ABSTRACT *Thirteen species belonging to the ostracode genus* Bairdia *are divided into four groups based on differences and similarities in the morphology of the male copulatory organ. The effect of temperature, salinity, and substrate on the distribution of* Bairda *is discussed. Four new species of* Bairdia *and one new species of* Bairdoppilata *collected in the Bahamas are described. The carapaces of females have smaller lenght-heigth ratios than those of males.*

Ecology and taxonomy of Recent Bairdiinae (Ostracoda)

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INTRODUCTION

Ostracodes have been extremely useful to geologists both for time-stratigraphic determination and depositional environment interpretation. In interpreting the paleo-ecology of fossil ostracodes, it is useful to know the environmental factors influencing the distribution of ostracodes now living. Of particular use is information concerning the distribution of living species whose ancestors have a long geologic record represented by an abundance of fossils. The genus *Bairdia* belongs in this category because it has a long range and is represented in the geologic record by an abundance of individuals and many species. Howe (1955, p. 13) estimated that at least 600 species of fossil and living ostracodes have been assigned to the genus *Bairdia*.

This study was made in the vicinity of the Bimini Islands, which are situated in the northwestern part of the Great Bahama Bank. The sample area covers approximately 320 square kilometers in the shallow waters east of the Bank rim (text-fig. 1). This papers is the third in a series describing Bahamian ostracodes. Previous papers are "Ecology and taxonomy of Recent marine ostracodes in the Bimini area, Great Bahama Bank" (Kornicker, 1958) and "Distribution of the ostracode suborder Cladocopa, and a new species from the Bahamas" (Kornicker, 1959). An ecological study in the Bahamian region becomes especially significant bacause the warm, clear shelf sea of this area may have similarities to limestone-forming seas which covered a large part of the continent in the past.

ACKNOWLEDGMENTS

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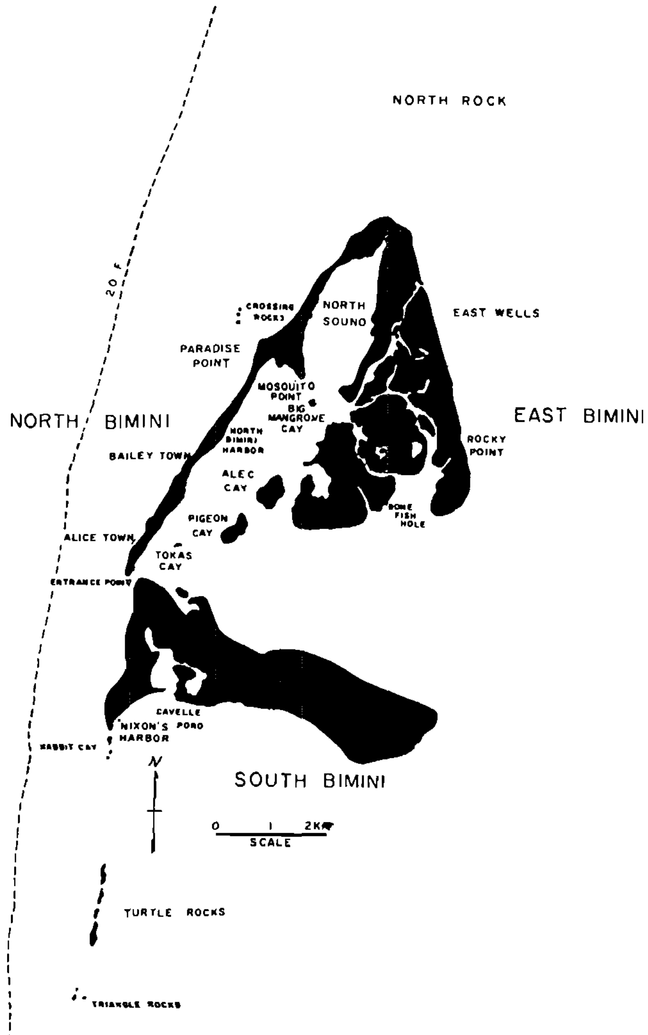
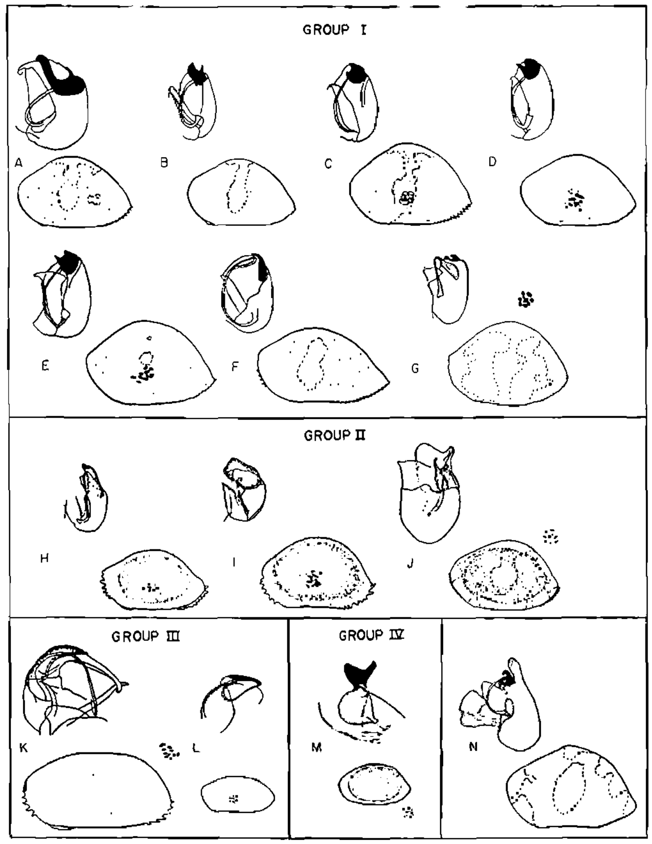
CLASSIFICATION OF BAIRDIA

The genus *Bairdia* has been considered by many ostracode workers as having an extremely long time range; for example, Sylvester-Bradley (1950, p. 756), after studying the muscle scars of living and Paleozoic *Bairdia*, concluded: "... *Bairdia* is truly a long-ranging genus, extending certainly from Carboniferous to Recent times, and perhaps from the lower Paleozoic (more than one species having been recorded from the Ordovician)." On the other hand, Sohn (1958*b*, p. 1646) restricted the stratigraphic range of *Bairdia* to the Middle Devonian through Permian and stated: "Additional genera can and should be erected for post-Paleozoic species currently referred to *Bairdia*. Criteria for separating the groups are carapace shape, hingement, denticulate margins, presence of ventro-terminal loculae, such as illustrated for Cretaceous species by van Veen (1934, pls. 7-8) and the Paleozoic genus *Ceratobairdia* by Sohn (1954, pl. 2, fig. 19), combined with the soft anatomy of living species."



TEXT-FIGURE 1

LOCALITY MAP OF BIMINI ISLANDS, BAHAMAS



TEXT-FIGURE 2

Carapaces, male copulatory organ, and muscle spots of ostracodes. Drawings are not to same scale.

A–G, group I: A, *Bairdia mediterranea* Müller; B, *Bairdia minor* Müller; C, *Bairdia frequens* Müller; D, *Bairdia obscura* Müller; E, *Bairdia decipiens* Müller; F, *Bairdia longevaginata* Müller; G, *Bairdia gigacantha* Kornicker, n. sp.

H–J, Group II: H, *Bairdia corpulenta* Müller; I, *Bairdia serrata* Müller; J, *Bairdia harpago* Kornicker, n. sp.

K–L, group III: K, *Bairdia reticulata* Müller; L, Bairdia sp. of de Vos.

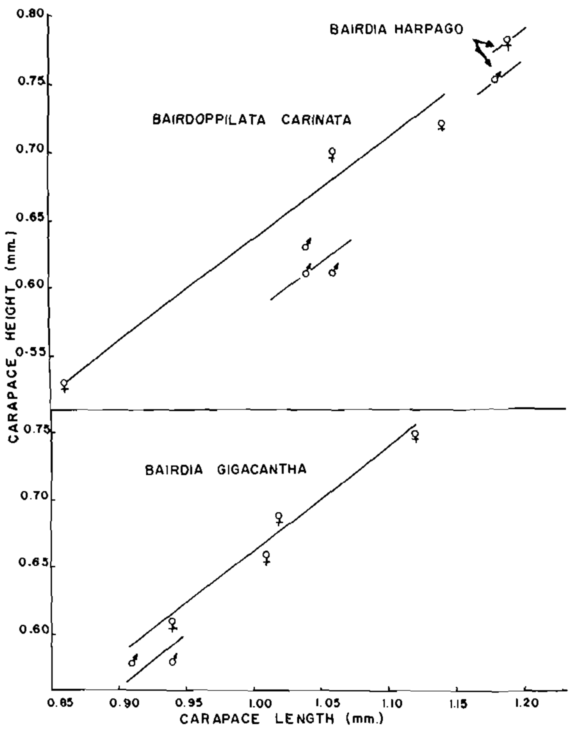
M, group IV: *Bairdia arostrata* Kornicker, n. sp.

N, *Bairdoppilata carinata* Kornicker, n. sp.

The carapace and associated male copulatory organ and muscle spots may not be from the same individual. The carapaces shown are not all from males. Muscle scars when shown outside the carapace may not be oriented the same way as the carapace. Drawing of penis is oriented with head at top.

Opinions by ostracode specialists on the stratigraphic range of *Bairdia* have been based on comparisons of the carapace morphology of *Bairdia* of different ages. As the degree of morphological difference may indicate different categorical rank in different groups (Mayr, Linsley, and Usinger, 1953, p. 121), it is quite possible that the carapace morphology of *Bairdia* does not reflect taxonomic differences to the same degree as in other ostracode groups. With this as a hypothesis, the writer compared the appendages of different species assigned to *Bairdia* living in modern seas in order to see whether or not appendage morphology was as consistent throughout the genus as the carapace. Early in the study it was observed that considerable variation occurs in the morphology of the male copulatory organ among species of *Bairdia*, and attention was then concentrated on this organ. Undoubtedly, the work of Müller (1894) on the Gulf of Naples Ostracoda remains the most comprehensive and detailed study of the anatomy of *Bairdia*; it was a principal source of information relating to the morphology of the male organ of *Bairdia*.

"Differences in genitalia have been used in many groups in delimiting species because the differences indi-



TEXT-FIGURE 3

Graph showing sexual dimorphism in carapaces of *Bairdia harpago* Kornicker, n. sp., *Bairdoppilata carinata* Kornicker, n. sp., and *Bairdia gigacantha* Kornicker, n. sp.

cate reproductive isolation" (Mayr, Linsley, and Usinger, 1953, p. 109). Groupings of species having similar male organs might constitute genera providing differences in the male organs from group to group are of sufficient magnitude. This satisfies the accepted definition of a genus as stated by Mayr, Linsley, and Usinger (1953, p. 48): "A genus is a systematic category including one species or a group of species of presumable common phylogenetic origin, which is separated from other similar units by a decided gap." The same authors (p. 48) suggest that the size of the gap be in inverse ratio to the size of the unit. Smaller gaps between genera derived from *Bairdia* might be justified because of the large number of species now assigned to *Bairdia.*

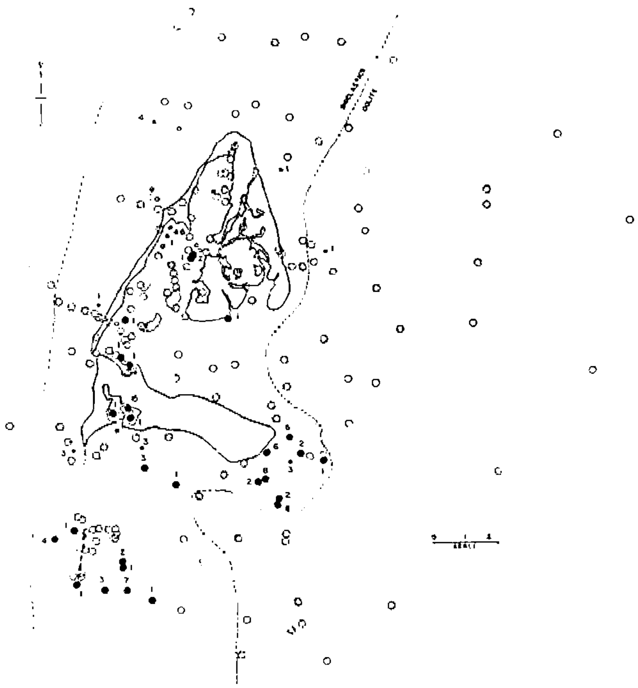
On the basis of similarities and differences in the morphology of the male copulatory organ, thirteen species of *Bairdia* were divided into four groups, each group having similar male organs which are considerable different from the male organs in the remaining groups (text-fig. 2). Although the groupings were based upon the male organ, a coincident result was the grouping of species having similar carapaces. Carapace differences between groups are, however, not as marked as differences in the antomy of the male organ. This suggests that the carapace of *Bairdia* is quite conservative and that the hypothesis that the carapace morphology of *Bairdia* does not reflect taxonomic differences to the same degree as in other ostracode groups is justified. Carapace differences between genera derived from *Bairdia* will be more subtle than those normally found between ostracode genera.

The differences in male organ structure between each of the four groups seems to be of the same degree as the difference in the male organ structure between *Bairdia* and the genus *Bairdoppilata,* which was separated from *Bairdia* on the basis of having hinge teeth not possessed by *Bairdia* (see text-fig. 2). This is considered to be a further indication that the gaps between the groups might be of generic importance. However, it is the writer's opinion that the taxonomy of the Ostracoda will be served best by basing new genera derived from *Bairdia* principally on recognizable gaps in carapace morphology, rather than on soft parts, which are absent in fossil forms. Until carapace morphology is better known, it seems best not to designate the groups established here on the basis of the male copulatory organ as being genera or subgenera, although they may actually deserve this designation.

Little attention has been given to patterns formed on the carapace of ostracodes by the distribution of opaque and translucent areas. Two species of *Bairdia* and one of *Bairdoppilata* collected in the Bahamas had patterns which were quite consistent for each species and were therefore useful in separating the species. A carapace was examined with a petrographic microscope by Robert L. Folk, who reported (1959, personal communication) that the opaque areas are formed by randomly oriented calcite grains, 1–2μ in size, whereas the translucent areas have a prismatic calcite structure with fibers perpendicular to the surface.

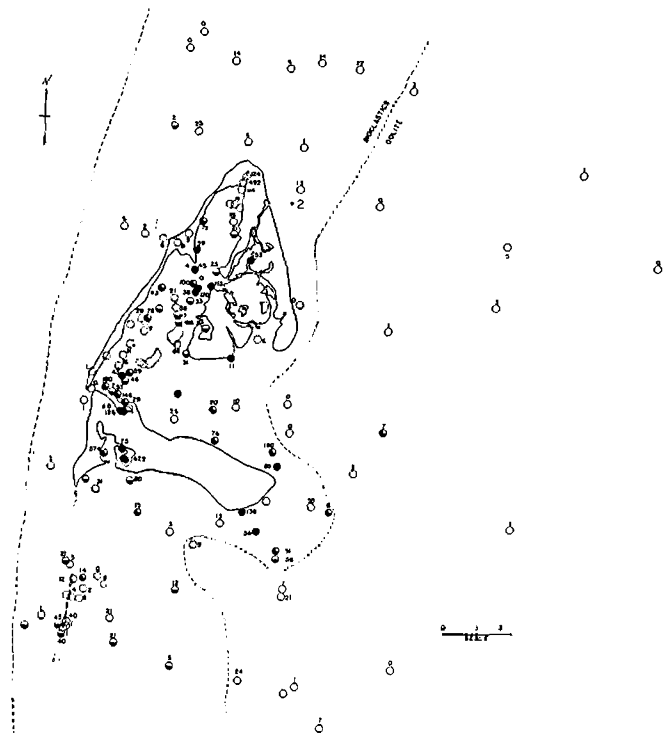
SEXUAL DIMORPHISM

Variation in the length-height ratio appears to be characteristic of many species of *Bairdia;* for example, Kellett (1934, p. 123) states: "The variation within a species of the length-height ratio may be considerable, for example in a collection of *Bairdia beedei* from the same horizon and locality the length-height ratio varies from 1.76 to 1.65." In order to determine whether or not a part of this variation might be due to sexual dimorphism, length-height ratios were calculated on Bahamian specimens of Bairdiinae of which the sex had been determined by examination of the genitalia. The length-height ratios obtained for males were higher than those obtained for females of the same species (text-fig. 3). Sexual dimorphism was greatest in *Bairdoppilata carinata,* in which the length-height ratio was about 1.70 for males and about 1.55 for females. Measurements used in determining length-height ratios were made on the left valve, which overlaps and is usually larger than the right valve. In general, males did not attain the size of females.



TEXT-FIGURE 4

Distribution of living specimens of *Bairdia* and *Bairdoppilata* collected in the Bimini area. Large circles represent spot samples. Small circles represent trawl samples. Number represent number of specimens in a 10 cc. subsample removed from spot samples and the number of specimens collected in each trawl sample. Empty circles represent samples not containing living *Bairdia* or *Bairdoppilata*. The dashed line separates bioclastic sediments on the left side of the line from sediments containing about 90% oolite on the right side of the line.



TEXT-FIGURE 5

Distribution of empty carapaces of *Bairdia* and *Bairdoppilata* collected in the Bimini area. Carapaces were removed from 10 g. samples by alcohol flotation. Numbers represent total number of Podocopa per sample. Filling within circles indicates relative abundance of Bairdiinae: Completely filled circles – abundant; half-filled circles – common; quarter-filled circles – rare.

OSTRACODE ECOLOGY

The literature on the ecology of post-Paleozoic ostracodes was summarized by Sohn (1957) in the "Treatise on Marine Ecology and Paleoecology." Sohn drew attention to the scarcity or lack of information concerning the ecology of living ostracodes in the following statement:

"The paleoecology of post-Paleozoic fossil ostracodes has been inferred from the known or assumed habits of living descendants of this group. The fact that most of the post-Paleozoic fossil ostracode genera contain species that are living at the present time gives credence to such inferences, but unfortunately data on the ecology of living ostracodes are relatively scarce."

The value of ostracodes as environmental indicators relative to other groups whose habits and habitat are better known has not been established with certainty. For example, Lozo (1943, p. 1069) stated: "Ostracodes, like ammonites, are apparently not as greatly affected by ecological conditions as foraminifera and are thus better qualified for time-stratigraphic determination." Benson (1959, p. 22), on the other hand, found that the ostracodes of the Todos Santos Bay region have about the same reaction to environmental change as the foraminifera.

In the present paper, the relationship of the genera *Bairdia* and *Bairdoppilata* to the water depth, temperature, substrate, and associated biota in diverse environments around Bimini is considered. Some of the literature containing information concerning the effect of these environmental factors on *Bairdia* has been summarized and in some instances reinterpreted.

DEPTH

Depth zonation of ostracodes has been observed by Remane (1933), Elofson (1941), and Benson (1959). The zonation probably results, not from changes in bathymetric pressure, but from changes in other environmental factors with depth, such as temperature, food availability, and bottom-current velocities.

The early explorations of the "Challenger" expeditions showed that the genus *Bairdia* is rare in the deep sea

TABLE 1

Distribution of species of *Bairdia* collected by the "Challenger" expedition*

	Shelf 10–200 m.	Slope 200–2000 m.	Abyssal 2–3000 m.,	3000 m.
Number of species	15	8	5	3
Number of samples containing *Bairdia* (%)	68	71	45	14
Maximum number of *Bairdia* species per sample	4	3	1	2
Number of samples**	22	24	9	14

* Data derived from "Challenger" Report (Brady, 1880).
** Brady examined 150 samples but reported only those containing ostracodes. Sample localities of those not containing ostracodes were not given by Brady (1880).

TABLE 2

Depth distribution of *Bairdia* and *Bairdoppilata* in the Bimini area

Depth (meters)	0–3		>3–6		>6–17		>17–21		>21–24	
	Number of individuals per sample									
Type sample	*10 cc.*	*Trawl*	*10 cc.*	*Trawl*	*10 cc.*	*Trawl*	*10 cc.*	*Trawl*	*10 cc.*	*Trawl*
Species										
Bairdoppilata carinata	11	22	6	7	0	0	0	0	0	0
Bairdia gigacantha	22	26	4	4	0	0	0	0	0	0
Bairdia harpago	13	3	3	0	0	0	3	0	0	0
Bairdia arostrata	3	1	2	0	0	0	1	0	1	0
Bairdia dinochelata	2	0	0	0	0	0	0	0	0	0
Total no. of samples	169	15	39	6	20	1	1	0	2	0
Total no. of samples with *Bairdia*	12	3	7	3	0	0	1	0	1	0
Total no. of samples with *Bairdoppilata*	7	3	3	4	0	0	0	0	0	0

and that the species diversity of *Bairdia* decreases with depth (Table 1). Several recent studies indicate that some species of *Bairdia* are restricted to certain depth zones. For example, Puri and Hulings (1957) listed *Bairdia* (one species) as common off Panama City, Florida, in the 20–21.7 meter depth zone, and possibly deeper; Curtis (MS.) found *Bairdia* (one species) restricted to the 15–25 meter depth zone in the Mississippi Delta area of the Gulf of Mexico; Hulings (1959) reported *Bairdia* as one of the genera characterizing the 200–3733 meter zone in the Gulf of Mexico and the 200–765 meter zone along the southern Atlantic Coast of the United States.

Collections from the Bimini area were from shallow water less than 24 meters deep. The number of samples collected in water deeper than 17 meters was insufficient to permit evaluation of the effect of the total depth-range sampled on species distribution. However, the depth distribution does indicate that the species under study are to be found in the largest numbers at depths shallower than 6 meters (Table 2). An exception to this pattern is *Bairdia arostrata*, which may become more abundant in deeper water. No specimens of *Bairdia* or *Bairdoppilata* were found in intertidal waters, but samples containing large numbers of specimens were obtained in shallow subtidal water one meter deep.

TEMPERATURE

Tressler and Smith (1948, p. 48) considered temperature to be a major factor effecting the seasonal distribution of ostracodes in the Solomons Island, Maryland, region. The temperature of the water in the Bimini area from which collections were made varied between 24° and 31° C. The temperature of the water in North Bimini Harbor was recorded as low as 14° C. on Jan. 12, 1956 (Krumholtz, personal communication), but no collections were made at that temperature. The genus *Bairdia* apparently is not limited to a narrow temperature range, because specimens of *Bairdia* were collected during the "Challenger" expedition from water at temperatures as low as 1.2° C. (Brady, 1880), which is in considerable contrast to the high water-temperatures in the Bimini area. Large numbers of *Bairdia*, however, may reflect warm seas. Brady (1880, p. 48) made the following statement concerning the genus *Bairdia*: "This is a widely dispersed genus, attaining, apparently, its greatest development in the tropical and southern seas, in dredgings from which regions the number of specimens of *Bairdia* not infrequently exceeds that of all the other Ostracoda together; the individuals, however, though numerous, are usually found to belong in each gathering to one, or at most two, predominant species."

Temperature also seems to exert major control over the number of species of *Bairdia* inhabiting a region, only a few species living in areas where the water is below 10° C. For example, Sars (1923) reported only one species of *Bairdia* living in the cold waters around Norway, whereas, Müller (1894) reported eleven species of *Bairdia* from the Gulf of Naples, where the water temperature is about 14° C. Furthermore, in the collections of the "Challenger" from the Australasian area, which includes the coasts of Australia, New Zealand, and the Eastern Archipelago south of the Equator, fourteen species of *Bairdia* were collected from water having a temperature above 10° C., whereas only four species were collected in colder, deeper water (Brady, 1880). The large number of species of *Bairdia* (ten species are not uncommon in a formation) found in Permian and Pennsylvanian shales and limestones (Bassler and Kellett, 1934) may reflect the warm seas in which they were deposited.

SUBSTRATE

Bairdia were collected by the "Challenger" expedition on many different substrates, including mud, sand, gray ooze, sandy mud and shells, *Globigerina* ooze, rock, and coral (Brady, 1880). Brady (1880, p. 26) reported *Bairdia hirsuta* Brady from red clay at station 296; however, that station is recorded by Thomson (1880, p. 58) as having *Globigerina* ooze. Only one species of *Bairdia* was taken alive during the "Challenger" expedition, so that the possibility exists that empty carapaces might have been transported from the habitat in which the animals lived.

In the Gulf of Naples, live *Bairdia* were collected from among calcareous algae and in shell detritus (Müller, 1894). Benson (1959, p. 42) reported a species of *Bairdia* limited to fine to very fine sand in the Bahia de Todos Santos, Baja California, and in coarser sand of fringing tide pools. Puri and Hulings (1957) reported a species of *Bairdia* inhabiting medium- to fine-grained, well sorted noncarbonate sands in the Panama City area of the Gulf of Mexico and in carbonate sands in Florida Bay. In the Paleozoic, according to the faunal lists of Bassler and Kellett (1934), the genus *Bairdia* seems to be about equally abundant in shale and limestone. Geis (1932, p. 176) reported *Bairdia* from the Mississippian Spergen limestone, which is oolitic.

The two major subdivisions of sediment in the Bimini area are bioclastics and oolite (see Kornicker, 1958, for further discussion of Bimini sediments). Specimens of *Bairdia* and *Bairdoppilata* were collected in most of the environments underlain by bioclastics but were rare or absent in oolite areas (text-fig. 4). In general, all genera of ostracodes were rare or absent in areas of oolite (text-fig. 5). Kornicker (1958, p. 213) believed that ostracodes that normally burrow into sediment are deterred from occupying oolite areas because of the difficulty of burrowing into oolite, which has a very high bulk density. A different explanation is required for the absence of *Bairdoppilata carinata* and the species of *Bairdia* from the oolite area because observations of these species in laboratory aquaria indicate that they are bottom surface crawlers and do not burrow. It is possible that these species do not inhabit the oolite sediments because they find crawling difficult on oolite owing to its good sorting and the shape and size of the individual ooids. A similar difficulty might be experienced by a dog walking on cannon balls or a mouse on marbles. This hypothesis is supported by laboratory observations, which showed that specimens of *Bairdoppilata lerneri* often fall on their sides when walking on oolite.

Six individuals of *Bairdoppilata carinata* (all mature specimens) were placed in a small vial containing oolite and were periodically observed. No food was added to the vial during the observation period. Under these conditions, the average life span of the six individuals was 29 days; one specimen lived 47 days. Although the data are too few to be conclusive, it does suggest that oolite is not inhibiting. None of the specimens burrowed into the oolite during the period of observation.

A considerable part of the bottom in the Bimini area is rock. Both rock and sand bottoms support varying amounts of plants and animals. The rock bottom is usually covered by at least a sprinkling of sand a millimeter or so in thickness. Depressions in the rock are usually sand-filled. Species of *Bairdia* and *Bairdoppilata carinata* lived on both rock and sand substrate in about the same numbers (Table 3).

ASSOCIATED BIOTA

The biota in the Bimini area with which *Bairdoppilata carinata* and the species of *Bairdia* were associated did not have a consistent or typical composition, but was quite variable. The largest single collection of Bairdiinae was obtained in North Bimini Harbor, near Mosquito Point, from a shallow channel one meter deep, which contained an accumulation of mangrove debris barely covering the bottom. The algae *Penicillus* and the jellyfish *Cassiopia* were abundant. A sample obtained by dragging a net along the bottom produced 23 specimens of *Bairdoppilata lerneri*, 20 specimens of *Bairdia gigacantha*, and 3 specimens of *Bairdia harpago*. A slow current passed over the bottom, and the area seemed well oxygenated. Living *Bairdia* were not obtained from heavy accumulations of mangrove debris that gave off hydrogen sulfide gas. An empty carapace of a *Bairdia* collected from this environment was decalcified. This supports a hypothesis of Sohn (1958*a*, p. 735) that wrinkled films of ostracode carapaces found in sedimentary rocks represent penecontemporaneous decalcification.

TABLE 3

NUMBERS OF LIVE *Bairdia* INDIVIDUALS COLLECTED FROM ROCK AND SAND BOTTOM IN THE BIMINI AREA

Species	Number of individuals* Rock bottom	Sand bottom
Bairdia gigacantha	13	13
Bairdoppilata carinata	10	7
Bairdia harpago	13	5
Bairdia arostrata	7	4
Bairdia dinochelata	1	3
	44	32

* The number of individuals refers to the number of living specimens in a 10 cc. subsample removed from bottom sediment obtained with an Emory grab sampler.

The species *Bairdia harpago* seemed especially abundant in a passage connecting the east and west parts of Cavelle Pond in 0.6 meter of water. The rock bottom there was covered by a thin veneer of sand. The dominant plant was the alga *Laurencia.* Other algae present were *Halimeda* and *Penicillus*; *Thalassia* was sparse. Sponges were common. The only coral living there was *Siderastrea radians. Bairdia harpago* was also collected in sand areas having thick growths of *Thalassia* and *Laurencia*, as well as from rock areas with a thin veneer of sand which supported sea whips, sea fans, stony corals, and the algae *Caulerpa*, *Laurencia*, and *Rhipocephalus*.

Bairdia gigacantha was very abundant in water 2 meters deep off the east shore of South Bimini. Collections from that area produced about equal numbers from rock bottoms supporting sea whips, sponges, the coral *Porites asteroides*, and the algae *Laurencia*, *Penicillus*, and *Halimeda*, and from calcareous sand bottoms supporting dense growths of *Thalassia* and *Laurencia.* Live ostracodes were more abundant along the east shore of South Bimini than in any other area sampled (Kornicker, 1958). Other small crustaceans, such as amphipods and copepods, were also very abundant in this area. The reason for the abundance of bottom life here is not known, but it does not appear to be the result of associated biota.

SALINITY

The genus *Bairdia* in today's seas is generally restricted to water having normal salinity of 30 to 40 parts per thousand. An abundance of *Bairdia* specimens in ancient sediments may indicate that deposition took place in marine water of normal salinity.

Müller (1894) collected many species of *Bairdia* in the Gulf of Naples, where the salinity is about 38.6 parts per thousand. *Bairdia* specimens were found to be particularly abundant in the Australasian region, where the salinity is about 35.0 parts per thousand (Brady, 1880). *Bairdia* has been reported (only one or two species) from offshore areas in the Gulf of Mexico where normal marine salinity of about 35.0 parts per thousand is encountered (Curtis, MS.; Hulings, 1959). A species of *Bairdia* was collected from the Gulf of Mexico off Panama City, Florida, in water having a salinity of 35.6 to 36.8 parts per thousand and from Florida Bay, where salinities are about 37 parts per thousand (Puri and Hulings, 1957). On the other hands, *Bairdia* specimens were conspicuously absent from San Antonio Bay (Swain, 1955) and from Mesquite and Aransas Bays (Engel, MS.), Texas, where salinities are usually below 20 parts per thousand.

Bairdia specimens were not found in the Chesapeake Bay region near the mouth of the Patucent River, where salinities of 10.0 to 19.4 parts per thousand were recorded (Tressler and Smith, 1948). *Bairdia* was absent from Alligator Harbor, an estuary in Franklin County, Florida, where the salinity range is approximately 28 to 34 parts per thousand, with greater fluctuations not uncommon (Puri and Hulings, 1957). *Bairdia* is absent from the Laguna Madre of Texas, where salinities above 45 parts per thousand are often encountered (investigation now under way by Kornicker and Wise).

During the time when the collections were made in the Bimini area, the salinity remained within the 30–40 parts per thousand range considered by Hedgpeth (1951) to represent normal marine water, except in the upper part of North Sound, where salinities of 46.5 parts per thousand were recorded (Turekian, 1957). Live individuals of *Bairdoppilata carinata* and species of *Bairdia* were not collected in North Sound; however, empty carapaces were found in the sediment in the lower part of the sound but were absent in the upper part, where salinities of 42 parts per thousand or higher had been recorded.

CONCLUSIONS

Consideration of similarities and differences in the structure of the male copulatory organ of Recent *Bairdia* indicates that the carapace of the genus *Bairdia* is resistant to change and does not reflect, to the same degree as the male copulatory organ, major morphological differences which might normally result in the definition of new genera.

Males of *Bairdia*, and especially of *Bairdoppilata*, of the species studied have higher length-height ratios than females and are smaller.

Bairdia is abundant in subtidal and shelf sediments, common in slope sediments (200–2000 meters), but rare in abyssal sediments (deeper than 2000 meters), and is usually absent from intertidal sediments. It is apparently restricted to waters of normal salinity. An abundance of individuals and a high diversity of species may reflect shallow, warm water, above 10° C. *Bairdia* has been collected from many different kinds of sediment but has not been reported from abyssal red clays and is scarce in Recent shallow-water oolite. It may be scarce in oolite because of the physical difficulty of crawling over the surface of oolite sediment.

SYSTEMATIC DESCRIPTIONS

Subclass OSTRACODA Latreille

Order PODOCOPA G. O. Sars

Family BAIRDIIDAE G. O. Sars, 1887

Subfamily BAIRDIINAE Sars, 1923

Genus **Bairdia** M'Coy, 1844

Type species: Bairdia curta M'Coy, 1844, *Synopsis Carboniferous limestone fossils of Ireland*, p. 164, pl. 23, fig. 6.

Generic characteristics: Shell more or less rhomboid in outline, with the anterior end rounded ventrally and the posterior end angular and produced. The midportion, especially in the right valve, tends to be straight. Left valve larger than the right and usually overlapping it, except in the anterior and posteroventral parts of the shell. Hinge adont. Surface smooth or punctate; living specimens often covered with hair.

Both pairs of antennae very slender, the anterior antennae (antennules) having long thin setae on the ends. The penultimate joint of the second antennae is unusually long and slender. Three pairs of thoracic legs are long and narrow. The furca bears 6–8 long slender setae; two or three of these may be considered terminal; four or five are situated along the ventral margin. Additional short setae may be present along the posterior margin of the furca near the distal end.

Bairdia gigacantha Kornicker, **new species**
Plate 1, figure 2a–c; text-figures 6A–J, 10A, D

Diagnosis: Carapace in lateral view more or less oval in outline; greatest height about in the middle; dorsal margin broadly arched. Carapace of male not as high as female; length-height ratio of females about 1.53, of males about 1.58. Anterior margin broadly rounded, with anterodorsal angle above midheight of valve; posterior beak bluntly acuminate, slightly below midheight. In dorsal view broadly ovate; greatest width about in the middle; both ends pointed. Left valve with a series of anterior and posterior spines; right valve with an anterior and posterior frill. Valves unequal, the left overlapping the right. Surface apparently smooth but with small pits visible under high magnification. Muscle scars consisting of a cluster of about nine ovoid bosses near center of valve. Long black hairs project from carapace surface. Both valves with opaque and translucent areas forming a more or less consistent pattern for the species. Opaque area at center of valve mushroom-shaped, with one or more small transparent areas in upper posterior part. Lobate opaque areas along anterior, posterior, and dorsal margins of carapace.

The hinge of the left valve consists of a narrow shallow groove above a thin straight bar at the straight dorsal contact. The area between the narrow groove and the dorsal edge of the valve is extremely broad. Beneath the bar is a recessed area which broadens at each end. The hinge of the right valve consists of a bar with a narrow groove along its dorsal side, which engages with the groove and bar of the left valve. The shelf forming the lower margin of the groove projects outward farther than the bar above the groove and fits into a recessed area below the bar of the left valve. The shelf projects very slightly at the ends of the straight portion of the hinge. The projection is more noticeable at the anterior than at the posterior end. Ventrally, a marginal ledge is found on the left valve on either side of the ventral overlap area. This ledge, upon which the edge of the right valve rests when the valves are closed, fades out above the ventral overlap area. The ventral overlap area of the left valve is well developed.

Body of living animal brown, with appendages bearing black setae. Brown color of body visible from outside through translucent areas of carapace. Furca bearing six setae; two proximal setae of about the same length and smaller than the other setae; third and fourth setae from proximal end of about the same size as the sixth clawlike seta; fifth seta clawlike, with secondary setae at distal end. One specimen had two small "points" on the posterior edge of the furca near the distal end. Male copulatory organ ovoid, with head consisting of two parts, the larger being hook-shaped (text-fig. 6G).

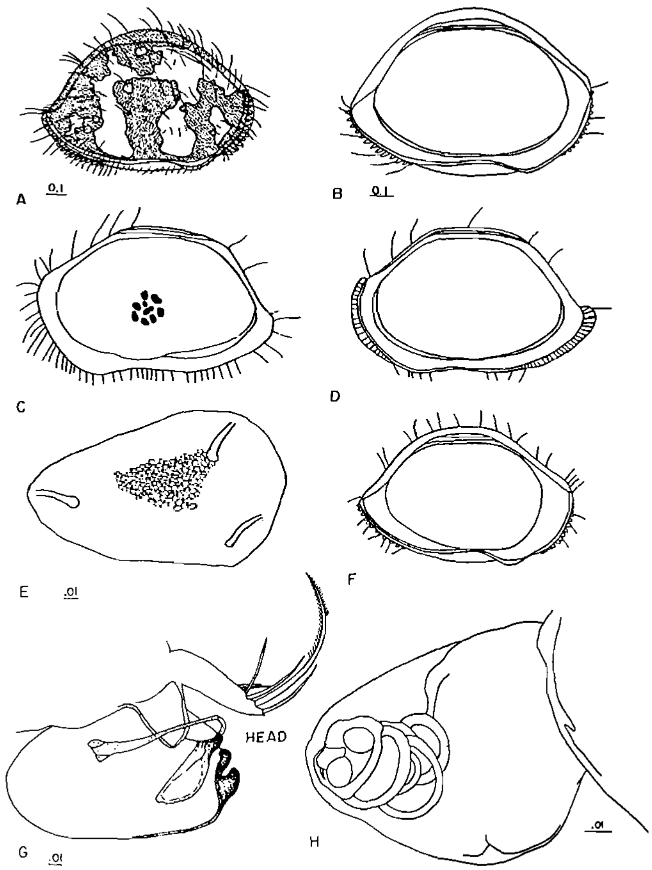
Comparisons: Bairdia gigacantha does not have the prominent pits of the holotype of *Bairdia bradyi* van den Bold (1957, p. 236), nor is the posterior end as acute.

Shell measurements (in mm.):

Specimen number	Length	Height	Length-height ratio	Sex	Valve
247–9–3 (holotype)	1.02	0.69	1.48	female	left
122B–1	0.94	0.61	1.54	female	left
122B–16	1.01	0.66	1.55	female	left
122B–4	0.91	0.58	1.57	male	left
122B–7	0.94	0.58	1.62	male	left
247–9–2	1.12	0.75	1.49	female	left

Material: Fifty-five specimens were collected in the Bimini area. Sex was determined in six individuals, four females and two males. The holotype, specimen no. 247–9–3, is illustrated in text-figure 6B, D–E, H, and in plate 1, figure 2b–c.

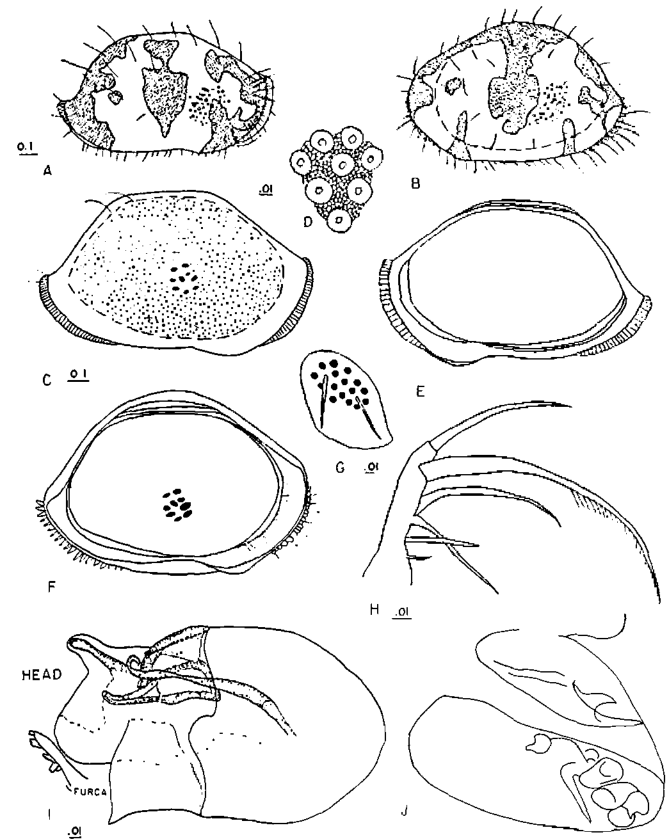
Occurrence: Specimens were collected in about the same numbers on rock and bioclastic sand substrates. No individuals were collected from oolitic sand, from areas exposed at low tide, or in the entrance to the main channel of North Bimini Harbor, where high current velocities are encountered. Rock bottom areas from which collections were made support sponges, corals, algae, *Thalassia*, echinoderms, crabs, crayfish, and worms. Sand bottom areas usually support *Thalassia*,



TEXT-FIGURE 6

Bairdia gigacantha Kornicker, n. sp. A, view of carapace of specimen number 247–9–2, a female, from the right side (part of right valve covered with pattern is more opaque than remainder of valve); B, view of left valve of specimen number 247–9–3, a female (holotype), from inside; C, view of inside of right valve of specimen number 247–9–1, a female, showing muscle scars; D, view of right valve of specimen number 247–9–3 from inside; E, detail of carapace wall of specimen number 247–9–3 from outside; F, view of left valve of specimen number 122B–7, a male, from inside; G, penis and furca of specimen number 122B–7; H, female genital organ of specimen number 247–9–3. Figures with similar magnification: A; B–D, F; E; G; H.

the alga *Laurencia* as well as smaller numbers of other species of algae, corals, sponges, and echinoderms. *Bairdia gigacantha* was collected in water ranging in depth from 0.6 to 5 meters. This species was not collected in the few samples obtained from greater depths. Collections were made in May, June, and December, 1956. The temperature of the water during the time of collection in December was about 24° C. In May and June, the water temperatures at the collection sites ranged from 26.5° to 29.5° C. The salinity of the water was about 37.5 parts per thousand.



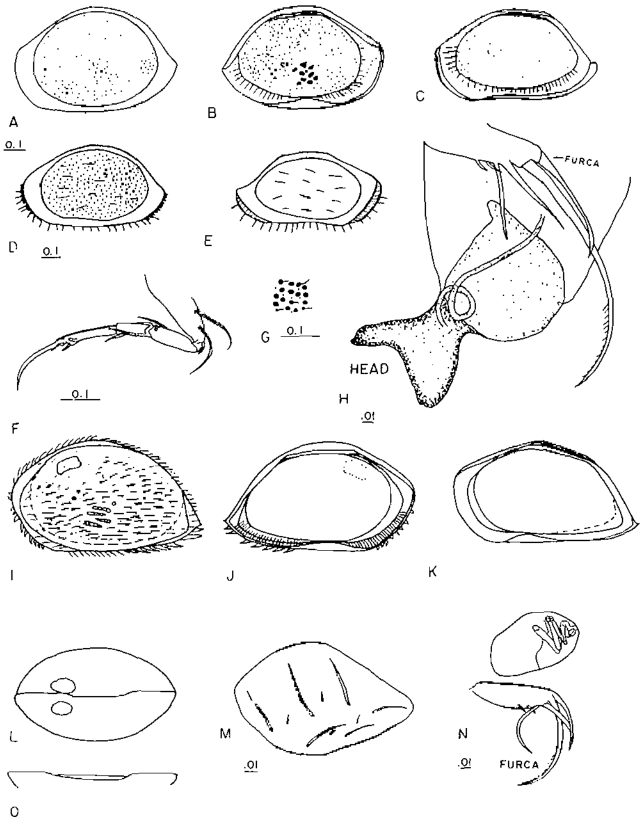
TEXT-FIGURE 7

Bairdia harpago Kornicker, n. sp. A, view of right valve of specimen number 122B–10, a male, from outside (patterned area is more opaque than remainder of valve); B, view of left valve of specimen number 122B–10 from outside; C, view of right valve of specimen number 122B–12, a female (holotype), from outside; D, detail of carapace wall of specimen number 122B–12 from outside; E, view of right valve of specimen number 122B–12 from inside; F, view of left valve of specimen number 122B–12 from inside; G, detail of carapace wall of specimen number 122B–12 showing distribution of surface hairs; H, furca of specimen number 122B–10; I, penis of specimen number 122B–10; J. female genital organ of specimen number 122B–12. Figures with similar magnification: A–B; C, E–F; D; G; H; I; J.

Bairdia harpago Kornicker, **new species**

Plate 1, figure 1a–b; text-figure 7A–J

Diagnosis: Shell in lateral view rhomboid oval in outline; greatest height about in the middle; dorsal margin broadly arched. Carapace of male not as high as that of female; length-height ratio of male (one specimen) 1.58, of female (one specimen) 1.52. Anterior margin broadly rounded, with anterodorsal angle above midheight of valve; posterior beak bluntly acuminate, slightly below midheight. In dorsal view broadly ovate;

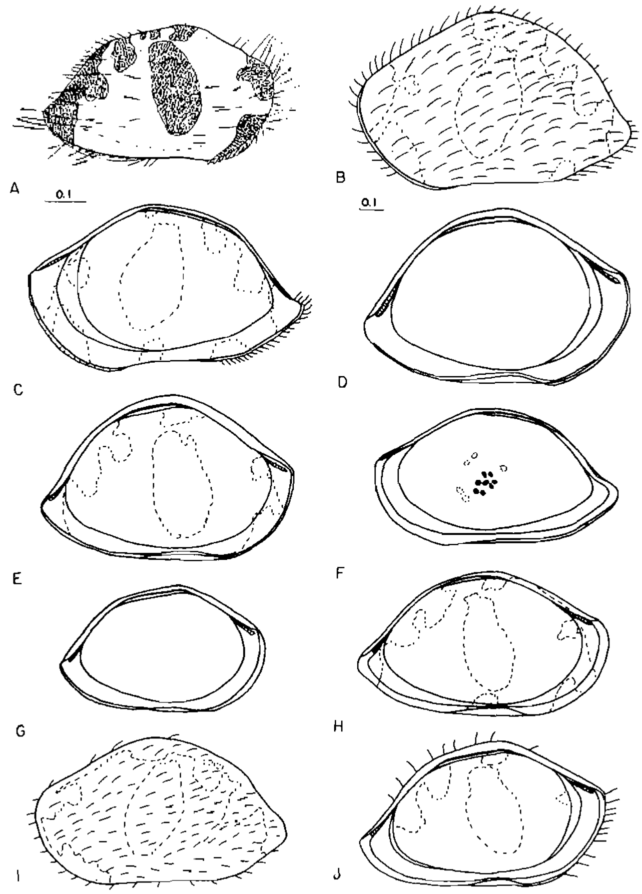


TEXT-FIGURE 8

A–H, *Bairdia arostrata* Kornicker, n. sp.: A, view of left valve of specimen number 92 (holotype) from outside; B, view of left valve of specimen number 92 from inside; C, view of right valve of specimen number 92 from inside; D, view of left valve of specimen number 122C–1, a male, from outside; E, view of right valve of specimen number 122C–1 from outside; F, leg of specimen number 122C–1; G, Detail of carapace surface of specimen number 122C–1; H, furca and penis of specimen number 122C–1.

I–O, *Bairdia dinochelata* Kornicker, n. sp.: I, view of left valve of specimen number 500–1, a female (holotype), from outside; J, view of left valve of specimen number 500–1 from inside; K, view of right valve of specimen number 500–1 from inside; L, sketch of dorsal view of specimen number 500–1; M, Detail of surface of specimen number 500–1; N, furca and female genital organ of specimen number 500–1; O, dorsal view of dorsal edge of left valve.

Figures with similar magnification: A–C, I–K; D–E; F; G; H; L; M; N; O.



TEXT-FIGURE 9

Bairdoppilata carinata Kornicker, n. sp. A, view of right side of carapace of specimen number 122B–6, an immature female, from outside (patterned area is more opaque than remainder of valve); B, view of left valve of specimen number 122B–2, a female (holotype), from outside; C, view of right valve of specimen number 122B–2 from inside; D, view of left valve of specimen number 122B–2 from inside; E, view of left valve of specimen number 122B–5, a female, from inside; F, view of right valve of specimen number 122B–11, a male, from inside; G, view of left valve of specimen number 122B–6, an immature female, from inside; H, view of left valve of specimen number 122B–11 from inside; I, view of left valve of specimen number 122B–3, a male, from outside; J, view of left valve of specimen number 122B–3 from inside. Figures with similar magnifications: A, B–J.

greatest width about in the middle; both ends pointed. Left valve with a series of anterior and posterior spines; right valve with an anterior and posterior frill. Valves unequal, the left overlapping the right. Surface with large pits. Muscle scars consisting of a cluster of about nine ovoid bosses near center of valve. Long black hairs project from carapace surface. Both valves of carapace with opaque and translucent areas forming a more or less consistent pattern for the species; centrally located opaque area spade-shaped; anterior and posterior opaque areas lobate.

The hinge of the left valve consists of a shallow groove above a very narrow straight bar at the straight dorsal contact; there is a broad area between the groove and the dorsal edge of the valve; the recessed area beneath the bar broadens at each end. The hinge of the right valve consists of a bar with a narrow groove along its dorsal side, which engages with the groove and bar of the left valve. The shelf forming the lower margin of the groove fits into the recessed area below the bar of the left valve. Ventrally, a marginal ledge is found on the left valve on either side of the ventral overlap area. This ledge, upon which the edge of the valve rests when the valves are closed, fades out above the ventral overlap area. The ventral overlap area and ventral lip of the left valve are well developed.

Furca with six setae; first seta from proximal end shortest; second seta about twice the length of the first; third seta about three times the length of the first; fourth and sixth setae slighly more than half the length of the fifth seta. The male copulatory organ is complex (text-fig. 7I).

Comparisons: The carapace of *Bairdia harpago* is similar in shape to that of *Bairdia gigacantha*. It differs from *Bairdia gigacantha* in being coarsely pitted and in having a different pattern of opaque and translucent areas on the carapace. For example, the spade-shaped, centrally located opaque area in *Bairdia harpago* does not come in contact with the ventral margin, whereas the opaque area in *Bairdia gigacantha* does. The carapace of *Bairdia harpago* resembles the carapace of *Bairdia bradyi* van den Bold, which was collected in the Bahamas by Brady (1868, p. 56, text-figs. 4–6, pl. 7). Brady's description is inadequate for comparison, and the holotype is not available.

Shell measurements (in mm.):

Specimen number	Length	Height	Length-height ratio	Sex	Valve
122B–10	1.18	0.75	1.58	male	left
122B–12 (holotype)	1.19	0.78	1.52	female	left
	1.19	0.68	—	female	right

Material: Twenty-one specimens were collected in the Bimini area. Appendages of three specimens were examined, one male and two females. The holotype, specimen no. 122B–12, is illustrated in text-figure 7C–G, J, and in plate 1, figure 1a–b.

Occurrence: Specimens were collected on both sand and rock bottom areas. This species is the only *Bairdia* collected in Cavelle Pond, a shallow pond on South Bimini which has restricted circulation with Bank water. It may be particularly abundant in the passage connecting the east and west segments of this pond. *Bairdia harpago* was collected in water ranging in depth from 1 to 28 meters. As very few samples were obtained at depths of 18 meters or greater, it is possible that this species is more abundant in deeper waters. Individuals were collected in June and December of 1956. The water temperature in December at the time of collection was approximately 24° C. In May, the water temperature at the collecting sites ranged from 27° to 31° C. Water salinities were about 37.5 parts per thousand.

Bairdia arostrata Kornicker, **new species**
Plate 1, figure 3a–b; text-figure 8A–H

Diagnosis: Carapace in lateral view rhomboid oval in outline; greatest height about in the middle; dorsal margin broadly arched; ventral margin nearly straight; posterior margin pointed; anterior margin rounded. In dorsal view broadly ovate; greatest width about in the middle; both ends acute. Valves unequal, the left overlapping the right; hinge adont. Left valve with a series of anterior and posterior short spines. Right valve with anterior and posterior frill. Surface pitted and hairy, with marginal radial pores. Muscle scars consist of about ten oval bosses located below center of valve. Carapace brown, with central area darker than periphery. Furca with six setae; two small proximal setae of about the same length; third and fourth setae of about the same size, shorter than the shorter of the two terminal clawlike setae. Male copulatory organ large and bifurcate (text-fig. 8H).

Comparisons: Bairdia arostrata resembles *Bairdia corpulenta* Müller in shape. It differs from that form in the bifurcate nature of the male organ and in having only four setae on the ventral margin of the furca following the two terminal setae. *Bairdia arostrata* differs from *Bairdia harpago* in that the peniproximal seta on the ventral margin of the furca is equal in length to the proximal seta. *Bairdia arostrata* is also smaller than *Bairdia harpago*; the male has a bifurcate copulatory organ; and the carapace is not differentiated into opaque and translucent areas.

Shell measurements (in mm.):

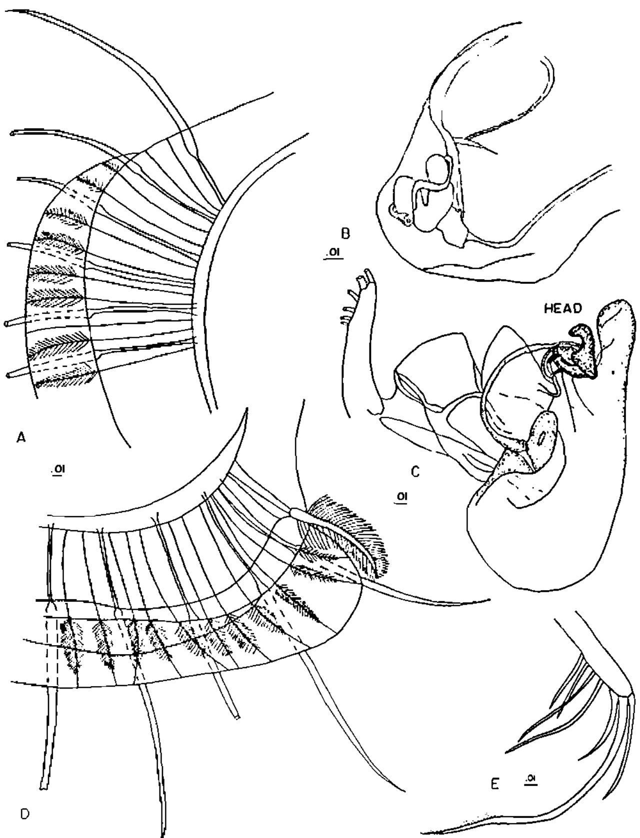
Specimen number	Length	Height	Length-height ratio	Sex	Valve
92 (holotype)	0.71	0.48	1.48	—	complete
122C–1	0.86	0.50	1.72	male	complete

Material: Twelve specimens were collected in the Bimini area. One individual, a male, was dissected. The holotype, specimen no. 92, is illustrated in text-figure 8A–C and in plate 1, figure 3a–b.

Occurrence: Specimens were collected on both rock and sand bottoms. This species was collected at water depths ranging from 1 to 22 meters. This species may be more abundant in deep water. Specimens were collected in May, June, and December, 1956. Water temperature in December at the time of collection was approximately 24° C. Water temperature in May and June at collecting sites ranged from 27.0° to 29.0° C. Water salinity was about 37.5 parts per thousand.

Bairdia dinochelata Kornicker, **new species**
Plate 1, figure 4a–d; text-figure 8I–O

Diagnosis: Carapace in lateral view rhomboid oval in outline; greatest height slightly anterior to the middle; dorsal margin broadly arched; ventral margin nearly straight; ventral side flattened. Anterior margin broadly rounded, with anterodorsal angle above midheight.



TEXT-FIGURE 10

A, D, *Bairdia gigacantha* Kornicker, n. sp.: A, anterodorsal corner, at high magnification; D, posteroventral corner, at high magnification; both A and D are from specimen number 247–9–1, which was decalcified with dilute hydrochloric acid before being drawn.

B–C, E, *Bairdoppilata carinata* Kornicker, n. sp.: B, female genital organ of specimen number 122B–5; C, penis of specimen number 122B–3; E, furca of specimen number 122B–5. Figures with similar magnification: A, D; B; C; E.

Posterior beak acuminate, ending in a short spine and located well below midheight. In dorsal view broadly ovate; greatest width about in the middle; pointed at both ends. Valves unequal, the left overlapping the right. Considerable overlap along anterior and posterodorsal margins, so that hinge line appears sinuous in dorsal view; hinge adont. Left valve with anterior and posterior marginal spines. Carapace finely punctate, with many short hairs and marginal radial pores. Four elongate muscle scars below center of valve; each scar appears to consist of linearly arranged, closely spaced bosses. Three faint ovoid scars are scattered above elongate scars. Carapace dark brown except over two irregular areas in the anterodorsal part of the valve. Ventrally, a marginal ledge is present on either side of ventral overlap area. This ledge, upon which the ventral edge of the right valve rests when the valves are closed, fades out above the ventral overlap area.

Furca with six setae; two proximal setae of about the same length, shorter than other setae; third, fourth, and sixth setae of about the same length, slightly longer than half the length of the fifth seta. Male unknown.

Comparisons: Bairdia dinochelata differs from the other ostracodes described in this paper in having four large horizontal muscle scars.

Shell measurements (in mm.):

Specimen number	Length	Width	Height	Length-height ratio	Sex	Valve
500–1 (holotype)	0.84	—	0.51	1.65	female	left
87–G	0.78	0.46	0.48	1.62	—	complete

Material: Four specimens were collected in the Bimini area. One specimen was dissected, a female. The holotype, specimen no. 500–1, is illustrated in text-figure 8I–N and in plate 1, figure 4a–b.

Occurrence: Specimens were collected on both sand and rock bottoms. Individuals were collected in water ranging in depth from 1.5 to 3.5 meters. Specimens were collected in May and June of 1956; none were found in collections made in December of 1956. Water temperatures taken during the time of collection ranged from 27.0° to 28.5° C. The salinity of the water was approximately 37.5 parts per thousand.

Genus **Bairdoppilata** Coryell, Sample, and Jennings, 1935

Type species: Bairdoppilata martyni Coryell, Sample, and Jennings, 1935, Amer. Mus. Nat Hist., Novitates, no. 777, p. 3, text-figs. 1–2.

Generic characteristics: Carapace bairdioid in lateral view. Left valve larger than the right and overlapping it on all margins, most strongly at dorsal and midventral contacts. A short series of crenulations supported on a small platform are present beneath the overlap margin at anterior and posterior angulations of left valve. Right valve with a series of crenulations on edge of valve which engage with crenulations on left valve.

Bairdoppilata carinata Kornicker, **new species**
Plate 1, figure 5a–e; text-figures 9A–J, 10B–C, E

Diagnosis: Shell in lateral view rhomboid oval in outline; greatest height slightly posterior to the middle. Difference in height of carapace of females and males considerable, females having a length-height ratio of about 1.55 and males 1.70. Anterior margin broadly rounded; anterodorsal angle above midheight of valve; posterior beak bluntly acuminate and slightly below midheight. In dorsal view broadly ovate; greatest width about in the middle; both ends pointed. Valves unequal, the left overlapping the right. Surface smooth; small pits visible under high magnification. Profuse long black hairs project from carapace. Muscle scars of male consisting of about nine oval bosses clustered around center of valve, with about five less distinct scars around periphery of cluster. Muscle scars of female centrally located, but individual scars extremely difficult to distinguish. Both valves with opaque and translucent areas forming a more or less consistent pattern; centrally located opaque area ovoid and inclined posteriorly; lobe-shaped opaque areas follow the anterior and posterodorsal margins.

The hinge in the left valve consists of a narrow groove above a thin straight bar at the straight dorsal contact; below the bar at each end is a short recessed area. Just below the anterior and posterior dorsal angles are short, low crenulated ridges. The hinge in the right valve consists of a bar with a groove along its dorsal side, which engage with the groove and bar in the left valve. Below the groove is a shelf, which does not project as far out as the bar above the groove except at each end, where this portion of the shelf engages the recessed areas below the bar of the left valve. The edge of the valve above the anterior and posterior dorsal angles is dentate, engaging the crenulations below the anterior and posterior dorsal angles of the left valve. A continuous ledge, against which the edge of the right valve rests when the carapace is closed, runs from the anterior ventral angle along the inside of the ventral margin, where it is best developed, to the posterior dorsal angle. The ledge is very faint at the anterior and posterior ends. Ventral overlap of the left valve is poorly developed.

Body of animal brown, with appendages bearing black setae. Furca with seven setae; two proximal setae are of about the same length and smaller than remaining setae; third seta somewhat longer than fifth seta; fourth seta about three-fourths as long as the sixth seta; fifth seta of approximately the same length as seventh seta. In one specimen, the third seta was of the same length as the fourth seta. Triangular and rectangular flaps lie between the head of the male copulatory organ and the furca. (see text-fig. 10C). Male copulatory organ has a lobe extending over the hooklike head of the organ.

Shell measurements (in mm.):

Specimen number	Length	Height	Length-height ratio	Sex	Valve
122B–2 (holotype)	1.14	0.73	1.56	female	left
122B–36	1.06	0.61	1.74	male	left
122B–9	1.04	0.63	1.68	male	left
122B–13	1.04	0.63	1.68	male	left
122B–11	1.04	0.61	1.72	male	left
122B–5	1.06	0.70	1.52	female	left
122B–6	0.86	0.53	1.62	female (immature)	left

Material: Forty-five specimens were collected in the Bimini area. Sex was determined in seven individuals, four males and three females. The holotype, specimen no. 122B–2, is illustrated in text-figure 9B–D and in plate 1, figure 5b–c.

Occurrence: Specimens were collected in about the same numbers on bioclastic sand and on rock surfaces with little sand cover. No individuals were collected from oolitic sand, areas exposed at low tide, or in the entrance to the main channel at North Bimini, where high water-velocities are encountered. Rock bottom areas from which collections were made support sponges, corals, algae, and *Thalassia.* Sand bottom areas support *Thalassia*, *Laurencia*, and other marine algae, worms, echinoderms, sponges, and corals. Sea whips and sea fans were present on rock bottom in the channel of North Bimini Harbor and on the Bank west and south of the Biminis. *Bairdoppilata carinata* was collected in water ranging in depth from 1 to 5 meters. This species was not collected in the few samples obtained from greater depths.

Collections were made during May, June, and December of 1956. The temperature of the water during the December collections was about 24° C. The temperatures at the collecting sites during May and June ranged from 26.5° to 29.5° C. The salinity of the water was about 37.5 parts per thousand.

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PLATE 1

1 *Bairdia harpago* Kornicker, n. sp.
a–b, external views of left and right valves of holotype, specimen no. 122B–12.

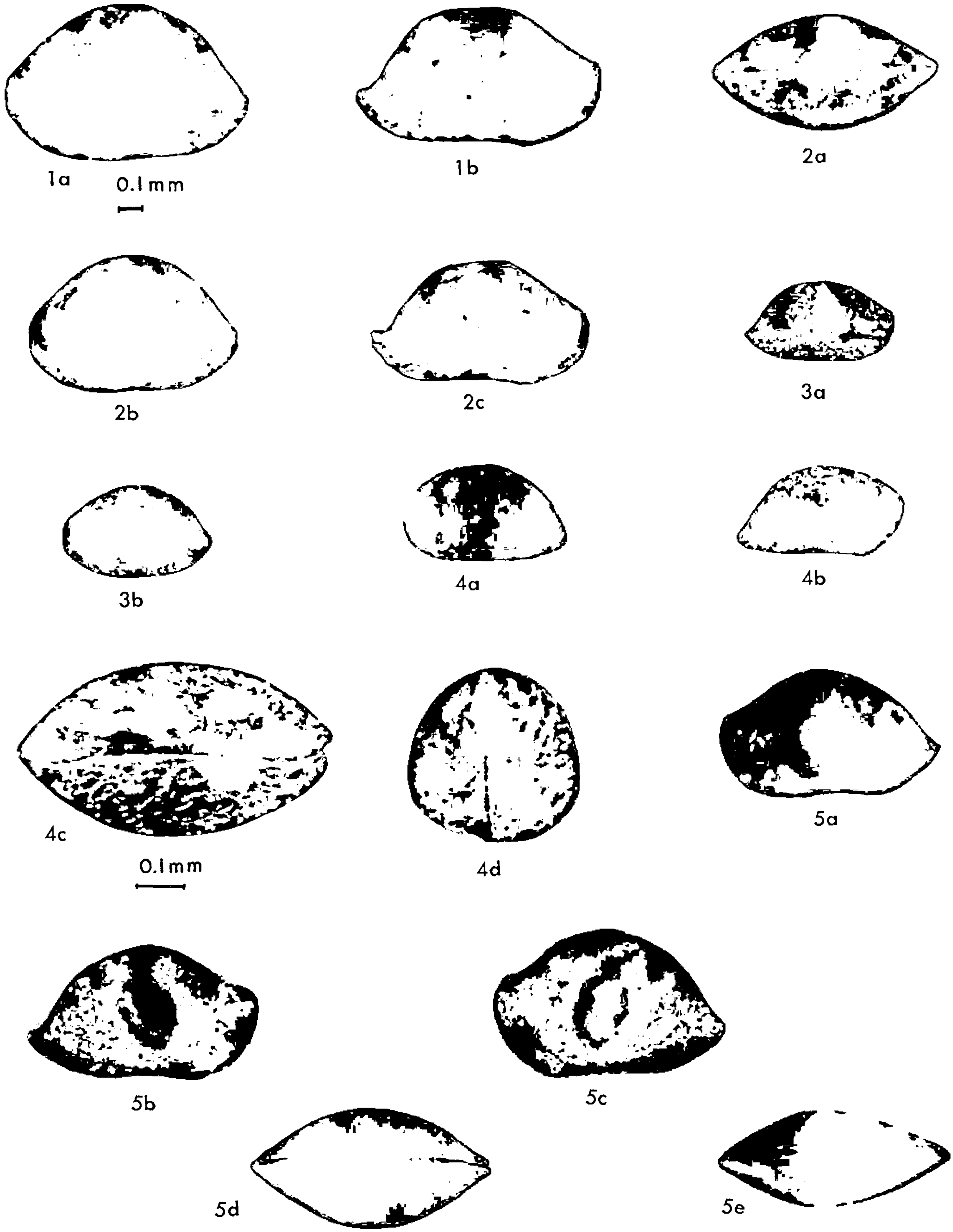
2 *Bairdia gigacantha* Kornicker, n. sp.
a, dorsal view of specimen no. 247–9–x, with anterior to left; b–c, external views of left and right valves of holotype, specimen no. 247–9–3.

3 *Bairdia arostrata* Kornicker, n. sp.
a–b, external views of right and left valves of holotype, specimen no. 92.

4 *Bairdia dinochelata* Kornicker, n. sp.
a–b, external views of left and right valves of holotype, specimen no. 500–1; c–d, dorsal view (anterior to right) and anterior view of specimen no. 87–G.

5 *Bairdoppilata carinata* Kornicker, n. sp.
a, external view of left valve of a male, specimen no. 122B–9; b–c, external views of right and left valves of holotype, specimen no. 122B–2; d, dorsal view (anterior to left) of a female, specimen no. 92–5306–I; e, dorsal view (anterior to left) of a male, specimen no. 246.

Specimens with similar magnification: 1a–b, 2a–c, 3a–b, 4a–b, 5a–e; 4c–d. Specimen in figure 5b–c was photographed with transmitted light to show distribution of opaque and translucent areas of valves. All photographs were made with 3000 speed polaroid film. Specimens in figures 3a–b and 4b were coated with silver nitrate solution. Hinge line in figures 4c, 4d, 5d, and 5e were retouched.


1a
0.1mm
1b
2a
2b
2c
3a
3b
4a
4b
4c
0.1mm
4d
5a
5b
5c
5d
5e

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