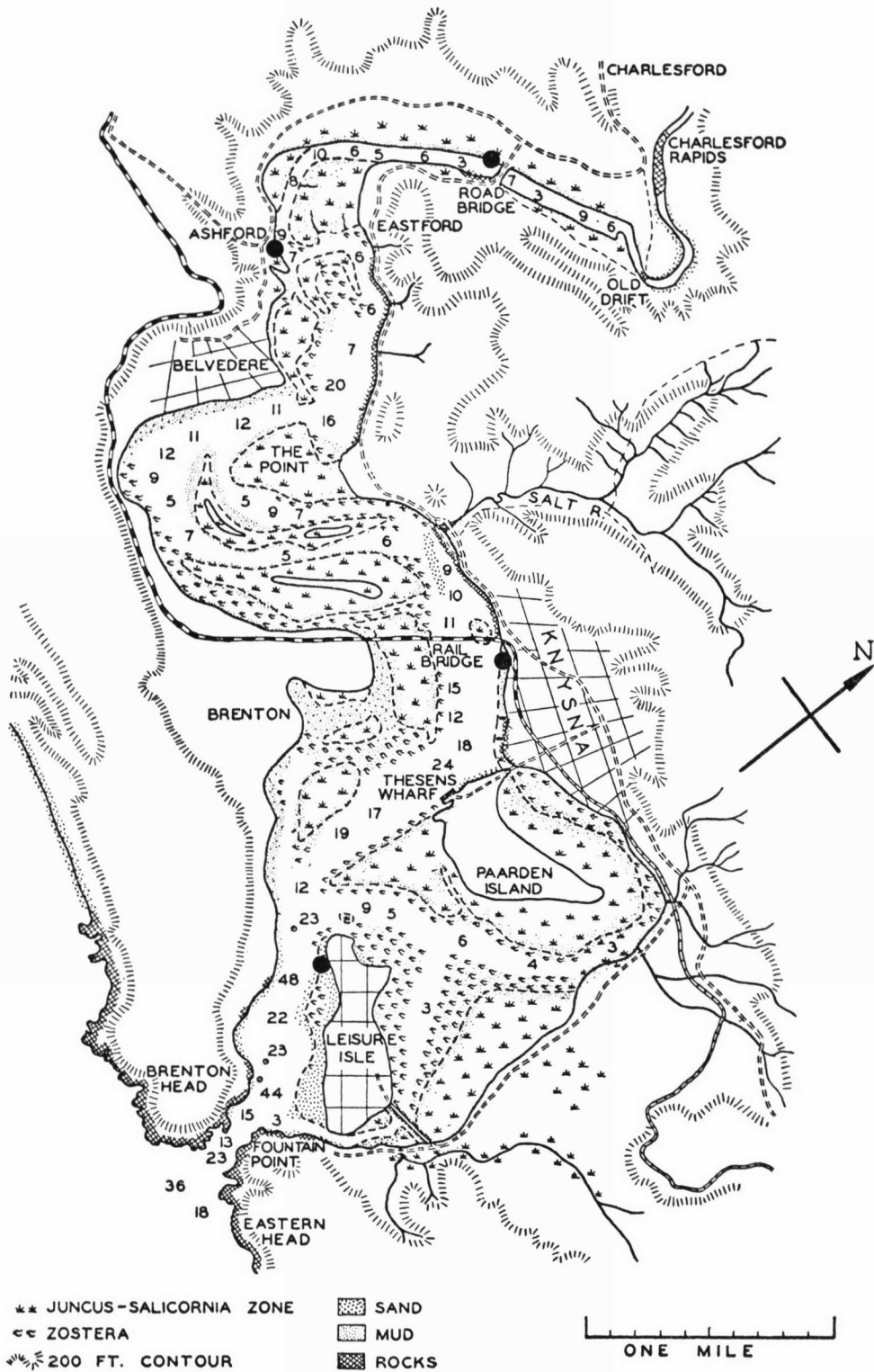


FIG. 2. Knysna Estuary redrawn from a government trigonometrical survey map and an Admiralty Chart. The low-tide level is shown by broken lines and the high-tide level by unbroken lines. The stations from which ostracodes were collected and which are referred to in the text are indicated by heavy black dots. The depths are shown in feet. (from DAY, MILLARD & HARRISON, 1952 with permission of Dr. J. H. DAY).

represents only one percent of the fauna. Two other species appear at this level, *Loxoconcha parameridionalis* (15%) and *Perissocytheridea estuaria* (6%). The mid-tide level (KNY221) fauna is very sparse. Here *Loxoconcha* is most numerous (38%), *Sulcostocythere* (32%) and *Perissocytheridea* (27%) are of approximately equal importance, and *Aglaiella* (4%) is rare. At the high neap tide level (KNY222) *Perissocytheridea* is the predominant form (79%) of the fairly abundant population. *Loxoconcha* is still common (17%), but *Sulcostocythere* is unimportant (4%) and *Aglaiella* is absent.

This occurrence of *Perissocytheridea estuaria* at high tide level presents an interesting problem. First of all, mechanical segregation of carapaces after death by such agents as current transport, wind sorting, or sediment abrasion must be considered as a possible explanation for this distribution. However, strict thanatocoenotic mechanical segregation can be discounted, as the greater proportion of the ostracode specimens of all four samples were whole carapaces containing the remains of soft parts. Few were broken or otherwise damaged. Thus it is probable that these species were actually living in the area from which they were collected.

Another possibility is that the ostracodes are brought up to the high levels with the rising tide and returned to the lower levels with the ebb tide. If such passive transportation actually occurs, several conditions must be present:

(1) The ostracodes are either swimmers or crawl on the surface of the sediment, so that they are subject to displacement by water currents.

(2) If this is the only factor operating, there should be no essential differences between the populations at different tide levels. However, if depth zones are present, these zones could be expected to migrate up and down the bank with changing sea level.

(3) In samples collected from an exposed mud bank, only dead specimens should remain in the area to represent the previous population. This was not the case in the Rail Bridge samples.

A third possibility is that the ostracodes burrow in the mud bank beneath the water table and therefore are not affected by the rise and fall of the tide. The salinity conditions in the interstitial waters of a sediment are relatively constant. Also the sandy mud composition of the substrate at Rail Bridge is favorable for burrowing animals. The two forms living at this level, *Perissocytheridea* and *Loxoconcha*, are very small, with thin but strongly reticulate carapaces.

These shell characters are known to be advantageous for a burrowing form. This latter explanation seems at present to be the most feasible.

DAY, MILLARD, & HARRISON (1951) found that certain typically marine species of larger benthonic invertebrates from around the Heads that live at high tide level can extend their ranges farther up the estuary than marine species living at lower tide levels, because of the higher average salinity at high tide level relative to that existing at lower levels. No evidence was found of such a trend in the distribution of the four ostracode species of Rail Bridge. The few specimens of Leisure Isle species that were collected at Rail Bridge were in the low level samples. Some of these specimens contained soft parts, therefore they probably were living at the time of collection.

### GENERAL ECOLOGY OF ASSOCIATED ORGANISMS

DAY, MILLARD, & HARRISON (1951) described four major biotic divisions, which correspond in their distribution to the major environmental divisions of Knysna Estuary. These divisions are based on occurrences of common, easily identified, large benthonic plants and animals. The limiting factors for these divisions are specified as follows (p. 385):

"*The Heads* have a marine rocky-shore fauna most of which is restricted to this area by the type of substratum and the wave action. *The Lagoon* [sound] has a fauna which is partly marine and partly estuarine. It includes many marine species which prefer sheltered waters and a bottom of sandy mud. These are prevented from spreading farther up the estuary by the change in substratum from sandy mud to soft mud and by the drop in salinity. *The Westford Channels* have a fauna almost entirely limited to estuarine forms, which prefer a muddy bottom and tolerate the lowered salinity. *Charlesford Rapids* have a very distinctive though restricted fauna, and the limiting factor is the low salinity."

*Vertical zonation.* Many species of animals and plants are vertically restricted within a sequence of zones corresponding to the different tidal levels. At the highest level of spring tides, either the small rush *Juncus kraussii* or *Salicornia meyeriana* is the dominant species of the vegetation. At a lower level the rice grass *Puccinella fasciculata* is common. A luxuriant growth of the sea grass *Zostera capensis* covers the mud slopes from mid-tide to below low-tide level.

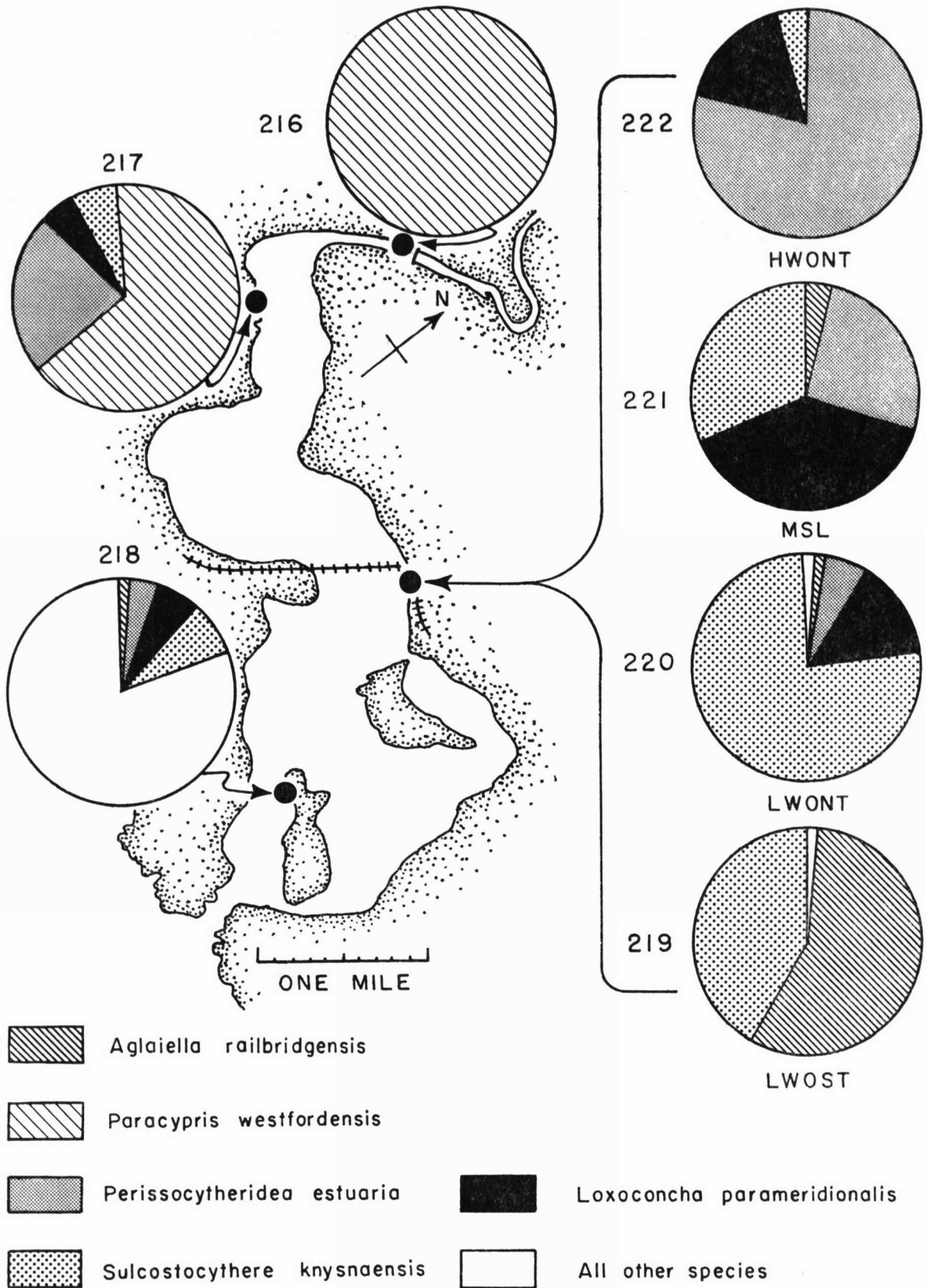


FIG. 3. Distribution and relative abundance of the five most common ostracode species found living within Knysna Estuary. HWONT=high-water level of neap tide; MSL=mean-spring tide level; LWONT=low-water level of neap tide; LWOST=low-water level of spring tide.

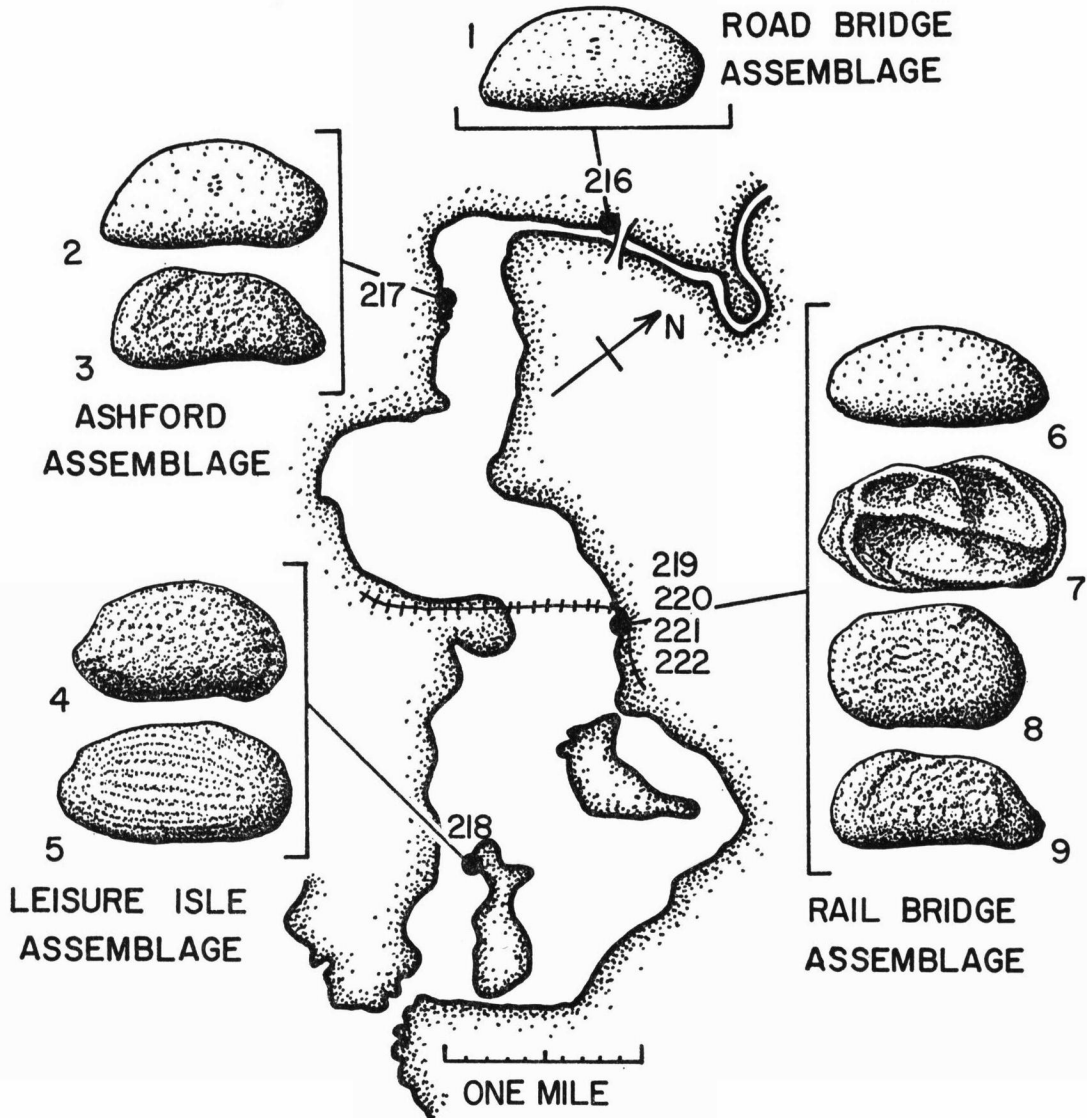


FIG. 4. Distribution of characteristic ostracode species in Knysna Estuary.

- 1, 2. *Paracypris westfordensis* BENSON & MADDOCKS.  
 3, 9. *Perissocytheridea estuaria* BENSON & MADDOCKS.  
 4. *Aurila dayii* BENSON & MADDOCKS.  
 5. *Cytheretta knysnaensis* BENSON & MADDOCKS.

6. *Agelaiella railbridgensis* BENSON & MADDOCKS.  
 7. *Sulcostocythere knysnaensis* BENSON & MADDOCKS.  
 8. *Loxoconcha parameridionalis* BENSON & MADDOCKS.

The aquatic vegetation is much richer than that of most South African estuaries, because of the unusually low turbidity of the Knysna River. Vertical zonation is apparent also in the distribution of the invertebrate population of the estuary.

*Distribution of species.* The biota of Brenton and Eastern Heads is wholly marine and typical for a rocky shore of the South Coast. Within the sound the noticeable reduction of the richness of the fauna is probably due to the increase in sandy substrate rather

than to the very minor decrease in salinity. The whole of the sound, from Fountain Point to "The Point," has essentially the same fauna. Whereas the lower limit of the sound is clearly marked, the upper boundary is transitional; but it can be located approximately at "The Point," where the substratum changes from muddy sand to fine mud. With this change in substrate the fauna abruptly diminishes, and in the Westford Mud Channels and Charlesford Rapids the fauna is impoverished.



## SYSTEMATIC DESCRIPTIONS

## GENERAL STATEMENT

The suprageneric classification used in this report is that proposed in the *Treatise of Invertebrate Paleontology, Part Q* (MOORE, 1961). This classification is used with the knowledge that it may be artificial for the more ornamented ostracodes. Many more forms from the Southern Hemisphere will have to be studied and more information become available about the variability of muscle-scar patterns, hinges, the relationship of carapace and soft-part morphology before a more suitable classification can be designed.

Most of the genera in the existing classification have been constituted for receipt of species known from Europe and North America. Many of the South African forms do not easily fit into these categories but have been temporarily placed in them rather than create monotypic genera. One exception to this procedure is *Sulcostocythere knysnaensis*, which seems at present to be sufficiently distinctive to warrant a new category.

The type-specimens of the new species described herein are being repositing in the collections of the Smithsonian Institution at the United States National Museum.

## Subclass OSTRACODA Latreille, 1806

## Order PODOCOPIDA Müller, 1894

## Suborder PLATY COPINA Sars, 1866

## Family CYTHERELLIDAE Sars, 1866

## Genus CYTHERELLA Jones, 1849

*Cytherella* JONES, 1849, p. 28; SARS, 1866, p. 125; —, 1923, p. 39; BRADY, 1880, p. 171; G. W. MÜLLER, 1894, p. 386; KEIJ, 1957, p. 44; BENSON, 1959, p. 39; POKORNÝ, 1958, p. 210; REYMENT, 1961, p. Q382; BENSON & COLEMAN, 1963, p. 14.

*Morrowina* LOETTERLE, 1937, p. 51.

*Type-species. Cytherina ovata* ROEMER, 1840, p. 104, pl. 16, fig. 21 (subsequent designation by ULRICH, 1894).

**Diagnosis.** Carapace thick-shelled, ovate; surface smooth or finely punctate. Right valve larger than left valve, interior with continuous groove around margin of left valve. Posterior half of carapace higher and more inflated than anterior, especially in females; females larger than males. Adductor muscle-scar pinnate, consisting of two vertical rows of small scars located in dorsomedian portion of carapace, usually expressed externally as shallow sulcus. *Jur.-Rec.*

CYTHERELLA sp. aff. *C. PUNCTATA* Brady, 1866

Pl. 1, Fig. 1, 2, 5.

*Cytherella punctata* BRADY, 1866, p. 362, pl. 57, fig. 2a,b; —, 1880, p. 174, pl. 36, fig. 6a,b, pl. 44, fig. 4a-g; CHAPMAN, 1926, p. 106, pl. 22, figs. 15, 16.

**Diagnosis.** Distinguished by its small, ovate shape, finely punctate surface, straight dorsal and ventral margins.

**Description.** Female: Carapace small, thick-shelled and moderately compressed; in lateral view ovate, dorsal margin straight and sloping slightly anteriorly, ventral margin straight to very slightly concave; anterior and posterior margins broadly and evenly rounded; greatest height at posterior end. In dorsal view anterior end narrowly tapered, sides straight and diverging slightly, posterior end gently inflated and abruptly truncated. Greatest thickness slightly less

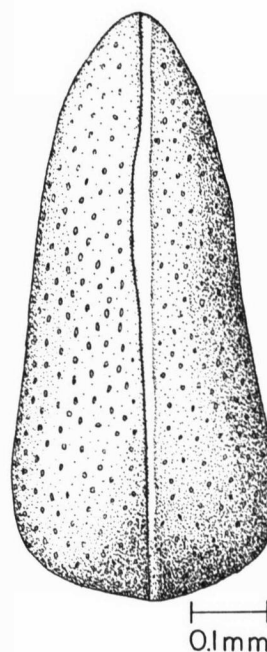


FIG. 5. *Cytherella* sp. aff. *C. punctata* BRADY, 1866. Dorsal view of female.

than one half the length and located just before posterior end. Cross-section subtriangular, dorsolateral region compressed. Surface of valve with numerous closely spaced small puncta, and with shallow depression just anterior to dorsomedian region of carapace. Right valve slightly larger than left, overlapping it entirely around margin; overlap conspicuous only dorsally. Marginal area in both valves very narrow. The muscle-scar pattern is normal platycopine, pinnate.

**Dimensions.** Female: Length 0.75 mm, height 0.42 mm, thickness 0.34 mm.

*Material.* Three specimens, of which two were whole carapaces containing soft parts, both mature females.

*Occurrence.* The two whole specimens are from Rail Bridge, low-water level of spring tide; the single valve is from Leisure Isle.

BRADY (1866) first described *C. punctata* from the Levant, later (1880) reported it from *Challenger* stations off Tristan d'Acunha, Port Jackson (Australia), Tasman Sea, the Malay Archipelago, and Straits of Magellan. CHAPMAN (1926) reported specimens identified as *C. punctata* from the Miocene and Lower Pliocene of the Victorian Mallee bores and from the Eocene of New Zealand. The form identified as *C. punctata* by EGGER (1901) from Australia is so poorly illustrated as to be unidentifiable and bears little resemblance to other illustrations of this species.

*Remarks.* Very few punctate species of *Cytherella* have been described. *C. sordida* G. W. MÜLLER, 1894, has a similarly pitted surface but differs from the Knysna species by its much more sinuous outline in lateral and dorsal view. *C. abyssorum* SARS, 1866, is similar in punctation and lateral outline but is larger (.95 mm), more compressed in dorsal view, and has a more sharply defined posterior swelling. *C. punctata* BRADY, 1866, as originally described, is smaller (0.57 mm) and has a more nearly horizontal dorsal margin, the posterior part of which slopes steeply backward if the illustrated specimen is correctly oriented (the soft parts of *Cytherella* were unknown at this time), but is very similar in dorsal view.

The specimens collected by the *Challenger* and identified by BRADY (1880) that are deposited at the British Museum were obtained from waters 100 to 150 fathoms deep off Nightingale Island, Tristan d'Acunha (stat. 135) and from waters 160 fathoms deep off the southern coast of Chile (stat. 305). There may be two species represented in this collection, even two genera depending on where one wants to draw the distinction between *Cytherella* and *Cytherelloidea*. Some of the Chilean forms are punctate more around the margins than in the center and possess broad subtle ridges along the posteroventral and postero-dorsal regions. These ridges are joined in a loop at the posterior margin. The other specimens from the *Challenger* stat. 305 are evenly rounded, uniformly inflated and finely punctate as shown in BRADY's illustration pl. 44, fig. 4a.

BRADY (1880) ascribes much variation to this species, figuring two extremes of size and shape in Pl. 44, figs. 4a-g. Figures 4e-g of the smaller variant

correspond quite closely to those of the original description and to the Knysna specimens except for the dorsal view, in which the greatest thickness is near the middle and the sides are more curved. The larger (.85 mm) forms illustrated in figs. 4a-d (BRADY, 1880) differ from the Knysna form by the concave ventral margin, nearly horizontal dorsal margin, anterior and posterior ends of nearly equal height, and greatest thickness near the mid-length. The Knysna specimens are also more coarsely punctate than the specimens described by BRADY.

CHAPMAN (1926) also recorded great variability in specimens identified as *C. punctata*, figuring two even more dissimilar variants. It does not seem likely that such great variation exists within just one species spread over such a widespread area.

### Suborder PODOCOPINA Sars, 1866

#### Superfamily BAIRDIACEA Sars, 1888

#### Family BAIRDIIDAE Sars, 1888

#### Genus BAIRDIA M'Coy, 1844

*Bairdia* M'COY, 1844, p. 164; BRADY, 1880, p. 47; G. W. MÜLLER, 1894, p. 267; SYLVESTER-BRADLEY, 1950, p. 751; BENSON, 1959, p. 42; POKORNÝ, 1958, p. 225; SHAVER, 1961, p. Q202; BENSON & COLEMAN, 1962, p. 17.

*Nesidea* COSTA, 1849, p. 183; G. W. MÜLLER, 1908, p. 99; ———, 1912, p. 241.

*Morrissitina* GIBSON, 1955, p. 1069 (*pro Morrissites* GIBSON, 1955, p. 21, *non* BUCKMAN, 1921).

*Acrafinella* SCHNEIDER, 1956, p. 92.

*Type-species.* *Bairdia curtus* M'COY, 1844, p. 164.

*Diagnosis.* Carapace very large, smooth or very finely punctate; left valve much larger than right and overlapping it dorsally and ventrally. Dorsal margin high and broadly arched, ventral margin nearly straight in central part or with slight sinuation, anterior and posterior portions curving upward to meet dorsal margin at about midheight. Anterior broadly rounded with no sharp distinction between anterior margin and dorsal and ventral margins, posterior usually narrowly rounded or subacuminate, sometimes drawn out into beak. Hinge simple, consisting of groove in left valve to receive dorsal margin of right valve. Duplicature wide, broad vestibule present around free margin. Muscle-scar pattern composed of many discrete scars arranged variously in a rosette pattern and an aggregate. *Ord.-Rec.*

#### BAIRDIA VILLOSA? Brady, 1880

Pl. 1, Fig. 3, 6, 8.

*Bairdia villosa* BRADY, 1880, p. 50, pl. 3, fig. 3a,b, pl. 5, fig. 2a-g, pl. 8, fig. 4a-f; VAN DEN BOLD, 1950, p. 901.

*Nesidea villosa* (BRADY), G. W. MÜLLER, 1908, p. 100; ———, 1912, p. 245.

*Description.* Carapace moderately large, typically bairdian in shape. Dorsal margin very highly arched,

ventral margin almost straight, extremities well rounded and not acuminate, greatest height equal to nearly two-thirds of length. Ovate in dorsal view with subacute and nearly equal extremities, posterior somewhat more acute. Right valve more elongate than left valve but not as high, with more sinuate ventral margin. Surface smooth. Marginal area fairly broad, with wide vestibule. Muscle-scar pattern consists of eight large scars and one or two smaller scars arranged in a rosette near the center of the carapace. Living animal with numerous coarse brown bristles.

*Dimensions.* For the largest specimen, figured pl. 1, figs. 6 and 8, length 1.05 mm, height 0.6 mm.

*Material.* 6 specimens, of which one was whole, none contained soft parts. Probably all but one valve are immature. Most specimens show signs of abrasion, and none retain the bristles for which *villosa* is named. Tentative identification of these specimens with BRADY'S species was facilitated by comparison of the Knysna specimens with a single well preserved specimen taken at Station WCD57 (West Coast Dredge Series of the University of Cape Town Ecological Survey, 32°4.6'S., 18°18'E., 20 meters). This specimen is rather larger than the Knysna forms, has a similar carapace, and retains the dense cover of bristles; however the soft-parts of this specimen were not studied.

*Remarks.* The largest specimen is rather smaller (1.05 mm) than the measurements given for BRADY'S species (1.4 mm). The shape and smooth surface of the carapace are similar to the illustrations of *Bairdia villosa*, but because of the immaturity of most of the specimens and the smaller size this can be only a tentative identification.

*Occurrence.* Leisure Isle. *Bairdia villosa* is seemingly cosmopolitan in the southern hemisphere. BRADY (1880) reported *B. villosa* from Tristan d'Acunha, Kerguelen Islands, Prince Edward Island, and Bass Strait, in depths ranging from 20 to 150 fathoms. G. W. MÜLLER (1908) also found this species in Observatory Bay in the Kerguelen Islands. VAN DEN BOLD (1950) reports *B. villosa* from north of Borneo but does not describe or illustrate this form.

#### Superfamily CYPRIDACEA Baird, 1845

#### Family PARACYPRIDIDAE Sars, 1923

#### Genus PARACYPRIS Sars, 1866

*Paracypris* Sars, 1866, p. 12; —, 1923, p. 69; BRADY, 1880, p. 31; G. W. MÜLLER (*partim*), 1912, p. 125; BENSON, 1959, p. 40; SWAIN, 1961, p. Q245.

*Phlyctenophora* BRADY, 1880, p. 32.

*Type-species.* *Paracypris polita* Sars, 1866, p. 12.

*Diagnosis.* Carapace smooth and elongate, in lat-

eral view with strongly arched dorsum, nearly straight venter, anterior margin broadly rounded, posterior end acuminate; in dorsal view thickest medially, tapering forward and behind; large anterior and posterior vestibules. Distinguished from *Macrocypris* by cyprid muscle-scar pattern of 4 anterior and 2 posterior scars, simple adont hinge, left valve larger than and overlapping right, branching radial-pore canals, and a well developed furca. Distinguished from *Pontocypris* by the presence of radiating spikes on the ejaculatory tubes of the male, and by the absence of natatory setae on the 2nd antennae. ?*Sil., Jur.-Rec.*

*Remarks.* *Phlyctenophora* BRADY, 1880, was distinguished from *Paracypris* by the absence of a branchial appendage on the mandibular palp and by a flexuous second thoracic leg, provided with a movable hinge between the second and third segments. The first character is questioned in the original description; the second is probably not of generic importance.

This is one of the few marine genera in the Cypridacea; members of this genus are bottom dwellers in brackish or shallow marine waters.

#### PARACYPRIS WESTFORDENSIS Benson & Maddocks, n. sp.

Pl. 1, Fig. 4, 11, 12.

*Diagnosis.* In lateral view dorsal margin obscurely tripartite, especially in right valve, ventral margin nearly straight, anterior margin broadly rounded, posterior and ventral margins join in rounded subacute ventral angle; very wide vestibules.

*Description.* Carapace smooth and elongate; in lateral view dorsal margin strongly arched, composed of three equal sections joining at distinct but rounded cardinal angles, particularly noticeable in right valve.

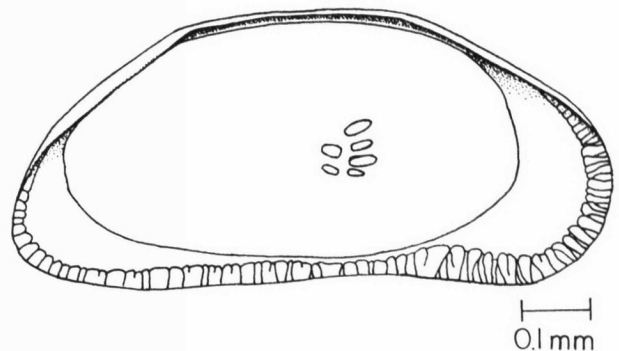


FIG. 6. *Paracypris westfordensis* BENSON & MADDOCKS, n. sp. Interior of left valve showing the incised groove of the adont hinge and the muscle-scar pattern.

The central section essentially horizontal, anterior section slopes gently forward to join broadly rounded

anterior margin, posterior section curves steeply down to intercept ventral margin in rounded subacute angle. Ventral margin very slightly concave or nearly straight; greatest height anteromedian. Elongate ovate in dorsal view, with greatest thickness median, sides converging evenly to narrowly and nearly equally rounded ends. Ovate in end view, greatest thickness at mid-height. Left and right valves very nearly equal in size, left overlapping right dorsally and ventrally.

Hinge simple groove in left valve receiving dorsal margin of right valve. Duplicature moderately to very wide, numerous branching radial-pore canals; anterior vestibule very wide, posterior vestibule less so. Muscle-scar pattern consists of six scars arranged as follows: One large cap scar, three smaller scars aligned vertically below, two small scars in vertical row behind. Brownish color of some specimens due to the contained soft parts. Some carapaces bear irregular opaque white patches, which may be the result of secondary replacement or recrystallization of calcareous shell material.

*Dimensions.* Length 0.85-0.90 mm, height 0.40-0.44 mm, thickness 0.36-0.39 mm. Sexual dimorphism not apparent.

*Material.* 149 specimens, most of which had both valves intact and contained remains of appendages.

*Remarks.* The shape of this species differs greatly from that of *P. polita* Sars and most other previously described species of *Paracypris*, which have a much more attenuate posterior end and a sloping dorsal margin. It is very similar to *Phlyctenophora zealandica* BRADY, 1880, as figured by KINGMA (1948) and KEIJ (1954); however, the latter species has a wider fused duplicature, a narrower vestibule, an evenly rounded

dorsal margin with no tripartite division, and a slightly more acuminate posterior.

*Occurrence.* This species comprises the total ostracode fauna at Westford Road Bridge. It is also abundant at Ashford, where it constitutes 64 percent of the total population. A single valve was found at Rail Bridge, at low-water level of spring tide.

**Genus AGLAIELLA Daday, 1910**

*Aglaiella* DADAY, 1910, p. 557; SWAIN, 1961, p. Q245.  
*Type-species.* *Aglaiella stagnalis* DADAY, 1910, p. 557.

*Diagnosis.* Carapace smooth, elongate, in lateral view with strongly arched dorsum, ventral margin nearly straight, greatest height median, anterior and posterior margins broadly and nearly equally rounded, posterior margin slightly more obliquely and narrowly rounded than anterior margin. Outline in dorsal view elongate oval, anterior and posterior ends equally tapered, greatest thickness median. Large anterior and posterior vestibules, broad fused duplicature, numerous branched radial-pore canals.

*Remarks.* The carapace of *Aglaiella* is like that of *Paracypris* except that the anterior and posterior ends are broadly and nearly equally rounded. *Aglaiella* differs from *Aglaiocypris* SYLVESTER-BRADLEY, 1947, which it resembles in shape, by the presence of complexly branching radial-pore canals; those of *Aglaiocypris* being straight and unbranched.

Neither the hinge nor the muscle-scar pattern have been described previously for *Aglaiella*. The type-species of this genus was originally described by DADAY from brackish waters of Egypt.

**AGLAIELLA RAILBRIDGENSIS** Benson & Maddocks, n. sp.

Pl. 1, Fig. 7, 9, 10.

*Diagnosis.* Carapace elongate oval in shape, dorsal

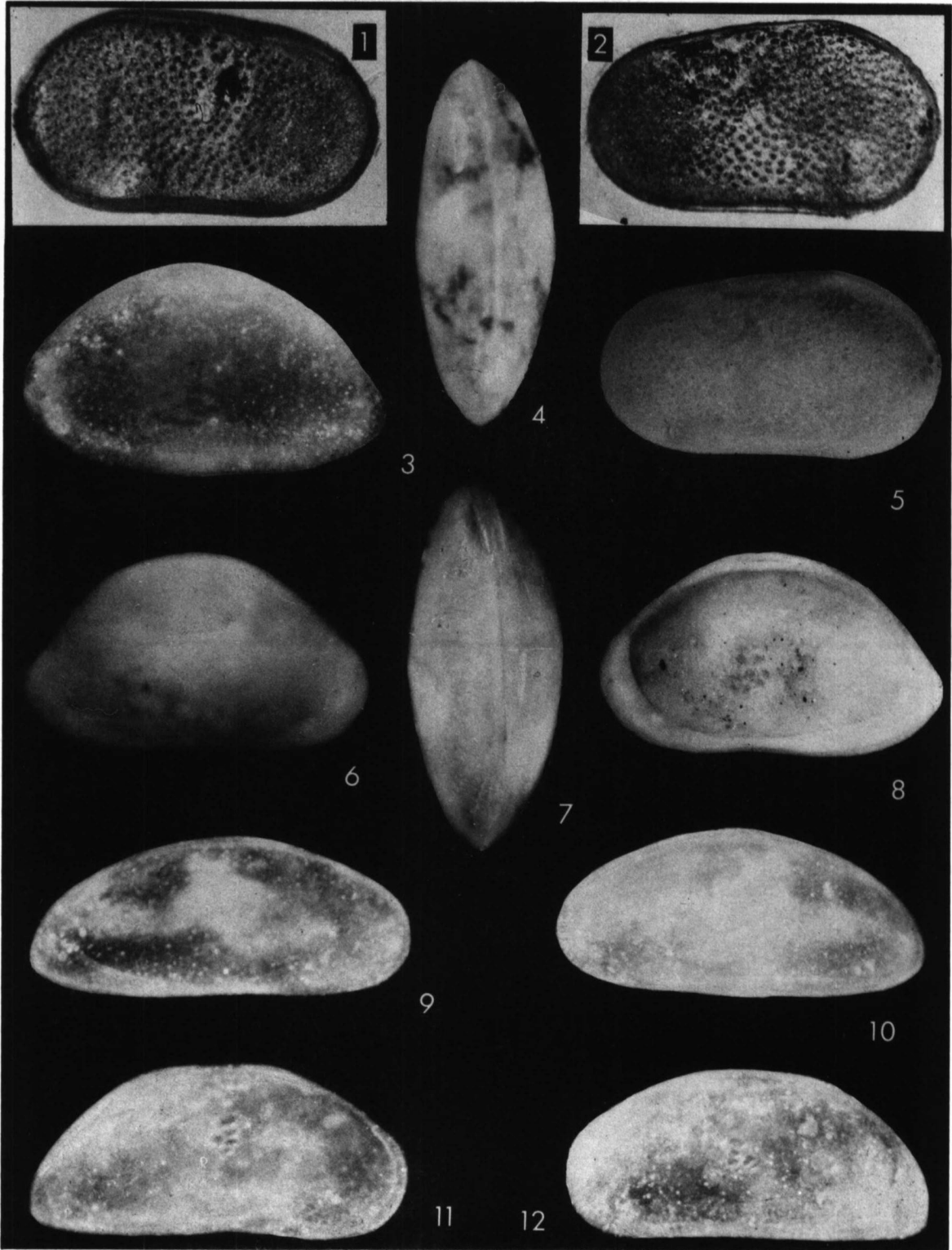
**EXPLANATION OF PLATE 1**

**CYTHERELLA, BAIRDIA, PARACYPRIS, AGLAIELLA**

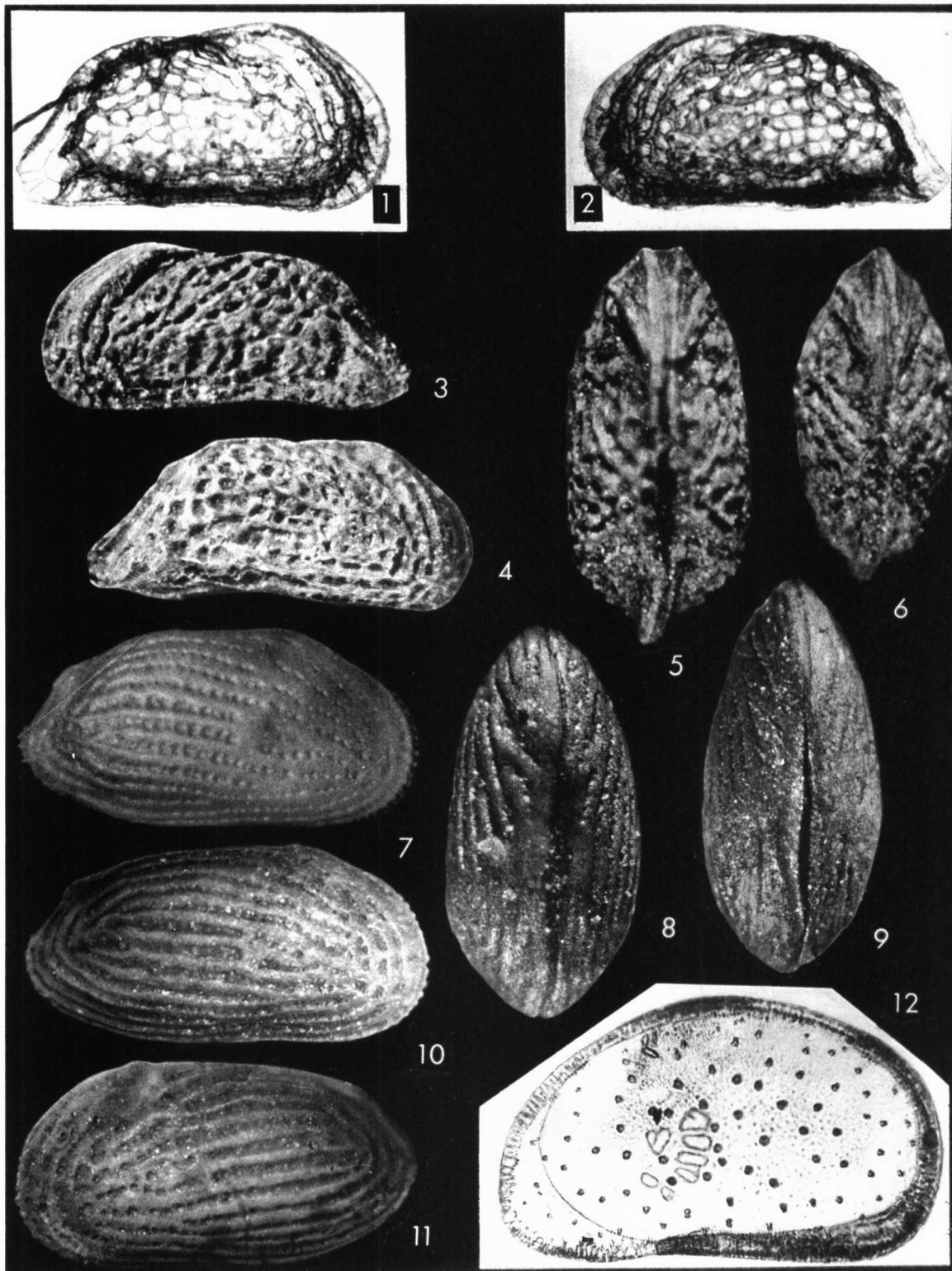
(All illustrated forms are from Knysna Estuary, Union of South Africa)

<p>FIGURE                  1, 2, 5.—<i>Cytherella</i> sp. aff. <i>C. punctata</i> BRADY, 1866;                  1, lateral exterior view of right valve (transmitted light); 2, lateral exterior view of left valve (transmitted light); 5, lateral exterior view of left valve (unstained specimen); all ×75. ....</p> <p>3, 6, 8.—<i>Bairdia villosa?</i> BRADY, 1880; 3, lateral exterior view of left valve (unstained immature specimen); 6, lateral exterior view of right valve (unstained specimen), ×55; 8, interior view of right valve (unstained specimen), ×55. ....</p>	<p>PAGE                  13                  14</p>	<p>4, 11, 12.—<i>Paracypris westfordensis</i> BENSON &amp; MADDOCKS, n. sp.; 4, dorsal view (unstained specimen); 11, lateral exterior view of right valve (unstained specimen); 12, lateral exterior view of left valve (unstained specimen); all ×70. ....</p> <p>7, 9, 10.—<i>Aglaiella railbridgensis</i> BENSON &amp; MADDOCKS, n. sp.; 7, dorsal view (unstained specimen); 9, lateral exterior view of right valve (unstained specimen); 10, lateral exterior view of left valve (unstained specimen); all ×65. ....</p>	<p>15                  16</p>
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BENSON & MADDOCKS — Recent Ostracodes, Union of South Africa



BENSON & MADDOCKS — Recent Ostracodes, Union of South Africa

margin broadly and gently arched, anterior and posterior margins broadly and nearly equally rounded, ventral margin straight.

*Description.* Carapace elongate and smooth; in lateral view suboval to elongate subtriangular, ventral margin straight, dorsal margin gently arched, greatest

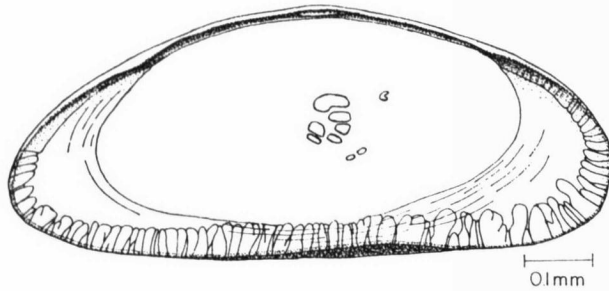


FIG. 7. *Aglaiella railbridgensis* BENSON & MADDOCKS, n. sp. Interior of left valve showing the adont hinge, cyprid muscle-scar pattern, and complexly branching radial-pore canals.

height less than half the length and located at mid-length, anterior and posterior margins broadly and evenly rounded. In dorsal view elongate-ovate with greatest thickness median, tapering gradually and equally toward anterior and posterior ends. End view ovate, greatest thickness at mid-height. Left and right valves of nearly equal size, left overlapping right.

Left valve hinge consists of strong groove, broken in middle by short tooth-like ridge rising from floor of groove; in right valve elongate anterior and posterior flanges separated by short pair of narrow horizontal grooves. Marginal area very broad, with large duplicatures; radial-pore canals numerous and complexly branching. Adductor muscle-scar pattern consists of six large, closely spaced scars: Large dorsal scar, three smaller scars in vertical row below, and two small, nearly fused scars in row behind. One antennal scar and two mandibular scars are also visible.

*Dimensions.* Length 0.91-0.95 mm, height 0.42-0.45 mm, thickness 0.36-0.39 mm. Sexual dimorphism not apparent.

*Material.* 212 specimens, of which more than half were whole carapaces containing remains of soft parts.

*Remarks.* This species differs from the type-species *Aglaiella stagnalis* in the elongate oval shape of the carapace. *A. stagnalis* is subreniform in lateral outline, having a more highly arched dorsum, more broadly and obliquely rounded anterior and posterior margins, and a slightly concave ventral margin.

*Occurrence.* This species is absent at Ashford and Westford Bridge. It composed 58 percent of the population collected at the low-water level of neap tide but was rare or absent at the other levels. A few specimens were found at Leisure Isle.

Superfamily CYTHERACEA Baird, 1850

Family CYTHERIDEIDAE Sars, 1925

Subfamily CLITHROCYTHERIDEINAE Kollmann, 1958

Genus PERISSOCYTHERIDEA Stephenson, 1938

*Perissocytheridea* STEPHENSON, 1938, p. 144; SWAIN, 1955, p. 618; HOWE, 1961, p. Q280; BENSON & KAESLER, 1963, p. 17. *Ilyocythere* HARTMANN, 1953, p. 310; —, 1957, p. 141, 142. *Ilyocythere* (KLIE), HARTMANN, 1953, p. 310-316.

*Diagnosis.* Recognized by its smooth to reticular, tumid, subpyriform carapace. Hinge antimerodont, similar to that of *Clithrocytheridea*. Marginal area moderately narrow, with anterior vestibules. Strong sexual dimorphism. *Mio.-Rec.*

PERISSOCYTHERIDEA ESTUARIA Benson & Maddocks, n. sp. Pl. 2, Fig. 1-6.

*Diagnosis.* Distinguished by its subtrapezoidal lateral outline with pronounced ventral caudal extension and conspicuous sexual dimorphism, males longer and with more produced posterior than females. Surface ornament of coarse puncta arranged in irregularly

EXPLANATION OF PLATE 2

PERISSOCYTHERIDEA, CYTHERETTA, XESTOLEBERIS

(All illustrated forms except Figure 7 are from Knysna Estuary, Union of South Africa)

FIGURE 1-6.—*Perissocytheridea esuaria* BENSON & MADDOCKS, n. sp; 1, lateral exterior view of right valve of female (transmitted light), ×105; 2, lateral exterior view of left valve of female (transmitted light), ×105; 3, lateral exterior view of left valve of male, ×90; 4, lateral exterior view of right valve of male, ×90; 5, dorsal view of male, ×100; 6, dorsal view of female, ×100 ..... 17

7-11.—*Cytheretta knysnaensis* BENSON & MADDOCKS, n. sp.; 7, lateral exterior view of right valve of specimen FAL250M, unstained; 8, dorsal view of presumed female; 9, dorsal view of presumed male; 10, lateral exterior view of right valve; 11, lateral exterior view of left valve; all ×70. .... 21  
12.—*Xestoleberis capensis* G. W. MÜLLER; interior of right valve of female (transmitted light), ×125. 25

reticular pattern, including diagonal anterodorsal ridge behind which is a shallow diagonal sulcus. No vestibule, simple radial-pore canals.

*Description.* Carapace of male fragile, elongate subtrapezoidal in side view; dorsal margin short and straight, anterior margin broadly and obliquely rounded, ventral margin sinuous; posterior margin sloping steeply, abruptly truncated just above ventral margin, producing acuminate ventral extension; greatest height at anterior cardinal angle. In dorsal view anterior end narrowly tapered, lateral margins diverge evenly to greatest thickness posterodorsally, posterior end narrows abruptly to thin keel of ventral caudal

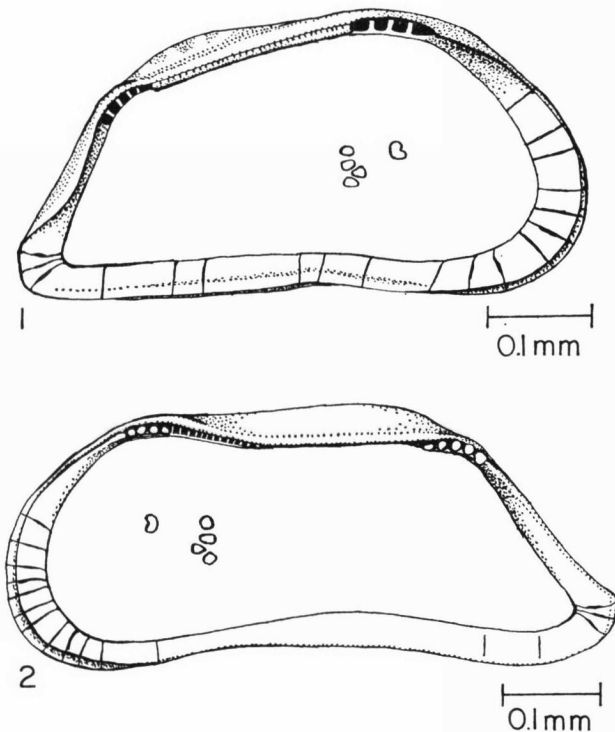


FIG. 8. *Perissocytheridea estuaria* BENSON & MADDOCKS, n. sp.—1. Interior of left valve of female.—2. Interior of right valve of male.

process. Shape of female similar but shorter, with less acuminate posterior and nearly straight ventral margin; in dorsal view carapace widest medially, narrowing slightly anteriorly and somewhat more abruptly posteriorly, posterior truncation and keel as in male.

Surface of both sexes with shallow puncta closely spaced forming irregularly reticular pattern. Major features of this pattern include: Slight thickening of anterior, ventral, and posterior edges as narrow marginal rim; relatively smooth anterior and posterior marginal areas; curved anterior ridge that originates

from marginal ridge at anterior cardinal angle, paralleling anterior margin, joining longitudinal pattern in ventral area; a short, oblique, dorsal sulcus behind this ridge; faint subcentral elevation and postjacent depression on most specimens; shallow longitudinal depression along dorsal junction of valve, bounded on either valve by short dorsal ridge. Linear trend of reticular pattern horizontal in ventrolateral area, diagonally sloping forward in dorsolateral area.

Hinge antimerodont, in right valve consisting of anterior four-lobed tooth and posterior five-lobed tooth separated by a shallow, crenulate groove bounded dorsally by flange, without ventral wall, in posterior half present only as shallow crenulate impression on underside of dorsal wall. Hinge of left valve consists of anterior socket with four pits bounded ventrally by narrow rim, thin crenulate ridge homologous with flange along dorsal margin, and posterior socket with five pits without distinct ventral wall. Selvage strong in anterior region, swelling dorsally, merging with anterior hinge tooth; in posterior and ventral regions selvage cannot be distinguished from margin of shell, except where it diverges and enlarges dorsally to form posterior hinge tooth. Flange distinct along anterior margin; arching dorsally over anterior and posterior hinge teeth to form dorsal wall of groove. List distinguishable along anterior margin. Sieve-type normal pore canals. Radial-pore canals few and straight in anterior, sparse or lacking along ventral margin, three visible at caudal tip. Muscle-scar pattern consists of uneven vertical row of four adductor scars and anterior crescentic antennal scar.

*Dimensions.* Male: Length 0.64-0.67 mm, height 0.28-0.30 mm, thickness 0.28-0.31 mm. Female: Length 0.54-0.58 mm, height 0.28-0.30 mm, thickness 0.27-0.29 mm.

*Material.* 234 specimens, of which most were whole carapaces containing remains of soft parts.

*Remarks.* Dr. GERD HARTMANN was kind enough to examine the soft parts of specimens of this species for us and made the following observations: This species is the most bizarre presently known within the genus, which was previously thought to contain only western hemisphere forms. The maxillae are typical, but the masticatory process is a little longer than is usually found in New World species. The copulatory appendage has a form that fits into the long posterior prolongation of the male valve. The first antenna has five joints; the second antenna has two claws, and the exopodite is a long bristle, which does not reach the tips of the claws. The masticatory



process of the maxilla is long and slender; the terminal joint of the palp is very thin and relatively long. The copulatory appendage possesses a basic capsule and a side capsule, which is typical for *Perissocytheridea*.

**Occurrence.** This species is most abundant at Rail Bridge, comprising 79 percent of the population of the high tide level sample, less abundant at mid-tide level, rare at low neap tide level, and absent in the low spring-tide level sample. It is also present upstream at Ashford. A few carapaces were found at Leisure Isle.

**Family SCHIZOCYTHERIDAE Mandelstam, 1959**

[*Nom. transl. et. correct.* BENSON & MADDOCKS, herein (ex Schizocytherides MANDELSTAM, 1959), *non* HOWE, 1961].

**Genus SULCOSTOCYTHERE** Benson & Maddocks, n. gen.

*Type-species.* *Sulcostocythere knysnaensis* BENSON & MADDOCKS, n. sp.

**Diagnosis.** Characterized by primitive schizodont hingement, simple cytherid marginal area and musclicar pattern, carapace inflated with deep dorsomedian sulcus, obscurely reticular surface bearing prominent heavy longitudinal and diagonal ridges, and compressed, truncate posterodorsal region without caudal extension; conspicuous sexual dimorphism. Similar to *Paijenborchella* in surface ornamentation, having prominent posterodorsal, median, and ventrolateral longitudinal ridges; a posterior vertical ridge; prominent ocular swelling; and variably reticular surface.

Differs from *Paijenborchella* by strongly developed anterodorsal ridge paralleling anterior margin, absence of a caudal process, and less reticulate surface.

**Rec.**  
**Description.** Lateral outline ovate to subrhomboidal; dorsal margin straight, sloping steeply posteriorly from greatest height near anterior; anterior margin broadly and obliquely rounded; ventral margin sinuate anteriorly, posterior portion broadly swung, obliquely upturned; posterodorsal area compressed, truncate; cardinal angles distinct. Surface ornament consists of coarse longitudinal and diagonal ridges: anterodorsal, posterodorsal, median, and several ventral longitudinal ridges, with minor vertical connecting ridges. Cross-section subtriangular, dorsally compressed, inflated below, venter flattened. Males more elongate than females.

Hinge primitive schizodont, in right valve consisting of anterior lobate tooth, postjacent anteromedian deep circular socket, narrow crenulate postmedian groove, and posterior lobate tooth. Ventral wall of anterior socket formed by a thickening of inward projection of carapace corresponding to anterodorsal region of external sulcus. Hinge of left valve with anterior loculate socket, small irregularly lobate postjacent anteromedian tooth, postmedian serrate bar, and posterior loculate socket. Anterior tooth of the median hinge element variably developed or preserved, usually bifid or trifid, sometimes nearly

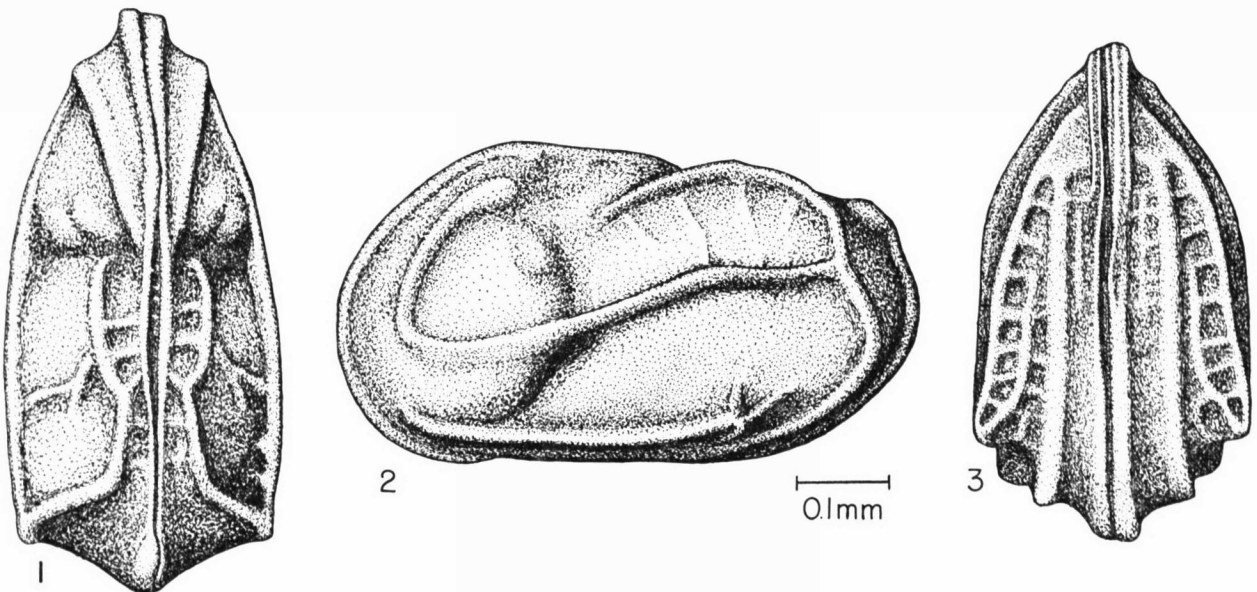


FIG. 9. *Sulcostocythere knysnaensis* BENSON & MADDOCKS, n. sp.—1. Dorsal view of male.—2. Lateral exterior view of left valve of male showing nature of surface ridges and median sulcus.—3. Ventral view of female showing ventrolateral ridges with secondary ridges between these and the ventral extension of the posterior ridge.

smooth, rising from hinge bar and supported by inward-protruding carapace in region of sulcus. Four small vertically aligned adductor-muscle scars on internal ridge corresponding to sulcus. Marginal area simple, with fused duplicature, few straight radial-pore canals.

*Remarks.* The hingement of this genus is apparently more primitive than that of other genera of the Schizocytheridae. The schizodont pattern of hingement is commonly defined as a type of amphidont hingement in which the anterior and anteromedian teeth are bifid. The posterior hinge tooth can be variably developed, being lobate or crenulate in *Paijenborchella* and *Neomonoceratina*. In *Schizocythere* this tooth is divided into a large round terminal tooth preceded by 2 or 3 smaller denticles. In *Palmenella* it is smooth and reniform, fitting into a socket that is bounded ventrally by an auxiliary tooth (HANAI, 1961).

The anterior tooth of the right valve is more variable than has been recognized hitherto, as can be seen in the excellent photographs by TRIEBEL (1949a, 1949b, 1950). In certain species the prominent, conspicuously bifid anterior tooth has an anterior step or extension connecting it with the selvage [e.g., *Palmenella limicola* (NORMAN) in TRIEBEL, 1949a, pl. 2, fig. 6c; *Paijenborchella caudata* (LIENENKLAUS) *ibid.*, b, pl. 3, fig. 16a, b; *Schizocythere hollandica* TRIEBEL, 1959, pl. 2, fig. 16; *Schizocythere appendiculata* TRIEBEL, 1950, pl. 3, fig. 27; *Schizocythere tessellata* (BOSQUET) *ibid.*, pl. 4, fig. 29]. Other species of these genera may lack this step, so that the anterior tooth is prominently bifid with steep sides.

Other variations within the schizodont pattern are possible. In *Payenborchella* (*Neomonoceratina*) *koenigswaldi* KEY (1954, pl. 3, fig. 14b), the anteromedian tooth and socket are not developed; the hinge of the right valve consists of trilobate anterior and posterior teeth connected by a crenulate groove.

The hingement of *Sulcostocythere* appears to be related most closely to that of *Paijenborchella*, the lobate anterior tooth differing only very slightly from the stepped bifid tooth of some species of *Paijenborchella*. The internal expression of the external sulcus as a support for the anteromedian hinge element is seen also in certain species of *Palmenella* and *Neomonoceratina*.

SULCOSTOCYHERE KNYSNAENSIS Benson & Maddocks, n.sp.  
Pl. 3, Fig. 1-12.

*Description.* Carapace small, thin, with deep dorso-medial sulcus, greatly swollen before and particularly

behind sulcus; anterior and posterior margins compressed, venter flattened. In lateral outline greatest height at anterior cardinal angle; dorsal margin straight, steeply sloping, slightly concave in posterior part of left valve; anterior margin broadly and obliquely rounded; ventral margin sinuate, posterior portion broadly swung, curving upward; posterior margin dorsally truncated, concave; cardinal angles distinct, obtuse, posterior one of left valve produced. Left valve larger than right, with dorsal overreach, especially at cardinal angles. Anterior and posterior submarginal regions compressed, thickened, smooth.

Surface coarsely ridged with intermediate smooth areas on the domicilium. Ridged surface consisting of: **Anterodorsal ridge** diverging from anterior ocular area, just anterior to sulcus, subparalleling anterior margin to below mid-height, to intersect median ridge

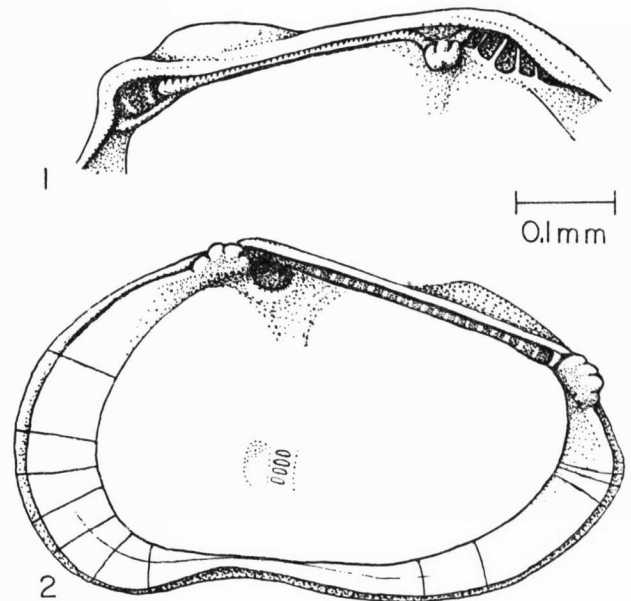


FIG. 10. *Sulcostocythere knysnaensis* BENSON & MADDOCKS, n. sp.—1. Schizodont hinge of left valve of female.—2. Interior of right valve of female showing the lobate terminal teeth of the hinge.

at acute angle; **median ridge** originating at ventral end of anterodorsal ridge, at about one-third body height, rising strongly and continuously to juncture with posterior ridge, uninterrupted crossing sulcus and with less relief just anterior to sulcus, where body wall swells to rounded subcentral tubercle-like prominence; **posterior ridge** originating behind sulcus at about three-quarters body height, arching angularly over posterior part of carapace, rising higher and obscuring posterodorsal margin, continuing ventrally as a sinuous vertical ridge to join median ridge at two-

thirds body height. Ventral extension of the posterior ridge continuous with vertical ridge, paralleling the ventral margin. Prominent **ventrolateral ridge** thick, alate, horizontal, most prominent posteriorly, with slightly curved anterior segment indistinctly continuous with anterodorsal ridge; ventrolateral ridge ends abruptly posteriorly, where it is joined by short vertical ridge extending dorsally about halfway to the median ridge. Ventral continuation of the posterior ridge curves beneath ventrolateral ridge, nearly joining it at anterior end.

Between ventral extension of posterior ridge and ventrolateral ridge is a third and smaller longitudinal ridge, posterior end of which curves up to join posterior end of ventrolateral ridge. Low vertical ridge connects posterior ridge with the median ridge, enclosing a pentagonal area on posterodorsal flank of carapace. Faint vertical ridge is sometimes present in area of subcentral swelling, dorsal to and joining median ridge just in front of sulcus.

These ridges stand high above the sides of the carapace but are variably developed. The sides of the major ridges are indented with large pits but are not perforated; particularly the median and posterodorsal ridges are thus indented. Thus some areas have a reticular appearance. The posterodorsal pentagonal area is especially reticulate in some specimens, with secondary ridges developed. Females present a more irregular, reticular appearance than males, which may have rather smooth interareas, because the same degree of surface sculpture is developed on a smaller area.

Carapace in dorsal view ovate-subtriangular, anterior broadly tapering, posterior truncate, ridges prominent. Greatest thickness near posterior. In ventral view carapace with arrowhead shape, ventrolateral ridge forming subdued wing, other ventral ridges conspicuous.

Internal features as described for genus, hinge strong but small, details difficult to distinguish on some specimens. Marginal area moderately wide, with no vestibules; few, straight, simple radial-pore canals. Adductor muscle-scar pattern as for genus, small; other scars not seen.

**Dimensions.** Male: length 0.64-0.67 mm, height 0.36-0.37 mm, thickness 0.33-0.37 mm. Female: length 0.61-0.63 mm, height 0.36-0.39 mm, thickness 0.33-0.36 mm.

**Material.** Approximately 450 specimens, of which nearly 300 were whole carapaces, most containing soft parts.

**Occurrence.** This species is the most abundant one in the Knysna fauna and also has the widest distribution. It is absent at Westford Bridge but is present at all the other localities. It is most abundant at Rail Bridge, where it is the predominant element (76%) of the population at low-neap tide level, and is also numerous at the low-spring tide and mid-tide levels. Specimens from Leisure Isle lack soft parts and show signs of abrasion.

#### Family CYTHERETTIDAE Triebel, 1952

##### Genus CYTHERETTA G. W. Müller, 1894

*Cytheretta* G. W. MÜLLER, 1894, p. 382; ———, 1912, p. 366; EDWARDS, 1944, p. 524; VAN DEN BOLD, 1946, p. 27; PURI, 1952, p. 202; TRIEBEL, 1952, p. 17; KEIJ, 1957, p. 130; PURI, 1958, p. 186; POKORNÝ, 1958, p. 293; HOWE, 1961, p. Q270; BENSON & COLEMAN, 1962, p. 00.

*Pseudocytheretta* CUSHMAN, 1906, p. 382.

*Cylindrus* NEVIANI, 1928, p. 106.

*Prionocytheretta* MÉHES, 1941, p. 360.

**Type-species.** *Cytheretta rubra* G. W. MÜLLER, 1894, p. 382, pl. 8, fig. 9, 10, 13, 16; pl. 39, fig. 8-22, 24 [= *Cytherina subradiosa* ROEMER, 1838; (subsequent designation by RUGGIERI, 1950, p. 9)].

**Diagnosis.** Carapace elongate-ovate, ventral margin upturned in posterior, posterodorsal area produced, angular, or truncate. Surface smooth, sometimes with prominent longitudinal ribs; left valve conspicuously larger than right, overlapping it dorsally, especially at cardinal angles. Hinge advanced, modified holamphidont, sockets of left valve frequently have secondary teeth on the ventral wall but may be otherwise poorly confined ventrally, median bar and groove smooth or finely crenulate, accessory toothlets sometimes present. Marginal area very wide, inner margin irregular, varying from meandrine to S-shaped to very slightly lobate in the anteroventral region; radial-pore canals long and numerous, curved, crowded. *Eoc.-Rec.*

In his discussion of the genus *Cytheretta* from the Tertiary of the Mainz Basin, TRIEBEL (1952) states his opinion that a proportionally narrow marginal area and a regular inner margin are indicative or at least characteristic of an immature specimen. This may be true in many instances, but it also seems possible that the evolution of the cytherettid duplicature has progressed beyond the stage characterized by the wide and irregular marginal area with very irregular radial-pore canals to the greater regularity of the inner margin accompanied by a narrower marginal area and straighter radial-pore canals. Several cytherettid species are now known in which specimens have been described possessing mature hinges and regular inner margins with relatively narrow marginal areas. It is yet to be demonstrated whether this represents pro-

gressive or retrograde evolution, but the organization and convergence of the setae around the free margin would seem to be an increasing advantage to the ostracode, seen in so many cytherid forms, rather than a disadvantage.

*CYTHERETTA KNYSNAENSIS* Benson & Maddocks, n. sp.  
Pl. 2, Fig. 7-11.

*Diagnosis.* Distinguished by its ribbed subreticular surface, which includes concentric rows of pits and ribs subparallel to the free margin, and longitudinal ribs in the central region. Small anterior vestibule, even moderately wide marginal area with regular inner margin, straight radial-pore canals, and fringe of 12 to 15 or more blunt spines around anterior margin.

*Description.* Elongate ovate in lateral view, dorsal and ventral margins subparallel, greatest height at anterior cardinal angle; anterior margin broadly and obliquely rounded; ventral margin straight, upturned in posterior portion; posterior margin truncate above midheight, slightly concave. Elongate-ovate in dorsal view, left valve overlapping right, especially at cardinal angles, posterior end broadly tapered, anterior end more narrowly rounded, greatest width located at about three-quarters of the length. Surface ornamented with longitudinal and concentric fine ribs separated by grooves with pits arranged in a linear reticulate pattern; ribbing strongest in postero-central part of carapace, concentric row of small rectangular pits separating high and smooth marginal rims around anterior margin, in posterodorsal region ribs tend to follow concave posterior margin, three ribs postjacent to antero-central region terminate to form smooth elevation in area of muscle-scars. Anterior cardinal area

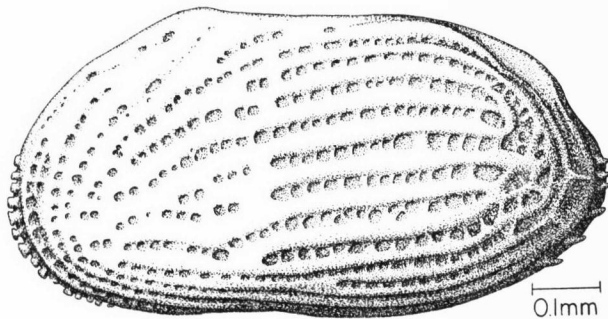


FIG. 11. *Cytheretta knysnaensis* BENSON & MADDOCKS, n. sp. Lateral exterior of left valve of specimen FAL250M, female showing the diagnostic ribbed subreticular surface.

high and smooth, without well developed eye tubercle, but with internal eye sinus.

Well preserved specimens possess narrow fringe of 12 to 15 or more small spines around anterior mar-

gin. Sexual dimorphism not conspicuous; presumed females slightly shorter in lateral view and somewhat more inflated posteriorly in dorsal view than males.

Hinge modified holamphidont: Right valve with smooth, stepped anterior tooth; small circular postjacent anteromedian socket that does not extend ventrally beyond groove, thick ventral wall continuous only with anteroventral boundary of median, narrow, finely crenulate groove; and smooth, posteriorly high,

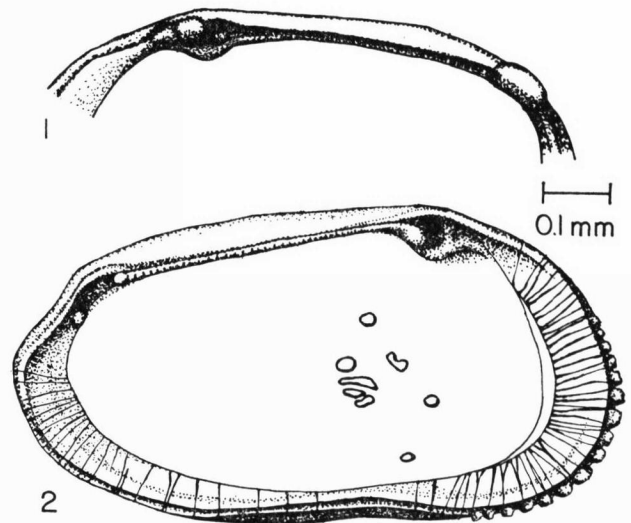


FIG. 12. *Cytheretta knysnaensis* BENSON & MADDOCKS, n. sp.—1. Hinge of right valve.—2. Interior of left valve showing the regular inner margin and small accessory tooth of posterior hinge element.

reniform posterior tooth. Hinge of left valve consists of small anterior socket, well confined ventrally, with shallow anterior extension; small, smooth, knob-like postjacent anteromedian tooth on narrow serrate median bar; and deep elongate posterior socket with no ventral wall; small accessory tooth strengthening posterior wall. Marginal area moderately wide, thick, inner margin entirely regular. Selvage strong, list distinguishable along part of ventral margin. Narrow vestibule present in anterior, radial-pore canals numerous, simple, straight. Muscle-scar pattern row of four adductor scars, V-shaped antennal scar, one mandibular scar below and in front of these scars, another just above inner margin.

*Dimensions.* Length 0.91-0.94 mm, height 0.47-0.50 mm, thickness 0.42-0.46 mm.

*Material.* From Knysna Estuary, 151 specimens, of which 32 had both valves intact, many were immature, none contained soft parts. One specimen from station FAL250 (False Bay Dredge Series of the University of Cape Town Ecological Survey 34°22.7'S,



18°43.1'E.) is illustrated in Pl. 2, Fig. 7, and text Figure 11, because of the unusually good preservation of the reticular ornament on this specimen.

**Remarks.** Except for the complete regularity of the inner margin this species agrees with the characters of the genus *Cytheretta*. Some specimens show a slight thickening of the anteroventral floor of the carapace cavity, where the sinuation of the inner margin would be located if this form were a typical cytheretid. This thickening may well be the last vestige of this inner marginal structure, or it may only reflect the low position of the mandibular muscle scars. A number of currently accepted species of *Cytheretta* show only a very slight anteroventral sinuation of the inner margin; the inner margin of *Cytheretta sahnii* PURI, 1952, is described as entirely regular (BENSON & COLEMAN, 1962, text fig. 12). Because such great variation in this character is known among species of this genus, it is not improbable that a continuous gradation to the state of no irregularity exists, and the end result would be represented by a species such as the one described. The duplicature of this species is not as wide as in most species of *Cytheretta*; an apparent result of this is that the radial-pore canals are all straight and functional, rather than curved and partially obsolete as in typical cytheretids.

**Occurrence.** This species is an abundant (30%) constituent of the Leisure Isle fauna. A single valve was also found at Rail Bridge, low-water level of neap tide.

#### Family LOXOCONCHIDAE Sars, 1925

##### Genus LOXOCONCHA Sars, 1866

*Loxoconcha* Sars, 1866, p. 61; —, 1926, p. 217; G. W. MÜLLER, 1894, p. 342; —, 1908, p. 113; —, 1912, p. 306; BRADY, 1880, p. 116; ALEXANDER, 1936, p. 693; MURRAY, 1938, p. 586; EDWARDS, 1944, p. 526; HORNIBROOK, 1952, p. 40; WAGNER, 1957, p. 64; KEIJ, 1957, p. 139; POKORNÝ, 1958, p. 292; HOWE, 1961, p. Q313; BENSON & COLEMAN, 1962, p. 36. *Normania* BRADY, 1866 (non BOWERBANK, 1869; nec BOECK, 1871) [see HOWE, 1961, p. Q313; 1962, p. 156].

*Loxoleberis* Sars, 1866, p. 130 [by HOWE, 1955, and 1961, p. Q313.]

**Type-species.** *Cythere impressa* BAIRD, 1850 (non M'COY, 1844). [= *Cythere rhomboidea* FISCHER, 1855 = *Loxoconcha bairdii* MÜLLER, 1894].

**Diagnosis.** Carapace high, ovate to subrhomboidal, anterior margin broadly and obliquely rounded, posteroventer broadly swung, wedgeshaped, venter sinuous; hinge gongyodont with crenulate median element; marginal area with small narrow vestibules, radial-pore canals straight, few to moderately numerous; four adductor muscle scars in vertical row, curved antennal scar, one or two mandibular scars;

surface smooth to coarsely pitted; males more elongate than females. *Cret.-Rec.*

#### LOXOCONCHA PARAMERIDIONALIS Benson & Maddocks, n. sp.

Pl. 4, Fig. 7-13

**Diagnosis.** Distinguished by its oblong to subrectangular and inflated shape; coarsely reticular surface over all of carapace, floor of pits without secondary pitting; delicate gongyodont hinge; conspicuous sexual dimorphism.

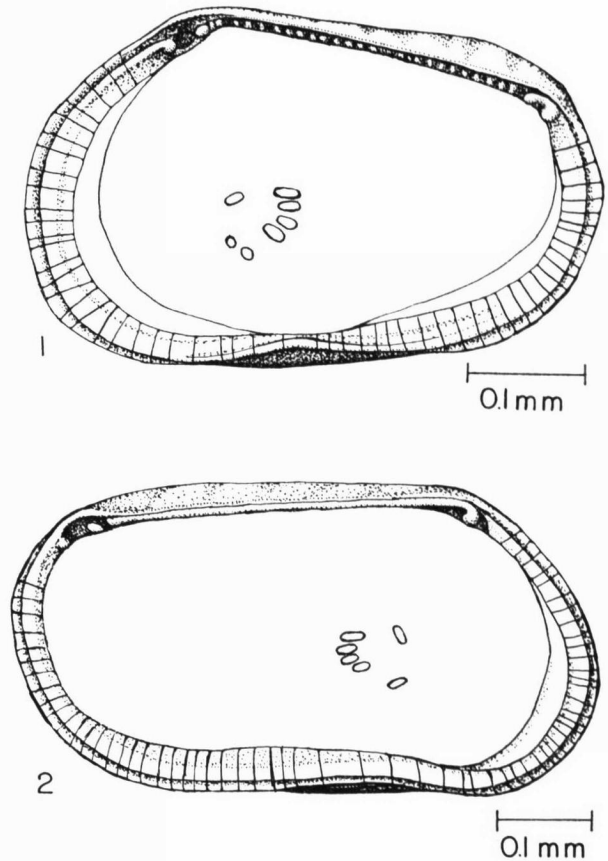


FIG. 13. *Loxoconcha parameridionalis* BENSON & MADDOCKS, n. sp.—1. Interior of right valve of female showing the delicate gongyodont hinge.—2. Interior of left valve of male.

**Description.** Carapace of male oblong to subrectangular, dorsal margin straight, parallel to the venter, anterior and posterior margins broadly and somewhat obliquely rounded, ventral margin nearly straight, with anterior sinuation, greatest height at anterior cardinal angle; shape of female similar but shorter, subquadrate, with less sinuous ventral margin. Plump in dorsal view, anterior end tapered, posterior end broadly rounded, with small keel formed by compressed posterior margin, greatest thickness

median; female similar in shape but shorter than male. Surface ornamented with closely spaced pits forming irregular reticular network; pattern of ridges roughly horizontal in ventrolateral area, vertical in dorsolateral area, paralleling anterior and posterior margins.

Inner margin with narrow anterior and posterior vestibules, numerous straight radial-pore canals, strong selvage. Hinge narrow, typically gongyodont, in the left valve consisting of thin, finely crenulate median bar, which curves ventrally at anterior end, terminating with a small knob; this knob preceded anteriorly by a small socket; posterior element composed of elongate socket with small tooth in the anteroventral portion. Anterior hinge element of right valve includes anterior socket preceded by terminal tooth-like enlargement of selvage, followed by small tooth that is an enlarged denticle of succeeding groove; finely crenulate median groove; and posterior claw-shaped tooth, the posterior end of which is enlarged. The muscle-scar pattern consists of curved row of four adductor scars, with single oval antennal scar and two mandibular scars.

*Dimensions.* Male: length 0.61-0.65 mm, height 0.33-0.35 mm, thickness 0.31-0.33 mm. Female: length 0.47-0.51 mm, height 0.28-0.31 mm, thickness 0.26-0.29 mm.

*Material.* 134 specimens, approximately half of which were whole carapaces containing remains of soft parts.

*Remarks.* This species is very similar to the Antarctic species *Loxoconcha meridionalis* G. W. MÜLLER, 1908, pl. 18, fig. 1, 9 (Gaussstation, lat. 65°S., long. 90°E.), from which it differs in the following points:

(1) MÜLLER did not distinguish males from females, as he had only four specimens. The illustrated forms resemble the female of the Knysna species. The length given for *L. meridionalis* is greater than for the Knysna female, but smaller than for the male.

(2) The floors of the pits in *Loxoconcha parameridionalis* do not contain the secondary pits described for *L. meridionalis*.

(3) The lateral outline of MÜLLER's species is more nearly rhomboidal, hence more typically loxoconchid, than that of the Knysna species. The posterodorsal region of *Loxoconcha meridionalis* is produced and compressed into a wide posterior keel; the outline of the posterior margin appears to be made up of two parts, the ventral part being broadly curved, merging with the ventral margin without any break, the dorsal part being straight or slightly concave, joining both the ventral part and the dorsal margin at distinct obtuse angles. In *L. parameridionalis* the posterodorsal region is not extended or compressed into a wide keel; the posterior margin is a single unbroken arc, meeting the dorsal margin in a rounded obtuse angle, broadly curving downward and merging with the ventral margin, its most posterior extremity extending only very slightly behind the end of the dorsal margin.

(4) In dorsal view the Antarctic species apparently possesses more distinct anterior and posterior keels than does the Knysna species.

(5) In both species a conspicuous ridge parallels the anterior and posterior margins. Associated with this ridge MÜLLER describes and illustrates a number of fairly distinct radial streaks ("ziemlich deutlicher radiärer Streifung") that are not radial-pore canals; the Knysna species exhibits no such structure.

*Occurrence.* Present in the same areas as *Clithrocytheridea estuaria* but in different proportions; most abundant at Rail Bridge, the dominant species (38%) of the mid-tide level fauna, less common at the high tide (17%) and low-water neap tide (15%) levels, absent at the low-water spring tide level; rare at Ashford and Leisure Isle.

**LOXOCONCHA MEGAPORA** Benson & Maddocks, n. sp.

Pl. 4, Fig. 1-6.

*Diagnosis.* Distinguished by its smooth surface,

### EXPLANATION OF PLATE 3 SULCOSTACYTHERE KNYSNAENSIS

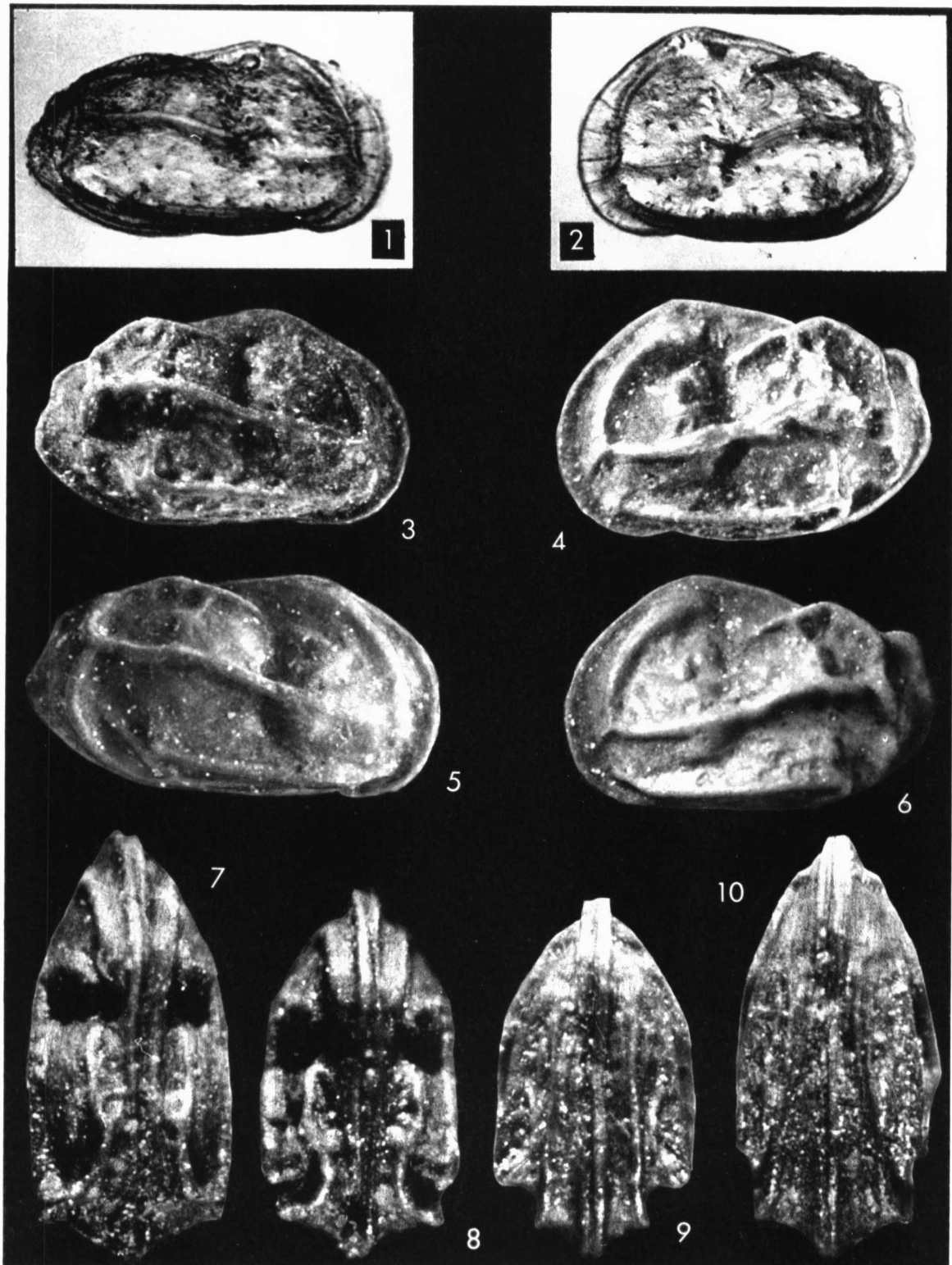
(All illustrated forms are from Knysna Estuary, Union of South Africa)

FIGURE

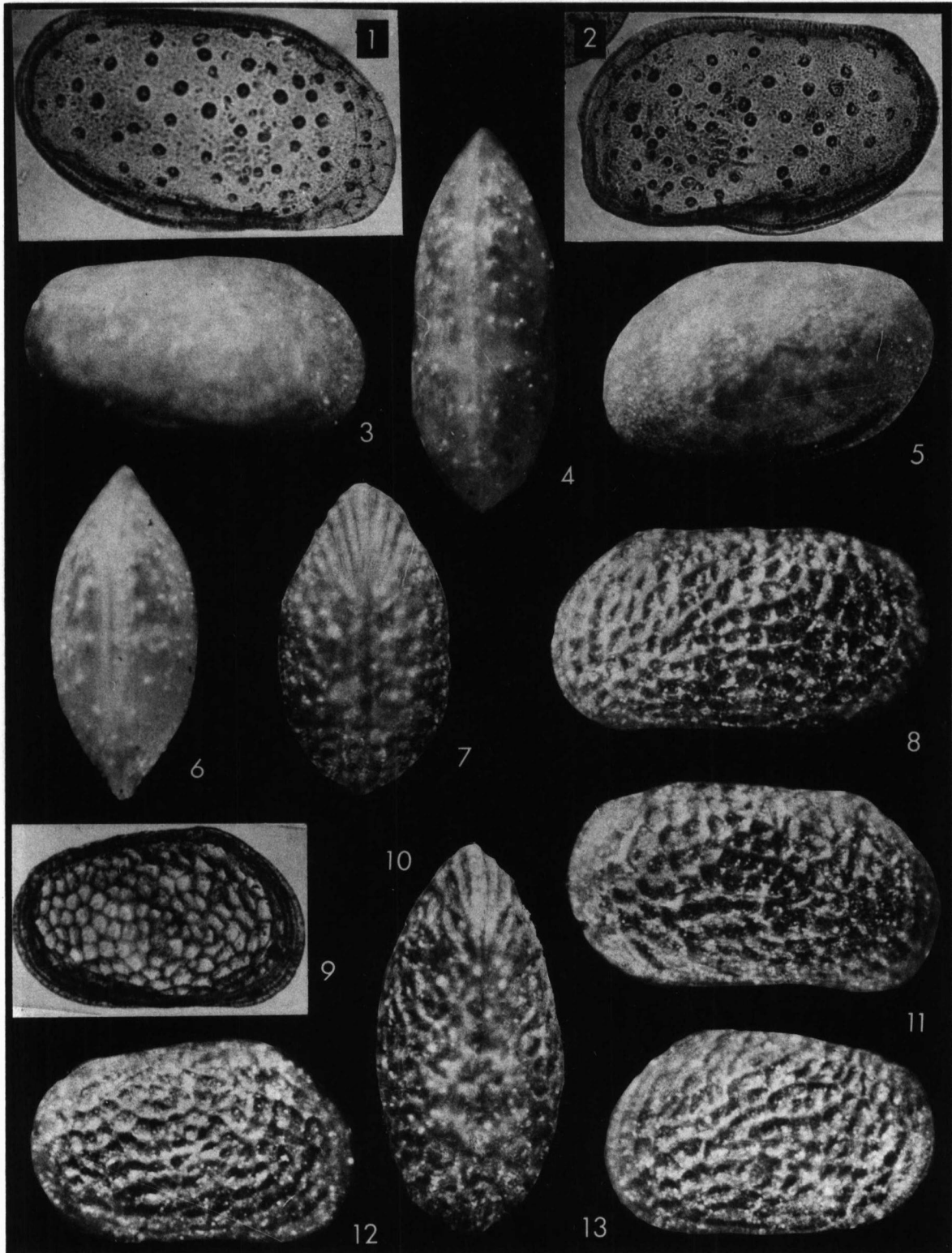
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1-10.—*Sulcostocythere knysnaensis* BENSON & MADDOCKS, n. gen., n. sp.; 1, lateral exterior view of right valve of male (transmitted light), ×85; 2, lateral exterior view of left valve of female (transmitted light), ×85; 3, lateral exterior

view of right valve of female, ×95; 4, lateral exterior view of left valve of female, ×95; 5, lateral exterior view of right valve of male, ×100; 6, lateral exterior view of left valve of female, ×95; 7, dorsal view of male; 8, dorsal view of female, ×100; 9, ventral view of female, ×100; 10, ventral view of male, ×100. ... 19



BENSON & MADDOCKS — Recent Ostracodes, Union of South Africa



BENSON & MADDOCKS — Recent Ostracodes, Union of South Africa



elongate subrhomboidal outline, compressed extremities, absence of caudal extension, large conspicuous normal-pore canals, and primitive bold gongyodont hinge.

*Description.* Carapace ovate-subrhomboidal in lateral view, posterior and posteroventral margins compressed into a thin keel. Dorsal margin straight, anterior margin broadly and obliquely rounded, ventral margin with anterior sinuation, continuous with broadly swung posterior margin to obtuse angulation above mid-height; cardinal angles rounded. Compressed ovate in dorsal view, with greatest thickness median, anterior and posterior ends sharply tapered. Surface smooth, in a few specimens with very fine pits arranged concentrically; normal-pore canals moderately numerous, very large and conspicuous. Presumed male more elongate than female.

Marginal area with moderate anterior and narrow posteroventral vestibules, few straight radial-pore canals with funnel-shaped proximal terminations in anterior vestibule. List, selvage, and flange weak but distinguishable around free margin. Hinge is bold primitive form of gongyodont, in left valve consisting of denticulate bar, anteriorly denticles become progressively enlarged and more widely separated, posteriorly spaces between teeth enlarge into sockets; anterior three denticles and posterior three interspaces particularly enlarged, merging to form elongate socket containing one or two small teeth. Right valve hinge complementary, having large anterior sockets that become progressively smaller posteriorly as intervening denticles become higher, last three denticles particularly enlarged, last two have a faint dorsal connection. Distinct ridges on both dorsal and ventral borders of right valve groove, incompletely developed accommodation groove over median bar of left valve to receive dorsal margin of right valve. Muscle-scar

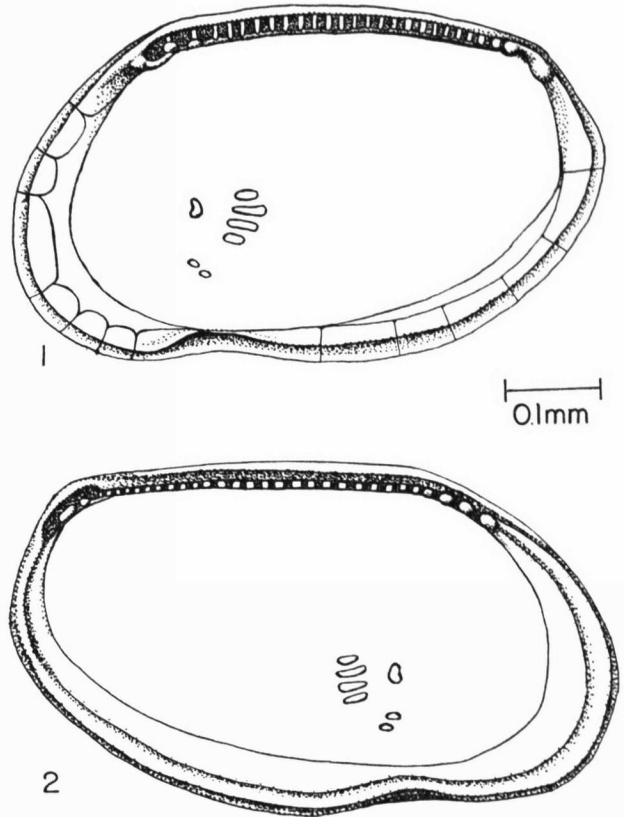


FIG. 14. *Loxoconcha megapora* BENSON & MADDOCKS, n. sp.—1. Interior of right valve of female showing the primitive bold gongyodont hinge.—2. Interior of left valve of male.

pattern a curved row of four adductor scars, two mandibular scars and antennal scar.

*Dimensions.* Male: length 0.63-0.72 mm, height 0.32-0.41 mm, thickness 0.29 mm. Female: 0.60-0.69 mm, height 0.38-0.40 mm, thickness 0.30 mm.

*Material.* 18 specimens, of which 10 were whole carapaces. None contained soft parts.

EXPLANATION OF PLATE 4  
LOXOCONCHA

(All illustrated forms are from Knysna Estuary, Union of South Africa)

FIGURE  
1-6.—*Loxoconcha megapora* BENSON & MADDOCKS, n. sp.; 1, interior of left valve of male (transmitted light), ×90; 2, interior of right valve of male (transmitted light), ×90; 3, lateral exterior view of right valve of male, ×85; 4, dorsal view of male, ×90; 5, lateral exterior view of left valve of female, ×100; 6, dorsal view of female, ×90. .... 24

7-13.—*Loxoconcha parameridionalis* BENSON & MADDOCKS, n. sp.; 7, dorsal view of female, ×100; 8, lateral exterior view of left valve of male, ×100; 9, lateral exterior view of right valve of female (transmitted light), ×95; 10, dorsal view of male, ×100; 11, lateral exterior view of right valve of male, ×100; 12, lateral exterior view of right valve of female, ×100; 13, lateral exterior view of left valve of female, ×100. .... 23

*Occurrence.* This species was found only at Leisure Isle.

Family XESTOLEBERIDIDAE Sars, 1928  
Genus XESTOLEBERIS Sars, 1866

*Xestoleberis* Sars, 1866, p. 66; —, 1928, p. 242; G. W. MÜLLER, 1894, p. 332; —, 1912, p. 295; BENSON, 1959, p. 55; HOWE, 1961, p. Q343.

*Type-species.* *Cythere aurantia* BAIRD, 1838, p. 142, pl. 5, fig. 26 (Subsequent designation by BRADY & NORMAN, 1889).

*Diagnosis.* Shell thin, usually smooth, egg-shaped; anterior turned ventrally, swollen to highly inflated posterior region where females carry young through the early stages of development; usually with crescentic eye scar, distinct muscle-scar pattern of four large adductor scars, V- or W-shaped antennal scar, and two mandibular scars; large anterior and posterior vestibules, narrow fused duplicatures; short, simple widely spaced radial-pore canals; hinge antimerodont, usually with pronounced overlap of left valve over right in dorsal region. *Cret.-Rec.*

XESTOLEBERIS CAPENSIS G. W. Müller, 1908  
Pl. 2, Fig. 12.

*Xestoleberis capensis* G. W. MÜLLER, 1908, p. 127; —, 1912, p. 300; STEBBING, 1910, p. 505.

*Diagnosis.* Distinguished by the equality of the greatest height and width of the carapace, width somewhat more than half the length just behind mid-length; radial-pore canals of two sizes; eye scar inconspicuous, narrow, often represented by two small scars; antennal scar heart-shaped; posteroventral marginal outline obtusely angulate. *Rec.*

*Description.* Lateral outline ovoid, narrowly rounded anteriorly, very broadly rounded and somewhat truncate behind, greatest height just behind mid-length; dorsal margin sloping steeply and evenly anteriorly, sloping more gently posteriorly; ventral margin very slightly sinuate; posterior margin broadly arched, nearly vertical, meeting dorsal and ventral margins at distinct, rounded obtuse angles. In dorsal view greatest width just behind mid-length, anterior narrowly rounded, posterior more broadly rounded in females, similar to anterior in males. Surface smooth, normal-pore canals large, numerous.

Hinge antimerodont, robust, in left valve the anterior element is formed of about 12 small sockets, the posterior element is a row of about 7 sockets; between these the dorsal margin projects as a smooth bar, the ends of which are faintly crenulate and grade into the floor of the sockets. In right valve rims of anterior and posterior margins are strengthened dorsally, becoming denticulate ridges; between these terminal hinge elements is an elongate, much depressed

groove, which is smooth in the center, crenulate at its ends. Duplicature wide, with wide anterior and narrow posterior vestibules; fused portion fairly narrow. Line of concrescence lobate as result of proximal enlargement of some radial-pore canals. Two sizes of radial-pore canals are present, some narrow and of the same width throughout, others thick and widening proximally. Both types are present along the anteroventral margin, but the larger type is dominant elsewhere. The muscle-scar pattern consists of four, large, oblong adductor scars arranged in a curved vertical row with ventral one smallest, dorsal one largest and triangular; antennal scar large, V-shaped

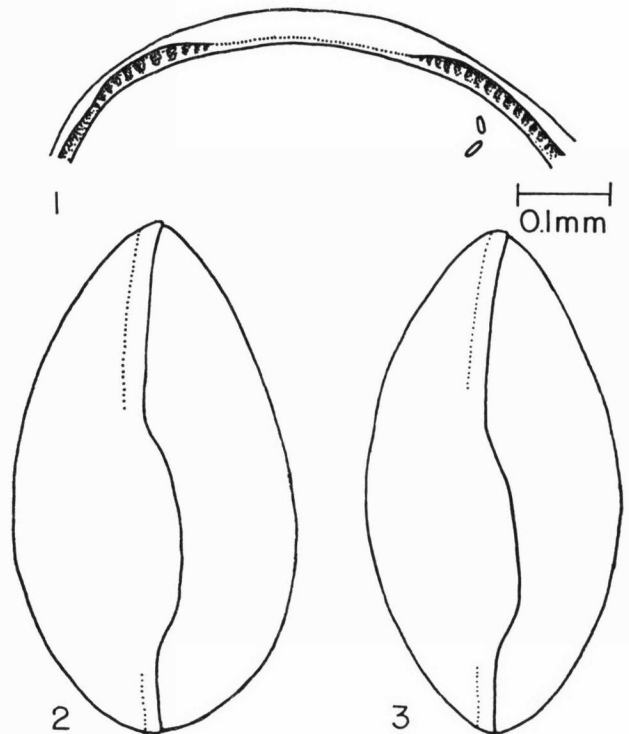


FIG. 15. *Xestoleberis capensis* G. W. MÜLLER, 1908.—1. Hinge and eye scars of left valve.—2. Dorsal view of female.—3. Dorsal view of male.

or heart-shaped; two oval mandibular scars present ventrally. Eye scar small, consisting of either a single narrow curved scar or two small elongate scars at an angle to each other. Presumed males smaller than females, less inflated posteriorly.

*Dimensions.* Presumed females: length 0.53-0.60 mm, height 0.33-0.36 mm, thickness 0.32-0.35 mm. Presumed males: length 0.55 mm, height 0.35 mm, thickness 0.35 mm.

*Material.* 48 specimens, of which 10 were whole carapaces, none containing soft parts, many immature.

*Remarks.* The Knysna specimens do not display as distinct a difference between the two types of radial-pore canals as MÜLLER indicated the Simonstown form possessed, nor do the thick and thin radial-pore canals alternate regularly along the anteroventral margin as described by MÜLLER. In other features of the carapace forms from Simonstown and Knysna are identical. *X. ramosa* MÜLLER, 1908, also described from Simonstown, differs from *X. capensis* by its greater size, more sinuous venter, and more irregularly lobate line of concrescence. *X. africana* BRADY, 1880, dredged by the *Challenger* Expedition from Simon's Bay, is much more tumid both in lateral and dorsal view. One whole specimen of *X. africana* is available for examination in the British Museum. The inner margin and the muscle-scar pattern could not be satisfactorily seen for comparison.

#### Family HEMICYTHERIDAE Puri, 1953

*Discussion.* The original controversial concept of *Hemicythere* expressed by SARS (1925) was that an intermediate form genus existed between *Cythere* and *Cythereis*. This group much enlarged, is now characterized by one of the most complicated of cytherid muscle-scar patterns. It exhibits a wide range of surface ornamentation as well as of hingement.

The subfamily *Hemicytherinae* PURI, 1953, was reviewed by POKORNÝ in 1955 and its classification revised mainly on the basis of specimens collected or described by ELOFSON from the Skagerack, Recent material from the Bay of Naples, or specimens available from the Tertiary of Moravia. With the nominotypical taxon *Hemicythere*, POKORNÝ included the genera *Heterocythereis*, *Urocythereis*, *Caudites*, *Procythereis*, and *Elofsonella* and erected the new categories *Aurila* and *Hemicytheria*. Within the same publication he discussed the phylogeny of the hinge and certain aspects of the marginal zone. In 1961 HOWE (*in* MOORE, 1961) included the above genera in the family *Hemicytheridae* and added those of *Mutilus*, *Nepheokirkos*, *Nereina*, *Tyrrhenocythere*, and *Urocythere*.

The common features present in these forms, described primarily from northern and southern Europe and southeastern North America (with the exception of *Procythereis* described by SKOGSBERG from the southern tip of South America), include an "almond-shaped" carapace and a range of adult amphidont hinges, but of particular importance is the consistency of the division in one or several of the central adductor muscle-scars and the presence of more than one antennal scar. The surface ornamentation of the hemi-

cytherids varies from completely smooth to punctate to heavily reticular or even ridged.

Considering the relative recency of information regarding this group of ostracodes and the rather limited distribution of known and well described forms, it is likely that many variations exist, as are described in this report, which are yet to be understood fully. It is not yet possible to adequately classify some of the South African hemicytherids, and the conservative point of view is taken in assigning them to pre-existing categories, even though they may not fit comfortably. We hope therefore to describe the following species or forms in anticipation of their future placement in more suitable taxa according to new information derived from the future study of southern hemisphere forms.

#### Genus HEMICYTHERE Sars, 1925

*Hemicythere* G. O. SARS (*partim*), 1925, p. 182; KLIE, 1929, p. 282; EDWARDS (*partim*), 1944, p. 517; VAN DEN BOLD (*partim*), 1946, p. 28; PURI (*partim*), 1953, p. 172; POKORNÝ, 1955, p. 6; OERTLI, 1956, p. 95; BENSON, 1959, p. 65; MANDELSTAM, 1960, p. 388; HOWE, 1961, p. Q302.  
*Cythereis gruppo auris* NEVIANI (*partim*), 1928, p. 72.  
*Cythereis (Eucythereis)* KLIE (*partim*), 1940, p. 415.  
 ?*Procythereis* SKOGSBERG (*partim*), 1928, p. 17.  
*Type-species.* *Cythere villosa* SARS, 1866, p. 42 (subsequent designation by EDWARDS, 1944).

*Diagnosis.* Carapace subrectangular to almond-shaped, anterior margin broadly and obliquely rounded; dorsal margin straight, gently sloping; ventral margin with anterior sinuation, posterior upturned; posterior margin usually with dorsal part concave, forming distinct angulation. Surface pitted to reticular. Hinge hemiamphidont. Marginal area with numerous straight radial-pore canals. Muscle-scar pattern a vertical row of four adductor scars, the middle two of which are divided, and two anterior scars. *Eoc.-Rec.*

#### HEMICYTHERE? sp.

Pl. 5, Fig. 3, 4, 6, 8, 9.

*Description.* Carapace hemicytherid, valves dissimilar in shape but of nearly equal size, left valve nearly oval, right valve more elongate. Dorsal margin straight or slightly convex, nearly horizontal, ventral margin sinuous, especially in right valve, greatest height at anterior cardinal angle. Anterior margin broadly rounded, in left valve meeting the dorsal margin without distinct angle, in right valve with shallow depression at this junction. Posterior margin of left valve rounded; right valve with short posteroventral extension, terminated by steeply sloping dorsal part of posterior margin. Ocular area expressed as a low smooth elevation. Ventral region much com-

pressed beneath a long, sharply incised, horizontal groove. Surface with numerous small puncta that are arranged in a fine reticular network. Small pits arranged in concentric rows paralleling the margins, especially obvious in anterior region. Above the major ventral row puncta arranged to form less conspicuous

horizontal rows parallel to the larger one. Pits are largest in center of carapace where regularity in reticular pattern decreases. In some specimens three diagonal ridges slope anteriorly in the anteroventer, adding radial element to otherwise concentric pattern of reticulae. Elongate in dorsal view, sides not inflated, tapering anteriorly and posteriorly from point of greatest thickness located at about two-thirds of the length.

Marginal area moderately wide, without vestibules; radial-pore canals numerous, straight; selvage strong; flange wide and continuous around free margin, dorsally wrapping over right valve hinge as reinforcement of dorsal wall of groove. Hinge heterocytherid; in right valve with high rounded anterior tooth, post-jacent shallow socket continuing into narrow smooth groove with a well developed ventral wall, and elongate wedge-shaped posterior tooth that is highest posteriorly. Left valve with well confined anterior socket, large rounded tooth on long narrow bar, which may become crenulate in terminal part, and elongate posterior socket; the dorsal wall of the carapace forms a shallow accommodation depression. Muscle-scar pattern hemicytherid, consisting of an arc of four adductors, with one of the central two divided; and three antennal scars; two additional divided scars are present above the antennal and adductor scars.

*Dimensions.* Larger form: length 0.68-0.72 mm, height 0.38-0.43 mm, thickness 0.27 mm. Smaller form: length 0.64 mm, height 0.36-0.38 mm, thickness 0.25 mm.

*Material.* Three specimens of the large form, of which one was whole; five specimens of the smaller form, of which three were whole; no soft parts.

*Remarks.* Two variations in form are distinguishable among these specimens. The larger form is less coarsely sculptured, with numerous small pits that do not create as distinct a reticulate pattern. The smaller form has larger puncta more deeply incised in a reticulate pattern; in the anteroventral region the three diagonal ridges are more strongly developed. Except for size and degree of sculpture the two forms are very similar. The internal features are identical except for size.

The ornamentation of the small form is very similar to that of *H. villosa* but somewhat more delicate, lacking any expression of a posterodorsal ridge; the type-species is also more quadrangular in lateral outline and has a crenulate posterior hinge element. The large form is very like *Cythere kerguelenensis* BRADY, 1880, which, however, is much larger (0.8-1.0 mm).

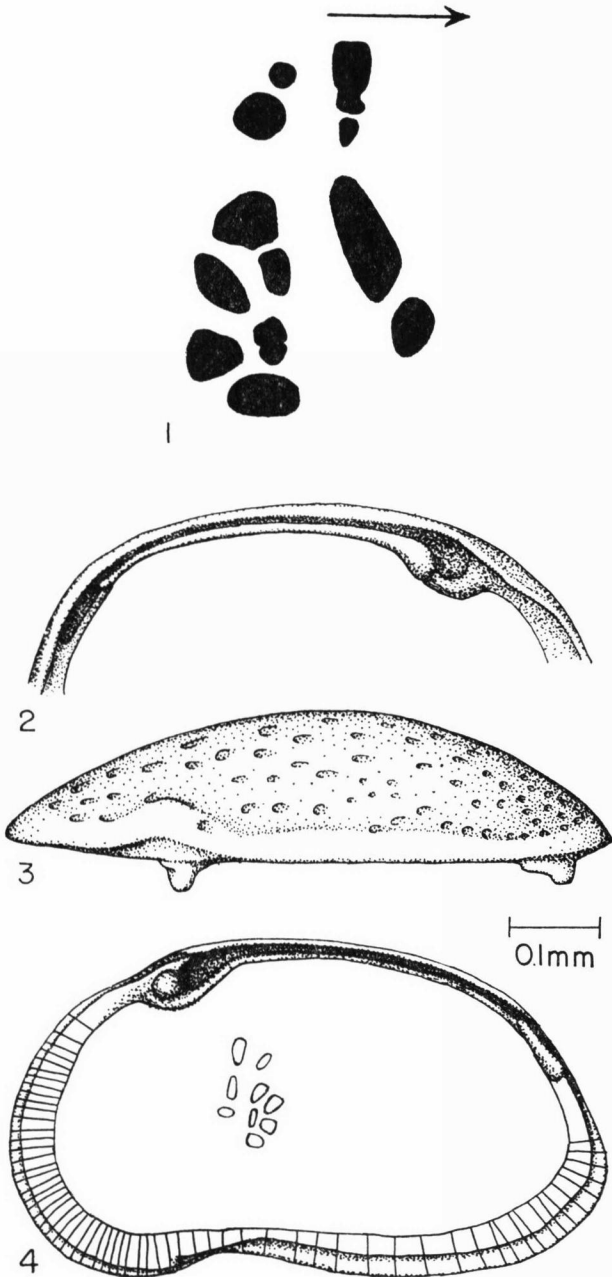


FIG. 16. *Hemicythere?* sp., The larger variant.—1. Muscle-scar pattern as seen on the interior of the left valve.—2. Hinge of left valve.—3. Dorsal view of right valve.—4. Interior of right valve showing the hinge and marginal area.



The *Challenger* specimens have serrate anterior and posterior margins. Specimens of this species as described by MÜLLER (1908) have a serrate posteroventral margin, and the puncta are confined to the posterodorsal part of the carapace. *Cythereis* (*Procythereis*) *robusta* SKOGSBERG, 1928, is larger (1.0 mm) than the large form but similar in shape and general ornament; it has arcuate vertical ridges parallel to the posterior margin, which are absent in the Knysna specimens; it lacks the three anteroventral radial ribs.

*Occurrence.* Leisure Isle.

#### Genus NEREINA Mandelstam, 1957

*Nereina* Mandelstam, in MANDELSTAM, *et al.*, 1957, p. 179; CHERNYSHEVA, 1961 (Basic Paleontology, Arthropoda volume), p. 394; MOORE, 1961 (by van den Bold), p. Q305.

*Type-species.* *Nereina barenzovoensis* Mandelstam, in MANDELSTAM, *et al.*, 1957, p. 179.

*Discussion.* The following two forms, which are not named in this report but described and referred to as sp. A and sp. B, are questionably and perhaps temporarily assigned to the genus *Nereina* for want of a more suitable category within the family Hemicytheridae. Sufficient specimens of these incipient species were not available nor are their affinities well enough understood.

*Nereina* MANDELSTAM as described and figured by VAN DEN BOLD (in MOORE, 1961, p. Q305, Fig. 231,3d) is similar to the forms of South Africa in that the interior features are much alike except for the different division of the central adductor muscle-scars, the merodont hinge of *Nereina*, and a difference in the emphasis of some of the broad, swollen ridges of the surface. The figured type-specimen (CHERNYSHEVA, 1961, fig. 1136, 1137) of the type-species (*N. barenzovoensis*) is obviously immature, and therefore the true configuration of the surface has yet to be adequately described. However, within the hemicytherids this is the only form yet defined that has smooth, broad ridges in a subdued, coarse reticular pattern, except for *Caudites*, which is attenuate in the posterior.

#### NEREINA? sp. A

Pl. 5, Fig. 1, 2, 5, 7.

*Description.* Carapace compressed, very thick; lateral outline hemicytherid, dorsal margin straight, sloping backward, ventral margin straight, or slightly sinuous in right valve, posterior portion curving upward. Anterior margin broadly rounded, depression in right valve formed at junction of dorsal and anterior margins, in left valve a boldly arched "ear" is present at anterior cardinal angle. The posterior cardinal angle is distinctly obtuse. Posterior margin slopes

steeply in a typical hemicytherid angulation, with posteroventral extension below mid-height. Surface smooth, irregularly undulating, with gross, subdued, broad ridges and reticular pattern of small pits that correspond to normal-pore canals. Faint reticular pattern visible in transmitted light (pl. 5, figs. 1, 2). Thickening of the shell wall forms a prominent ventrolateral keel joining a vertical posterior keel; from this junction the ventral keel continues to angle of posterior margin; carapace abruptly compressed below and behind these keels. Ocular area represented by smooth swollen elevation merging with wide, thickened marginal and dorsal rims. Subcentral tubercle not well developed but expressed as low smooth elevation. Carapace seen dorsally very much compressed, with anteromarginal and posterodorsal elevations and ventrolateral keel standing out boldly.

Duplicature wide, with numerous straight radial-pore canals, no vestibule; selvage and flange strongly developed around free margin. Hinge strongly holamphidont, in right valve with high conical anterior

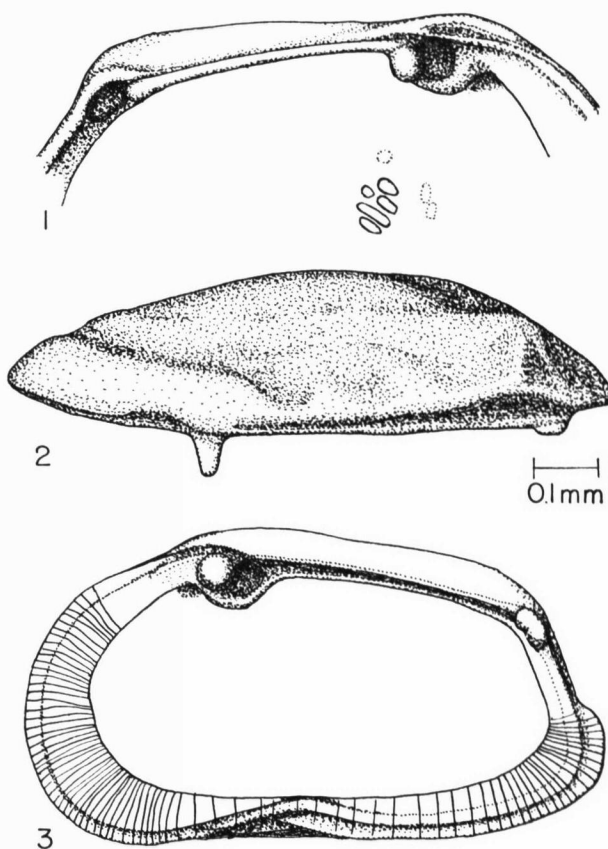


FIG. 17. *Nereina?* sp. A.—1. Hinge and muscle scar pattern of left valve.—2. Dorsal view of right valve.—3. Interior of right valve.

tooth, deep postjacent socket that is continuous with narrow shallow groove, both strongly bounded ventrally, and small smooth posterior tooth. Muscle-scar pattern obscure, apparently consisting of four adductor scars, one or two of which are divided, with two antennal scars.

*Dimensions.* Length 0.65-0.69 mm, height 0.34-0.38 mm, thickness 0.28 mm.

*Material.* Five specimens, all single valves. These specimens have been abraded, but this abrasion probably does not entirely account for the observed absence of reticulate ornament.

*Remarks.* The true affinities and classification of this form is yet to be determined (see discussion under generic citation).

*Occurrence.* Leisure Isle.

**NEREINA? sp. B**

Pl. 5, Fig. 11, 14

*Description.* Carapace compressed, heavy; ovate in lateral view, greatest height at anterior cardinal angle, shape hemicytherid but posterodorsal angulation is not pronounced nor is ventral sinuation. Dorsal margin straight, sloping backward; anterior margin broadly rounded, in left valve joining dorsal margin evenly at junction of dorsal and anterior margins. Ventral margin gently sinuated in both valves but especially so in right, posterior portion sloping upward; posterior margin sloping down to meet ventral margin just below mid-height with suggestion of hemicytherid angulation in right valve. Seen dorsally greatest thickness just behind mid-length, anterior and posterior ends tapered to acute angle, sides gently and evenly curving. Surface rugose, bold, irregular, with puncta but with no organized pattern of punctation or reticulation. The most conspicuous structure is a strong thickening of the shell wall ventrally to form a strong ventrolateral keel, triangular in cross-section, above the ventral margin and not hiding it in lateral view. The dorsal wall of this keel is irregularly pitted and slopes downward; the ventral wall is horizontal, forming a flattened venter. Broad longitudinal and nearly horizontal crest occupies central portion of valve. This elevation also triangular in cross-section, but represents a low swelling rather than a distinct ridge. Irregularly shaped nodes present in dorsal area: largest node below and in front of the anterior cardinal angle, smallest node just behind mid-length, third node near posterior margin slopes down and back near median ridge. Other minor nodes are also present. A row of about six large pits parallels the anterior margin. Margins thickened but do not stand

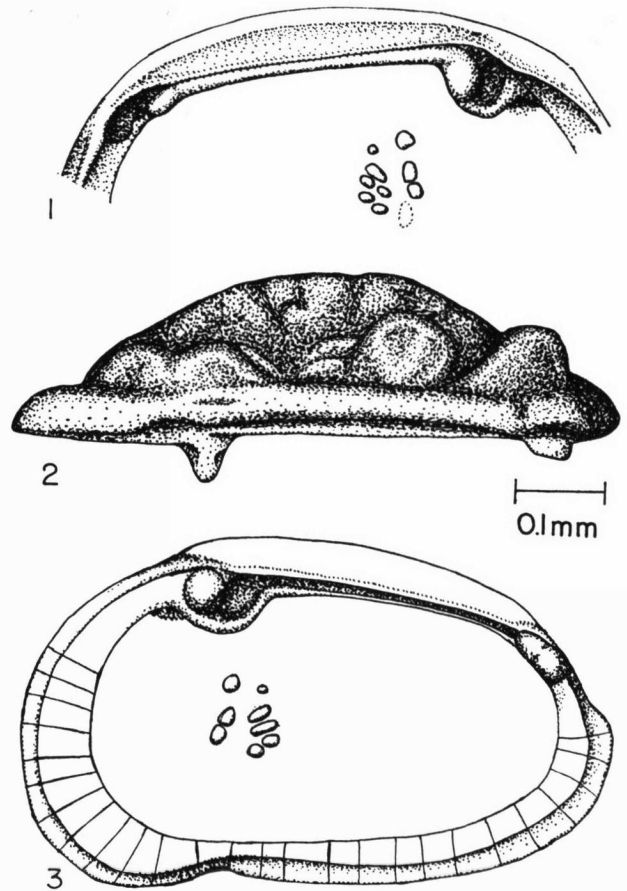


FIG. 18. *Nereina?* sp. B.—1. Hinge and muscle scar pattern of left valve.—2. Dorsal view of right valve.—3. Interior of left valve.

up as ridges. Normal-pore canals moderately large, numerous.

Internal surface of valve smooth, with no impressions of external features. Hinge holamphidont, robust; right valve hinge with stepped anterior tooth, deep socket that is continuous with well defined groove, and high reniform posterior tooth. In left valve, posterior socket with central thickening in ventral wall, posterior portion of hinge bar curved downward. Selvage strong and continuous around margin, forming anterior and posterior hinge teeth and dorsal margin of median groove. List indistinct around free margin but forms strong ventral wall to the socket and groove. Flange wide and continuous around free margin and wraps over dorsal margin to form narrow but distinct secondary ridge over dorsal wall of right valve socket and groove. Dorsal wall of carapace swollen on right valve to form an incompletely defined accommodation groove. Marginal area wide, without vestibules; radial-pore canals indistinct but apparently

simple, not numerous. Small eye sinus present in front of and below anterior hinge element. Muscle scars are large tubercles arranged around small shallow depression; pattern is composed of curved row of four adductor scars, the second from top being divided into two scars, in front of these two antennal scars in a diagonal row, some distance above these another large scar, above the adductors a single very small scar.

*Dimensions.* Length 0.62 mm, height 0.37 mm, thickness of one valve 0.14 mm.

*Material.* One whole carapace and one left valve, both abraded but otherwise well preserved, no soft parts.

*Remarks.* Characters of this species do not fit any of the previously described genera of the Hemicytheridae. It lacks the punctate to reticular surface ornament that is typical of this family, but it is otherwise typically hemicytherid in muscle-scar pattern, hinge, and general shape. The increased width of the ridges would seem to have obscured the underlying pattern of reticular ridge arrangement. The surface of this form appears to be another evolutionary step from the typical reticular hemicytherid in the direction of a more massive, heavily armored, rugose carapace. Pore canals, both radial and normal, are fewer in number than is common in many hemicytherids. This form is questionably assigned to *Nereina* until more information about its affinities is available.

*Occurrence.* Leisure Isle.

#### Genus AURILA Pokorný, 1955

*Aurila* POKORNÝ, 1955, p. 17; KEIJ, 1957, p. 114; WAGNER, 1957, p. 59; HOWE, 1961, p. Q302; BENSON & COLEMAN, 1962, p. 34; BENSON & KAESLER, 1962, p. 22; non POKORNÝ, 1958, p. 268.

*Hemicythere* SARS (*partim*), 1925, AUCT.

*Cythereis gruppo auris* NEVIANI (*partim*), 1928, p. 72.

*Cythereis (Eucythereis)* KLIE (*partim*), 1940, p. 415.

*Type-species.* *Cythere convexa* BAIRD, 1850, p. 174, pl. 21, fig. 3 [= *Cythere punctata* MÜNSTER, 1830].

*Diagnosis.* Shape of the carapace shortened hemicytherid; hinge holamphidont, usually with groove in ventral side of posterior tooth of right valve; small tooth in corresponding socket of left valve. Surface reticular with angular excavations around margins, pits more rounded in central area. Muscle-scar pattern consisting of vertical row of four adductor scars, of which the second from the top is divided, and three antennal scars in front. *Mio.-Rec.*

AURILA DAYII Benson & Maddocks, n. sp.

Pl. 5, Fig. 10-12.

*Diagnosis.* Valves very dissimilar in size and shape, surface with numerous pits arranged in reticular pattern; pits along anterior and posterior ventral margins

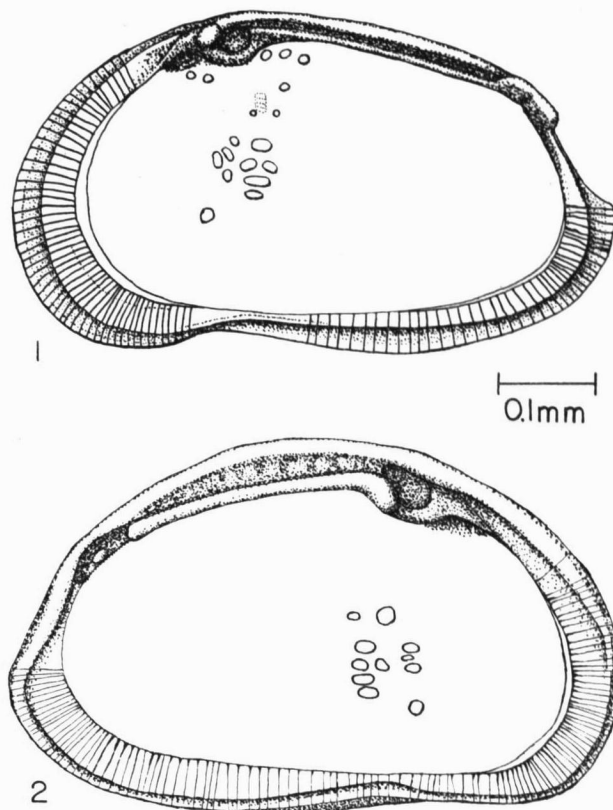


FIG. 19. *Aurila dayii* BENSON & MADDOCKS, n. sp.—1. Interior of right valve.—2. Interior of left valve showing weak vertical braces in the broad accommodation groove.

enlarged and polygonal in shape; lacking strong development of anterodorsal and posterodorsal ridges, without conspicuous ventrolateral keel.

*Description.* Carapace hemicytherid, valves very dissimilar in lateral outline. Right valve with straight dorsal margin, sloping gently posteriorly, anterior margin broadly and obliquely rounded, posterior margin sharply angulate above mid-height, ventral sinuation well forward, broad posteroventral swing. Left valve higher than right, dorsal margin broadly arched, junctions with anterior and posterior margins gradual rather than angulate, ventral margin gently sinuate. Ovate in dorsal view with tapered ends, greatest thickness median. Surface with numerous polygonal pits arranged concentrically in a reticular pattern, pits along anterior and posterior margins enlarged and more angular in shape. Ventral margin compressed below sharply incised groove. Eye tubercle distinct.

Inner margin traversed by numerous straight radial-pore canals, vestibule narrow or absent, selvage strong. Hinge robust, in right valve consisting of stepped smooth anterior tooth; deep circular socket

with strong ventral wall or socket lock, which is not continuous with the ventral confining ridge of the following groove; a smooth groove with strong ridges, opening from the dorsal wall of the anterior socket; and an elongate posterior tooth, smooth except for a groove in its ventral side. Left valve hinge with a deep anterior socket with strong ventral ridge, smooth downward-pointing tooth that is continuous with a smooth median bar, elongate posterior socket with small tooth growing from ventral ridge. Accommodation groove with weak vertical braces developed above median bar of left valve, more highly arched than necessary to accommodate the dorsal flange of right valve groove, so that dorsal margin of left valve stands much higher than that of right valve. Muscle-scar pattern includes vertical row of four adductor scars, the second from the top being divided into two scars, anterior row of three antennal scars, one mandibular scar, and a number of other dorsal body scars. Eye sinus deep, anterior to hinge.

*Dimensions.* Length 0.63-0.68 mm, height 0.39-0.45 mm, thickness 0.32 mm.

*Material.* 233 specimens, of which 90 were whole carapaces, no soft parts.

*Remarks.* The left valve of *Aurila cicatricosa* (REUSS), 1850, as figured by KEIJ (1957, pl. 20, fig. 8), has a more highly arched dorsal margin and a more acuminate posterior than the Knysna species. *A. conradi* (HOWE & MCGUIRT) and *A. schmidtae* (MALKIN) are much smaller, with a more strongly developed ventrolateral keel, dorsal margin more convex, with distinct cardinal angles on both valves. The new species also lacks the anterodorsal and posterodorsal oblique ridges of these and other species. It is more elongate than *A. convexa* (BAIRD), lacking the crenulate hinge groove and posterior marginal spines of

this species. The Knysna species is very similar to *A. punctata* (VON MÜNSTER), 1830, as figured by KEIJ (1957, pl. 20, fig. 7), and to a specimen identified as such from the Rupelian of the Paris Basin, but it is more elongate, lacks the angular posterodorsal ridge, and has deeper pits that form a more regularly reticulate pattern. *Eucythereis mirabilis* KLIE, 1940, is similar in lateral outline, but further comparison is not possible as the exterior ornamentation of this species has not been illustrated.

*Etymology.* This species is named in honor of Prof. J. H. DAY of the University of Cape Town, Union of South Africa.

#### Genus UROCYTHEREIS Ruggieri, 1950

*Urocythereis* RUGGIERI, 1950, p. 28; POKORNÝ, 1955, p. 9; ———, 1958, p. 266; GREKOFF, 1956, p. 72; KEIJ, 1957, p. 115; WAGNER, 1957, p. 62; HOWE, 1961, p. Q306.

*Type-species.* *Cytherina javosa* ROEMER, 1838, p. 516, pl. 6, fig. 7.

*Diagnosis.* Carapace elongate hemicytherid, subrectangular; surface coarsely reticulate; hinge amphidont, anterior tooth of right valve on elongated base, posterior tooth reniform, anterior tooth of left valve not well differentiated; muscle-scar pattern consisting of four adductor scars, one or two of which are divided, and two antennal scars. *Mio.-Rec.*

*Remarks.* WAGNER (1957), KEIJ (1957), and HOWE (1961) state that *Urocythereis* has three antennal scars. WAGNER describes the hinge as near antimerodont, with the anteromedian element poorly developed and the posterior element crenulate.

#### UROCYTHEREIS sp. Pl. 6, Fig. 1-4

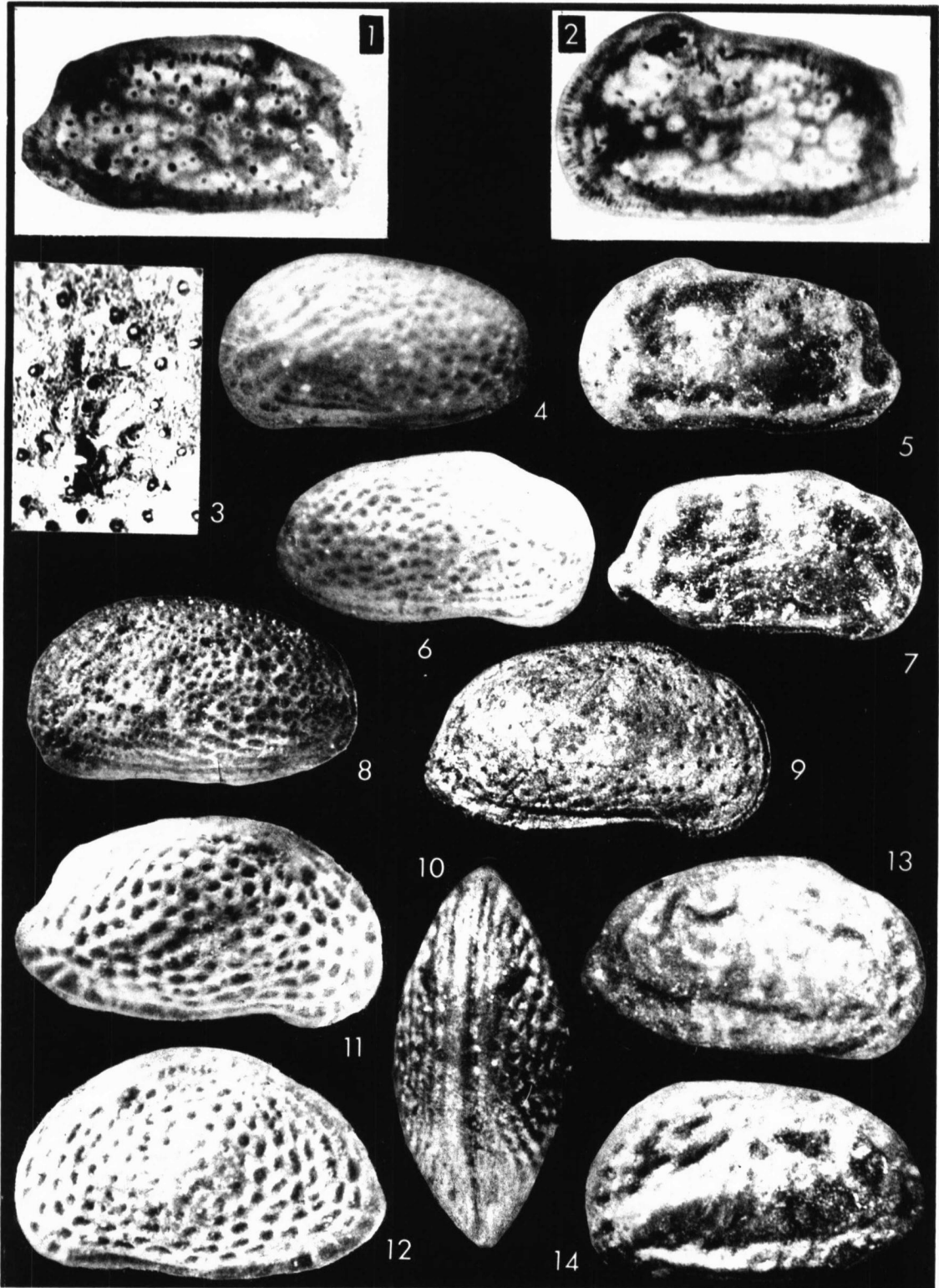
*Description.* Carapace elongate, compressed, subrectangular; in lateral view dorsal margin straight, nearly parallel to the venter; ventral margin sinuous,

### EXPLANATION OF PLATE 5 HEMICYTHERE, AURILA, NEREINA

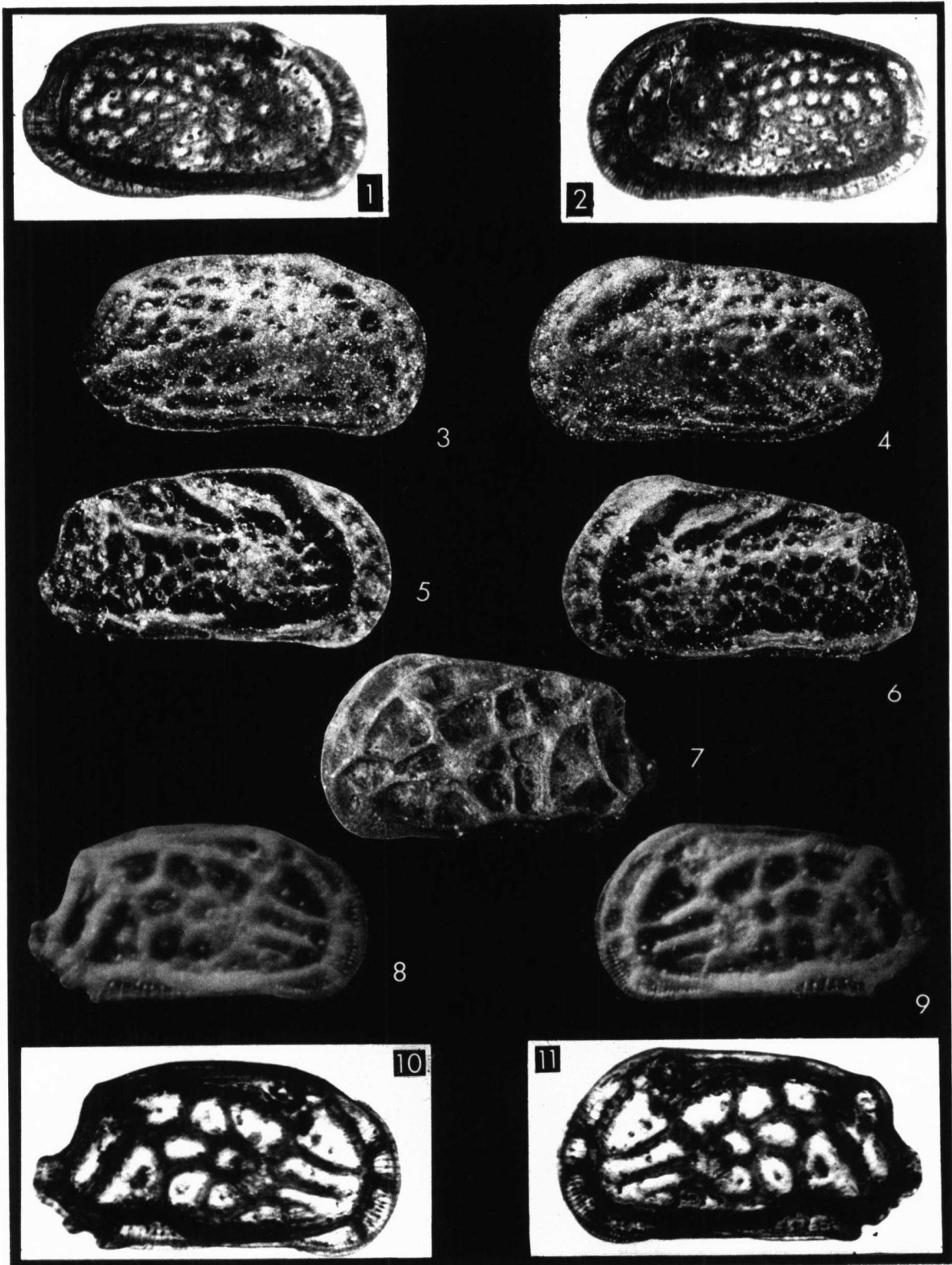
(All illustrated forms are from Knysna Estuary, Union of South Africa)

FIGURE	PAGE	
1, 2, 5, 7.— <i>Nereina?</i> sp. A; 1, lateral exterior view of right valve (transmitted light), ×90; 2, lateral exterior view of left valve (transmitted light), ×90; 5, lateral exterior view of left valve, ×80; 7, lateral exterior view of right valve, ×80. ....	29	(black light, ×80; 8, lateral exterior view of left valve, large form, ×80; 9, lateral exterior view of an abraded right valve, large form, ×80. ....
3, 4, 6, 8, 9.— <i>Hemicythere?</i> sp.; 3, muscle-scar pattern seen from exterior of left valve, large form (transmitted light); 4, lateral exterior view of left valve, small form (black light), ×80; 6, lateral exterior view of right valve, small form		27
		10-12.— <i>Aurila dayii</i> BENSON & MADDOCKS, n. sp.; 10, lateral exterior view of right valve, ×95; 11, dorsal view, ×95; 12, lateral exterior view of left valve, ×95. ....
		31
		13, 14.— <i>Nereina?</i> sp. B; 13, lateral exterior view of right valve, ×75; 14, lateral exterior view of left valve, ×75. ....
		30





BENSON & MADDOCKS — Recent Ostracodes, Union of South Africa



BENSON & MADDOCKS — Recent Ostracodes, Union of South Africa

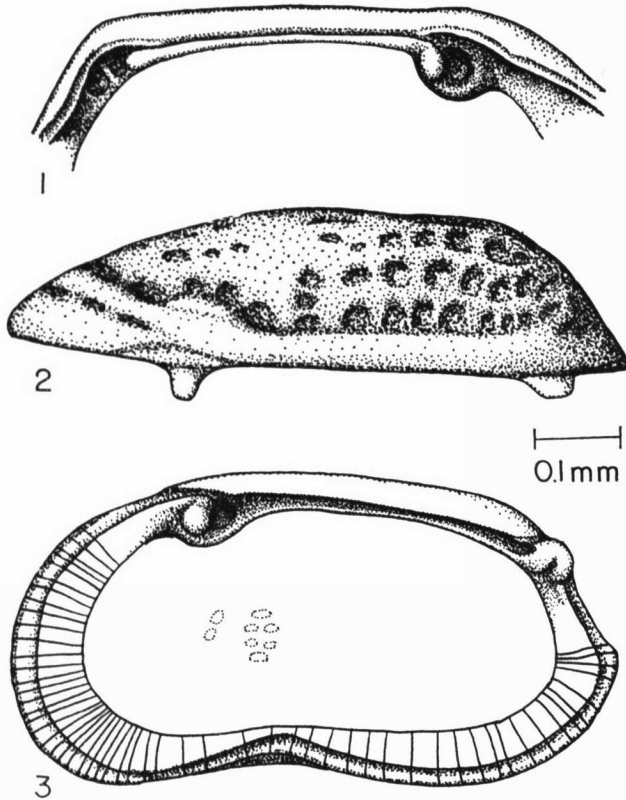


FIG. 20. *Urocythereis* sp.—1. Hinge of left valve.—2. Dorsal view of right valve.—3. Interior of right valve.

posterior portion sloping upward. Anterior margin broadly and evenly rounded, right valve with slight depression at junction of anterior and dorsal margins, greatest height at anterior cardinal angle. Posterior cardinal angle rounded but distinct; dorsal part of posterior margin concave, forming hemicytherid angulation, ventral part not much extended beyond dorsal margin, continuing without break into ventral margin. Elongate in dorsal view, sides parallel, greatest thickness near posterior.

Surface ornament consists of shallow rounded pits, arranged in more or less reticular pattern that is strongest on posterior half of carapace. Low elevation at anterior cardinal angle continues ventrally as broad, smooth, thickened anterior marginal rim; an indistinctly developed row of pits parallel to anterior margin divides this rim into two low ridges. Behind this rim are three or four larger pits. The anteromedian portion of carapace nearly smooth, bearing only a few widely separated very small pits. The posteromedian part bears several irregular horizontal rows of deeper pits that form a strongly reticulate pattern, which has a faint radial pattern away from the anteromedian region. Posterior part abruptly compressed behind suggestion of posterodorsal vertical ridge, but reticulate pattern continues over this sloping surface to posterior margin. Ventrally short lateral grooves are formed by the merging of several pits. Beneath these grooves a larger groove parallels the entire ventral margin. This groove causes compression of carapace with no ventrolateral ridge above it.

Marginal area moderately wide, with numerous straight radial-pore canals, each with median swelling; no vestibule. Hinge holamphidont, in right valve with high rounded anterior tooth; deep circular socket merging with well defined smooth groove, both with strong continuous ventral ridge; high rounded posterior tooth with a deep groove in its ventral surface. Selvage conspicuous, list not differentiated around free margin, flange wide and conspicuous, wrapping over hinge to form a low secondary ridge. Muscle-scar pattern generally indistinguishable, apparently hemicytherid.

*Dimensions.* Length 0.70-0.76 mm, height 0.37-0.40 mm, thickness 0.29 mm.

*Material.* Five specimens, of which three were whole carapaces; no soft parts. Although all specimens show signs of abrasion, they are otherwise well

EXPLANATION OF PLATE 6  
UROCYTHEREIS, BRADLEYA, MUTILUS

(All illustrated forms are from Knysna Estuary, Union of South Africa)

FIGURE	PAGE
1-4.— <i>Urocythereis</i> sp.; 1, lateral exterior view of right valve (transmitted light), ×80; 2, lateral exterior view of left valve (transmitted light), ×80; 3, lateral exterior view of right valve, ×80; 4, lateral exterior view of left valve, ×80.	30
5, 6.— <i>Bradleya?</i> sp.; 5, lateral exterior view of right valve of male, ×85; 6, lateral exterior view of left valve of male, ×85.	35

7-11.— <i>Mutilus</i> sp.; 7, lateral exterior view of left valve, ×85; 8, lateral exterior view of right valve (black light), ×85; 9, lateral exterior view of left valve (black light), ×85; 10, lateral exterior view of right valve (transmitted light), ×95; 11, lateral exterior view of left valve (transmitted light), ×95.	34
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preserved, and the absence of reticulate ornament on the anterior surface is undoubtedly a characteristic of the species and should not be attributed to poor preservation.

*Remarks.* The hinge is more strongly holamphidont than is usual for species of *Urocythereis*, and the muscle-scar pattern could not be observed accurately, but in shape and ornamentation the specimens fit this genus very well. The reticulate pattern of this species is rather similar to that of *Cythereis* (*Cythereis*) *disco-phora* SKOGSBERG, 1928, but the latter seems to have more numerous and deeper pits, especially in the anterior region; also the female that is figured (pl. 2, fig. 1) has a more highly arched dorsal margin than the Knysna specimens.

*Occurrence.* Leisure Isle.

#### Genus *MUTILUS* Neviani, 1928

*Mutilus* NEVIANI, 1928, p. 93; RUGGIERI, 1956, p. 168; POKORNÝ, 1958, p. 268; HOWE, in MOORE, 1961, p. Q304; MANDELSTAM in CHERNYSHEVA, 1961, p. 388.

*Type-species.* *Cythereis* (*Mutilus*) *laicancellata* NEVIANI, 1928, p. 93, pl. 2, figs. 66-68; (subsequent designation by RUGGIERI, 1956, p. 168) [= *Cythere* *retiformis* TERQUEM, 1878, p. 116, pl. 13, figs. 16a-d].

*Diagnosis.* A broad, subrectangular hemicytherid with obliquely rounded anterior, angulation of posterior below middle, a very coarsely reticular surface, and reniform to incised posterior tooth; second from top adductor muscle-scars divided, three antennal scars. *Mio.-Rec.*

#### *MUTILUS* sp. Pl. 6, Fig. 7-11.

*Description.* Carapace small, very coarsely reticular; in lateral view dorsal margin straight, nearly horizontal; ventral margin nearly straight, posterior part sloping upward; greatest height at anterior cardinal angle. Anterior margin broadly and obliquely rounded, in right valve with shallow depression at junction with dorsal margin, broadly rounded but distinct cardinal angle in left valve. Posteroventral portion of carapace drawn out, caudate, truncated below mid-height; dorsal part of posterior margin distinctly concave, forming a hemicytherid angulation. Perpendicular to the posteroventral marginal area are two thick ridges that continue beyond the margin as short thick spines. In dorsal view greatest thickness in posteromedian region, sides gently curved and converging anteriorly, abruptly compressed posteriorly.

Surface ornament consists of very high thick ridges enclosing deep polygonal fossae, with minor ridges sometimes developed within larger fossae. Subcentral tubercle and eye tubercle conspicuously developed as

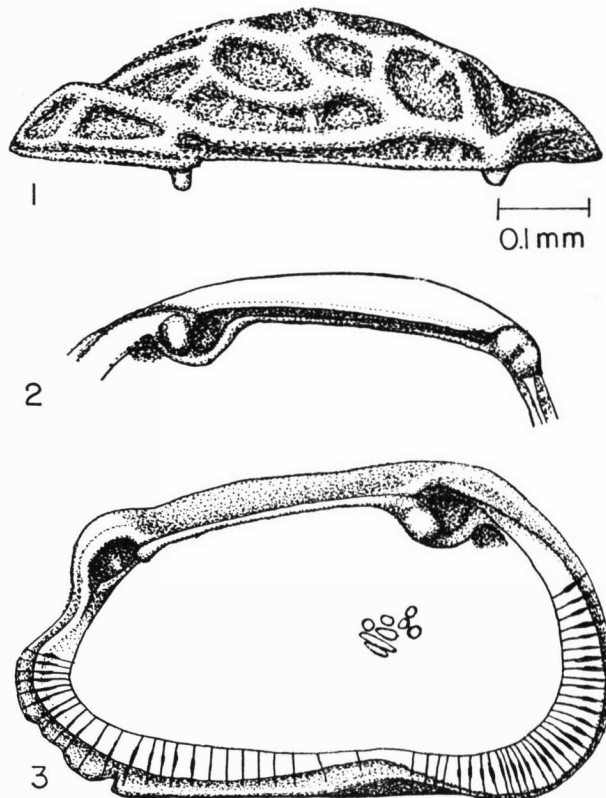


FIG. 21. *Mutilus* sp.—1. Dorsal view of right valve.—2. Hinge of right valve.—3. Interior of left valve.

high nodes formed by junction of major ridges. Additional high area at junctions of ridges in posterodorsal and posteroventral regions. Ventral portion of the carapace very sharply compressed beneath horizontal, rather alate, keel, forming a flattened ventral surface. Left and right valves very nearly equal in size, right not as high as left. On most specimens (including pl. 6, figs. 8-11) all ridges are of about the same height and thickness. A ridge of minor size is formed by the thickening of the anterior and ventral margins, very close to and paralleling the rim. Another especially thick ridge subparallels anterior margin, merging with eye tubercle and continuing parallel to dorsal margin as far as major junction near posterior. This ridge also continues ventrally as a keel; however the prominence of this keel is due to the curvature of central part of the carapace and the abrupt compression of the carapace below this keel. Two anteromarginal ridges are connected by three or four minor cross-ribs in anteroventral region. A posteromarginal ridge, only approximately parallel to the posterior margin and a short distance from it, connects the dorsal and ventral ridges. Another nearly vertical ridge connects the dorsal and ventral ridges at a



greater distance from the posterior margin. The space thus enclosed is divided by a short diagonal ridge into two large, approximately triangular fossae. The median portion of the carapace is crossed by a number of prominent ridges separating polygonal fossae, arranged as follows: Three large anterior, anterodorsal, and posterodorsal fossae; two slightly smaller pits beneath these; behind the subcentral tubercle two rows of two smaller pits each and one smaller pit beneath these. Anterior to the subcentral tubercle are two horizontally elongated fossae, the lower one is the larger and may be partially divided. In some specimens (pl. 6, fig. 7) some of the larger pits may be subdivided into smaller pits by minor ribs.

Marginal area of moderate width; without vestibules; fairly numerous straight radial-pore canals with median swellings. Hinge robust, holamphidont; median bar and groove smooth; teeth of right valve high and smooth, posterior tooth with a distinct groove on ventral side. Muscle-scar pattern consists of a curved vertical row of four scars, the second from the dorsal one is divided, and three anterior scars.

*Dimensions.* Length 0.62-0.66 mm, height 0.34-0.35 mm, thickness 0.17-0.19 mm.

*Material.* Four specimens, of which one was a whole carapace, none contained soft parts.

*Remarks.* This species is very similar to *Cythereis* (*Cythereis*) *glauca* SKOGSBERG, 1928 (p. 110, pl. 3, figs. 2, 6, 7; pl. 6, fig. 4, text-fig. 19). The lateral outline and major features of the reticular patterns are similar; however *glauca* has more numerous ribs, of which the horizontal ones tend to be more strongly developed, and which enclose more numerous and smaller pits. *Cythere craticula* BRADY, 1880 (p. 89, pl. 21, fig. 7a-d) is similar to both *glauca* and the Knysna species, differing in the details of its reticular surface ornament. *?Bradleya aurita* (SKOGSBERG), 1928, also has a similar type of ornamentation, but it is more subquadrate, more inflated, and differs in the details of reticulation, having more numerous and smaller pits than the Knysna species. These species are undoubtedly very closely related. Although the pattern of ribs and pits is very variable within each of the previously named species, no forms have been described so far which display as coarse a pattern as the Knysna specimens.

*Occurrence.* Leisure Isle. *Cythere craticula* BRADY was collected by the *Challenger* in Simon's Bay. *Cythereis glauca* SKOGSBERG and *?Bradleya aurita* (SKOGSBERG), were reported from the Recent of the Pacific Coast of California and Baja California and from Pliocene sediments of California.

### Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948

#### Genus BRADLEYA Hornibrook, 1952

*Bradleya* HORNIBROOK, 1952, p. 38; BENSON, 1959, p. 63; KEIJ, 1957, p. 97; REYMENT, 1961, p. Q336. (See Remarks.)  
*Cythereis* JONES, 1849; SKOGSBERG (*partim*), 1928, p. 7; LEROY (*partim*), 1943, p. 368.

*Type-species.* *Cythere arata* BRADY, 1880, p. 101, pl. 24, fig. 2a-c.

*Diagnosis.* Carapace subquadrate, smooth or ornamented with a network of smooth ridges, lacking a caudal process, dorsal and ventral keels well developed, subcentral tubercle. Hinge hemiamphidont, posterior tooth of right valve varying from denticulate to lobate to nearly smooth, median groove crenulate. Muscle-scar pattern consists of a vertical row of four adductor scars and two anterior antennal scars. *U. Cret.-Rec.*

*Remarks.* The application of the concept of *Bradleya*, as first defined by HORNIBROOK (1952, p. 38) for *Cythere arata* BRADY, 1880, and several other New Zealand ostracode species, to some American (BENSON, 1959, p. 63) and European (KEIJ, 1957, p. 97, 98) forms is questionable. *Cythere arata* is quite distinctive, possessing an unusual surface that is ornamented with strong dorsal and ventrolateral ridges and a small subcentral tubercle; however, the reticular pattern accentuated in these features dissipates in the intervening regions. As the variability in strength and arrangement of the reticular patterns of the trachyleberids with strong dorsal and ventrolateral ridges is considerable, it may be desirable to restrict the concept of *Bradleya* to those forms with surface characteristics similar to those of the type-species. Forms with ornamentation such as that possessed by *Bradleya? dictyon* (BRADY), which are heavily reticular, might well be set apart. We hesitate to do this at the present time because of the uncertainty of the designation of the holotype of *B. dictyon*. Upon examination of BRADY's specimens in the British Museum (N.H.) in London it seemed quite evident that there may be in fact several species included under this name.

The following form, which is described but not named, does not add to the solution of this problem but does perhaps help to emphasize the need to study further this closely related group of reticular species.

#### BRADLEYA? sp.

Pl. 6, Fig. 5, 6.

*Diagnosis.* Characterized by a strongly reticular surface, with prominent subcentral tubercle and anterior and ventral keels, weak dorsal and postero-median ridge, strong holamphidont hinge with bilobed posterior element.

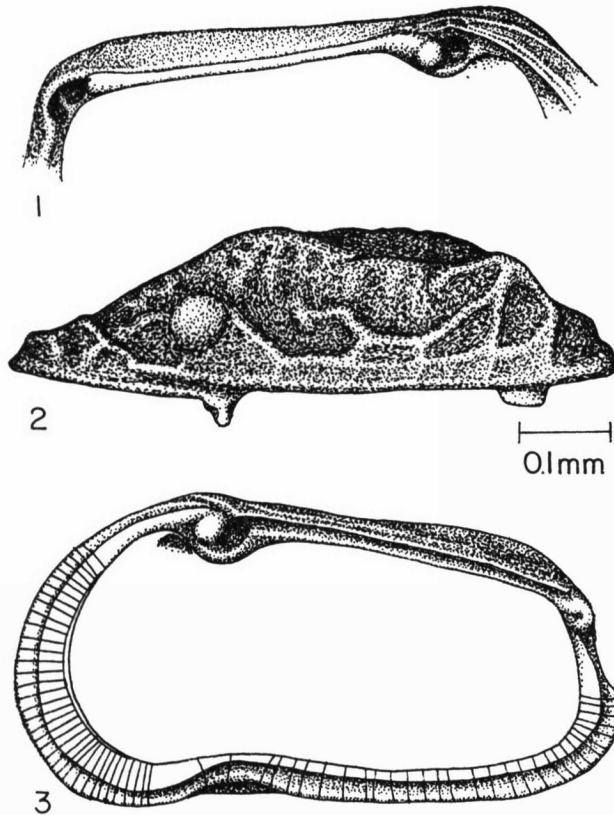


FIG. 22. *Bradleya?* sp.—1. Hinge of left valve.—2. Dorsal view of right valve.—3. Interior of right valve. The muscle-scar pattern was not seen.

**Description.** Carapace elongate subrectangular, compressed, presumed males more elongate than females. Dorsal and ventral margins straight, converging slightly toward posterior, anterior margin broadly rounded, posterior margin angulate above mid-height. Greatest height at anterior cardinal angle, greatest thickness just behind mid-length. Carapace compressed dorsolaterally, widening and flattened ventrally. Surface strongly reticular, pits polygonal, closely packed; the floor of each pit contains a mound-like elevation bearing large opening of normal-pore canal in center. Thick high ridge subparallel to anterior and ventral margin, originating from ocular swelling and continuing as ventrolateral ridge or keel parallel to ventral margin. Between this ridge and anterior margin is a row of indistinct pits. Behind the major

ridge the pits are somewhat enlarged. A minor diagonal ridge in the posteromedian area ends in sharply angulate posterodorsal keel. The area of the subcentral tubercle is smooth and elevated slightly above the neighboring ridges.

Hinge strong, in right valve with smooth anterior tooth on broad base, deep socket incompletely enclosed ventrally, smooth groove that is not continuous with socket but originates from dorsal wall of socket, and smooth high posterior tooth with deep groove on ventral side; corresponding socket of left valve is biloculate. Flange and selvage distinct, list not as well developed. Marginal area wide, with narrow vestibule and numerous straight radial-pore canals. Muscle-scar pattern was not clearly distinguishable but appeared to consist of three adductor scars and two antennal scars.

**Dimensions.** Female: length 0.67 mm, height 0.38 mm.

**Material.** Six specimens, of which one was whole, several were immature.

**Remarks.** The muscle-scar pattern, which is an important character for distinguishing many of the trachyleberid genera, could not be seen clearly on these specimens. The shape in lateral view is more elongate than is typical of *Bradleya*, and the reticular surface has a posterodorsal loop more commonly found in species of *Orionina*; however, this form has a hinge and different arrangement on longitudinal surface ridges than does *Orionina*.

In details of shape and reticulation, especially in the presence of mound-like normal-pore canal openings within the polygonal puncta, this species is very like *Cythereis microreticulata* LEROY (1943, p. 370, pl. 59, figs. 17-22), described from the Upper Pliocene Santa Barbara Formation of California. The Knysna specimen differs from *microreticulata* especially by a stronger development of the ventrolateral ridge, which however is not angularly terminated as in LEROY's species. The Knysna specimens have a more prominent expression of the posterodorsal ridge and the median ridge connecting it with the subcentral area. They also have a very thick, high ridge paralleling the anterior margin that is absent in the California species.

**Occurrence.** Leisure Isle.

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