

SOME NEW INTERSTITIAL COPEPODS FROM WALTAIR COAST

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ABSTRACT

The paper reports the occurrence of eight new species of harpacticoid copepods from the interstitial sands of Waltair coast. These belong to 7 genera. The description and distribution of these forms with reference to the size of the sand grains, depth and tidal levels are given in the paper.

In the course of an investigation of the interstitial fauna in the beach sands of Waltair coast during the years 1960-63, we encountered several species of harpacticoid copepods in the intertidal zone. A brief report of the species already known is being published elsewhere. The present paper deals with description of eight new species collected during the survey. The type specimens of new species are deposited in Zoology Museum, Andhra University, Waltair.

The specimens were studied in the fresh condition and all the figures of body appendages are drawn to the same scale with the aid of a camera lucida. The length of specimens mentioned in the text was measured from anterior end of rostrum to posterior end of caudal rami and the seta formula given for the first four pairs of swimming legs is inclusive of spines.

Family: ECTINOSOMIDAE

Genus: *Arenosetella* Wilson

Arenosetella setosus n.sp. (Fig. 1)

Occurrence.—Specimens of both sexes were commonly encountered in coarse and medium sand with fine shell gravel between low and mid-water levels, Palm Beach and Lawson's Bay, Waltair.

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Female.—Length 0.55–0.58 mm. Body cylindrical, slightly compressed laterally and without demarcation between metasome and urosome. Cephalosome nearly rectangular and about twice the length of succeeding segments. Rostrum prominent and triangular. Urosome 4-segmented and slightly tapering posteriorly. Anal operculum small, slightly incised on posterior border and bears no dorsal claws. Caudal rami as long as broad and as long as anal segment. Each ramus bears 1 subterminal pectinate seta and 4-apical setae of varying length.

Antennule short and 5-segmented, terminal segment being longest. First segment bears a long pectinate seta while fourth and terminal segments carry an aesthete each. Antenna 3-segmented, the 2-segmented exopod attached to apex of basal segment. First and second exopod segments carry 1 and 2 pectinate setae respectively. Terminal endopod segment bears 2 lateral and 6 apical geniculate setae. Mandible with biramous palp, the 1-segmented exopod attached to basal segment. Maxillule, maxilla and maxilliped of usual shape. Walking legs I–IV similar in construction. Both rami 3-segmented with longer endopods. Each exopod bears 3-modified setae on inner border. Seta formula for legs as follows:

	<i>Exopod</i>	<i>Endopod</i>
Legs I–IV ..	1 2 3 2 2 5	1 2 3 1 2 5

Fifth leg well developed and of usual shape. Inner and outer lobes bear 2 and 3 setae respectively. Genital field with a small concave lamina bearing a slender filament on either side. Egg-sac single with 3 eggs arranged one behind other.

Male.—Length 0.50–0.52 mm. Resembles female in general shape. Urosome 5-segmented. Caudal ramus, antenna, mouth parts and legs I–IV as in female. Antennule 6-segmented, fourth segment being longest and geniculate between fourth and fifth segments. First segment carries a long pectinate seta while the fourth bears an aesthete and a bunch of 12–15 hairs. Terminal segment tipped with an aesthete and a stout seta. Fifth leg resembles that of female except for smaller size. Sixth leg is a small lamina with an inner spine and an outer seta.

Remarks.—Among the species of the genus *Arenosetella* Wilson known to lack dorsal claws on anal operculum, the present form approaches *A. mediterranea* Chappuis (1954) in bearing 2 setae on inner border of terminal endopod segment of legs I–IV but differs from it in having exopod of antenna

2-segmented and in the structure of other appendages. It is further distinguished by the shape of the caudal rami which are as long as broad.

Arenosetella noodti† n.sp. (Fig. 2)

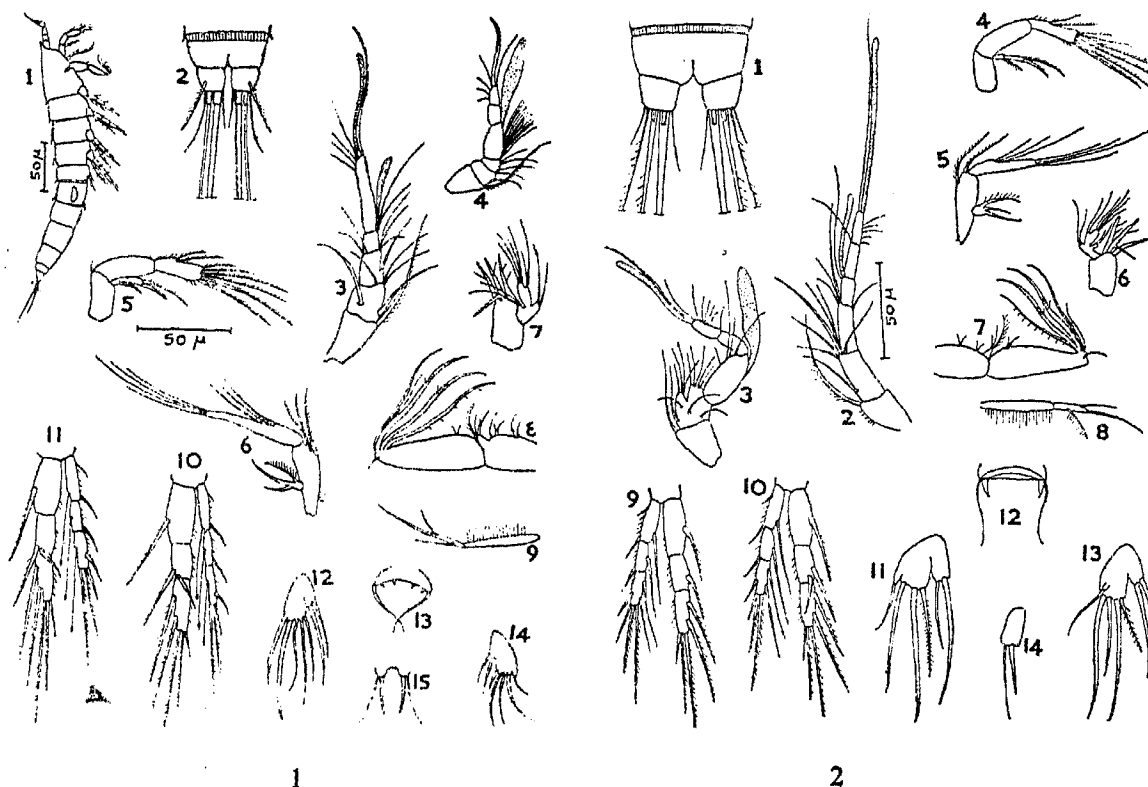


FIG. 1. *Arenosetella setosus* n.sp, 1 = Adult ♂; 2 = CR; 3 = Al♀; 4 = Al♂; 5 = A2; 6 = Md. P; 7 = Mxl; 8 = Mx; 9 = Mxp; 10 = P1; 11 = P4; 12 = P5 ♀; 13 = GF ♀; 14 = P5 ♂; 15 = 2P6 ♂.

FIG. 2. *Arenosetella noodti* n.sp. 1 = CR; 2 = Al♀; 3 = Al♂; 4 = A2; 5 = Md. P; 6 = Mxl; 7 = Mx; 8 = Mxp; 9 = P1; 10 = P3; 11 = P5 ♀; 12 = GF ♀; 13 = P5 ♂; 14 = P6 ♂

Occurrence.—Both sexes common in coarse sand near low watermark, Palm Beach, Waltair.

Female.—Length 0.58–0.62 mm. Body cylindrical without demarcation between metasome and urosome. Cephalosome rectangular and nearly equal to the length of first two metasome segments united. Rostrum prominent and triangular. Urosome 4-segmented. Anal operculum slightly notched posteriorly and bears no dorsal claws. Caudal rami wider than long and slightly tapering. Each ramus bears 5 apical setae of varying length.

† Named after Dr. Wolfram Noodt, Kiel, West Germany.

Antennule 6-segmented, basal being stoutest and bearing a pectinate seta. Fourth and terminal segments bear an aesthete each. Antenna 3-segmented, the 2-segmented exopod attached to apex of basal segment. First and second exopod segments bear 1 and 2 pectinate setae respectively. Terminal endopod segment bears 2 lateral and 6 apical modified setae. Mouth parts of usual type. Legs I-IV of similar construction except for absence of a spine on second endopod segment of first leg and their seta formula is as follows:

	<i>Exopod</i>			<i>Endopod</i>		
	1	2	3	1	2	3
First leg ..	2	2	6	1	1	5
Legs II-IV ..	2	2	6	1	2	5

Fifth leg of usual shape and bears 2 inner and 4 outer setae, the first outer seta being plumose. A broad lamina occurs on genital field carrying a stumpy and a slender filament on either side. Egg-sac single with 5-6 eggs arranged in two rows.

Male.—Length 0.61-0.64 mm. Resembles female in general shape of body. Urosome 5-segmented. Antennule 5-segmented and geniculate between third and fourth segments. Third and terminal segments bear an aesthete each. Fifth leg resembles that of female. Sixth leg is nearly a rectangular lamina with an inner spine and an outer seta. Other appendages resemble those of female.

Remarks.—Among known species of the genus *Arenosetella* Wilson which lack dorsal claws on anal operculum, the new species resembles *A. tenuissima* (Klie, 1935) in having caudal rami broader than long and *A. mediterranea* Chappuis (1954) in the structure of legs I-IV. It, however, markedly differs from the former in the structure of antennule and from the latter in the 2-segmented nature of exopod of antenna, in addition to variation of other appendages.

Genus: *Pararenosetella* Lang

Pararenosetella clavata n.sp. (Fig. 3)

Occurrence.—Both sexes common in coarse and medium sand between low and mid-water levels, Palm Beach, Waltair.

Female.—Length 0.56-0.60 mm. Body cylindrical without demarcation between metasome and urosome. Cephalosome rectangular and nearly

twice the length of succeeding segments. Rostrum small and elliptical. Urosome 4-segmented and tapers posteriorly. Anal operculum without dorsal ornamentation. Caudal rami longer than broad and as long as anal segment. Each ramus bears 1 subterminal and 4 apical setae and a terminal claw from which derives the specific name.

Antennule 5-segmented, terminal segment being longest. Third and terminal segments bear a flattened seta and an aesthete each. Antenna 3-segmented with 2-segmented exopod attached to apex of basal segment. First exopod segment bears a pectinate seta while the second has an apical spine. Terminal endopod segment bears 2 lateral spines and 2 lateral and 6 apical modified setae. Mouth parts as shown in figure. Legs I-IV similar in construction. Exopod bears 2 hastate setae on inner border of second and third segments. Seta formula for legs as follows:

	<i>Exopod</i>	<i>Endopod</i>
	1 2 3	1 2 3
Legs I-IV	2 2 5	1 2 3

Fifth leg 2-segmented. Basal segment bears 1 outer and 2 inner setae while distal has 4 apical setae of varying length. Genital field with semi-circular lamina carrying a short and slightly curved filament on either side. Egg-sac single with 5-8 eggs one behind other.

Male.—Length 0.52-0.55 mm. Resembles female in shape of body. Urosome 5-segmented. Antennule 5-segmented, terminal segment being longest. Fourth and terminal segments bear a long seta and an aesthete each. Fifth leg resembles that of female except for smaller size. Sixth leg is an elongate lamina with spinules on inner border and 2 apical setae of varying length.

Remarks.—Among species of the genus *Pararenosetella* Lang, though the present form approaches *P. psammae* Noodt (1955) in the armature of legs I-IV, it shows striking differences in the structure of several appendages. Caudal rami armed with terminal claws and exopods of walking legs carrying modified setae distinguish the new species.

Family: CYLINDROPSYLLIDAE

Genus: *Leptastacus* T. Scott

Leptastacus waltairensis n.sp. (Fig. 4)

Occurrence.—Both sexes common in medium sand 15 cm. below surface near half-tide level, Palm Beach and Lawson's Bay, Waltair.

Female.—Length 0.35–0.38 mm. Body cylindrical without demarcation between metasome and urosome. Fusion of first segment with head indicated by a constriction. Rostrum short and elliptical. A median red eye spot present behind rostrum. Urosome 4-segmented and slightly tapers posteriorly. Caudal rami cylindrical, slightly taper posteriorly and nearly longer than twice the length of anal segment. Each ramus bears a dorsal seta borne on two basal joints and 2 lateral setae. Terminally a stout pectinate seta occurs with a short bristle on either side. A short inner and an apical spine also present.

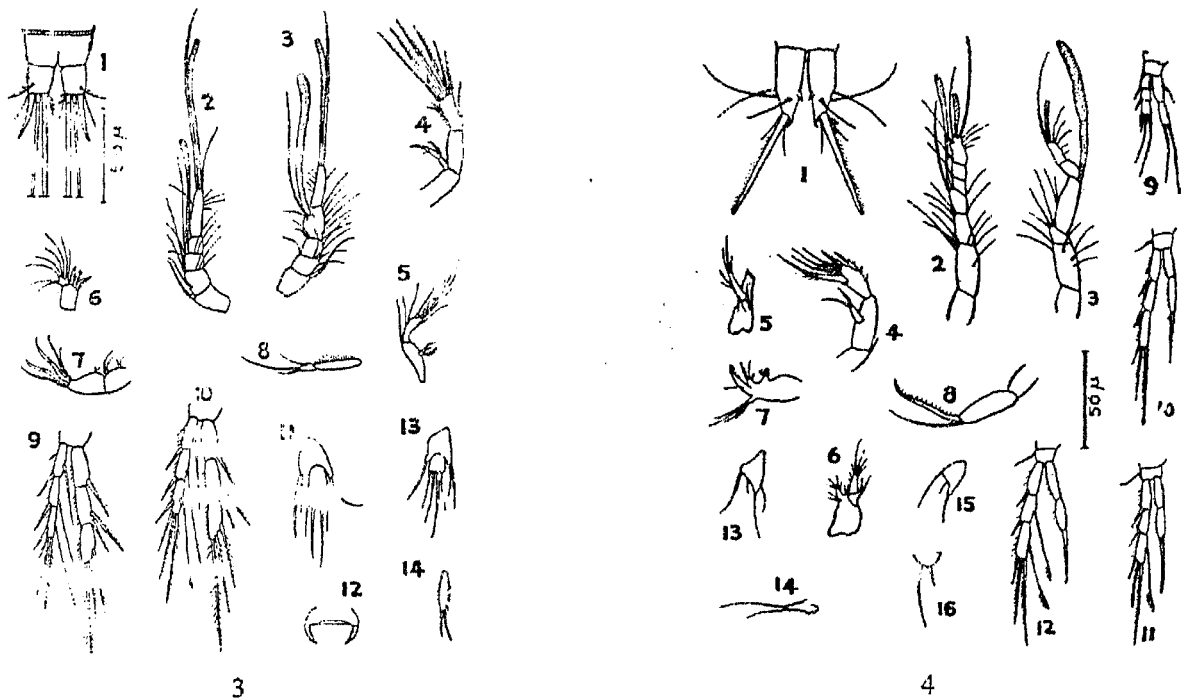


FIG. 3. *Pararenosetella clavata* n.sp. 1 = CR; 2 = A1 ♀; 3 = A1 ♂; 4 = A2; 5 = Md; 6 = Mxl; 7 = Mx; 8 = Mxp; 9 = Pl; 10 = P4; 11 = P5 ♀; 12 = GF ♂; 13 = P5 ♂; 14 = PC ♂.

FIG. 4. *Leptastacus waltirensis* n.sp. 1 = CR; 2 = A1 ♀; 3 = A1 ♂; 4 = A2; 5 = Md; 6 = Mxl; 7 = Mx; 8 = Mxp; 9 = Pl; 10 = P2; 11 = P3; 12 = P4; 13 = P5 ♀; 14 = GF ♀; 15 = P5 ♂; 16 = P6 ♂.

Antennule 7-segmented, second segment being longest. Fourth and terminal segments bear an aesthete each. Antenna 3-segmented. Single-segmented exopod attached to second endopod segment and bears 2 apical setae. Terminal endopod segment bears 2 pectinate spines and 4 geniculate setae. Mandible with 2-segmented palp. Maxillule and maxilla of usual shape. Maxilliped well-developed, prehensile and bears 2 apical spines, one of them being denticulate. Legs I–IV with 3-segmented exopods and 2-segmented endopods. Third exopod segment of third leg and second and third

exopod segments of fourth leg bear a modified seta each. Seta formula for legs as follows:

	<i>Exopod</i>			<i>Endopod</i>	
	1	2	3	1	2
First leg ..	1	1	3	1	2
Second leg ..	1	1	3	0	1
Third leg ..	1	1	4	0	1
Fourth leg ..	1	2	4	0	1

Fifth leg is a triangular lamina with 1 inner, 1 apical and 2 outer setae. Two triangular laminae occur on genital field, each with 2 slender filaments of varying size. Egg-sac single with 3 eggs one behind other.

Male.—Length 0.35–0.36 mm. Resembles female in shape of body. Urosome 5-segmented. Antennule 6-segmented, fourth segment being longest and geniculate between fourth and fifth segments. Fourth and terminal segments bear an aesthete each. Fifth leg resembles that of female except for absence of the inner seta. Sixth leg is a semicircular lamina with an inner spine and an outer seta. Other appendages similar to those of female.

Remarks.—Among species of the genus *Leptastacus* T. Scott, the present form closely approaches *L. nichollsi* Krishnaswamy (1951) and *L. euryhalinus* Krishnaswamy (1957) in the general structure of appendages but differs from both of them in the armature of caudal rami, antennule, antenna and legs III–VI.

Genus: *Psammastacus* Nicholls

Psammastacus spinicaudatus n.sp. (Fig. 5)

Occurrence.—Both sexes common in coarse and medium sand at all levels of intertidal, Palm Beach and Lawson's Bay, Waltair.

Female.—Length 0.63–0.66 mm. Body cylindrical without demarcation between metasome and urosome. Rostrum small and triangular. Cephalosome rectangular and slightly longer than twice the length of succeeding segments. Urosome 4-segmented and slightly tapers posteriorly. Posterior border of anal operculum ventrally drawn out into 2 short spinous outgrowths underlying caudal rami. Caudal rami conical and slightly longer than anal segment. Each ramus bears 1 apical and 3 lateral setae and a terminal claw. One of the lateral setae borne on two basal joints.

Outer margin of ramus bears a row of numerous spinules. In fresh specimens, a black glandular structure seen extending from anal segment into caudal rami.

Antennule 7-segmented, second segment being longest and bearing a pectinate seta. Fourth and terminal segments carry 1 and 2 aesthetes respectively. Antenna 2-segmented, with basal segment partly divided at joint of attachment of 1-segmented exopod. Exopod short and carries an apical seta fringed with 2 lateral bristles. Terminal endopod segment bears 3 spines and 4 geniculate setae. Mouth parts resemble generic type. First leg with 1-segmented exopod and 2-segmented endopod. Legs II-IV with 3-segmented exopods and 2-segmented endopods. Third exopod segment of third leg and second and third exopod segments of fourth leg bear 1, 1 and 2 modified setae respectively. Seta formula for legs I-IV as follows:

	<i>Exopod</i>			<i>Endopod</i>	
	1	2	3	1	2
First leg ..	4	-	-	1	2
Second leg ..	1	1	3	0	1
Third leg ..	1	1	4	0	1
Fourth leg ..	1	2	5	0	2

Fifth pair of legs partly fused in between and each is a triangular lamina bearing 2 inner and 2 outer setae. Genital field with a pair of rectangular laminae each carrying a slender filament. Egg-sac single with two large eggs one behind the other.

Male.—Length 0.62 mm. Resembles female in shape of body. Uro-some 5-segmented. The black anal gland seen in female absent. Antennule resembles that of female and geniculate between fifth and sixth segments. Fifth pair of legs completely fused in between into a broad lamina with 1 inner and 2 outer setae on either side, the outermost seta being long and plumose. Sixth leg resembles fifth leg and bears an inner and an outer seta.

Remarks.—Three species of the genus *Psammastacus* Nicholls are known so far. They are *P. brevicaudatus* Nicholls (1935), *P. confluens* Nicholls (1935) and *P. acuticaudatus* Krishnaswamy (1957). Though the new species closely resembles *P. acuticaudatus* in general structure of appendages, it differs from it in the armature of caudal ramus, antennule, antenna and legs III-VI.

Family: PARAMESOCHRIDAE

Genus: *Paramesochra* T. Scott*Paramesochra denticulata* n.sp. (Fig. 6)

Occurrence.—Both sexes frequent in medium sand near half-tide level, Palm Beach, Waltair.

Female.—Length 0.32 mm. Body depressed, broad anteriorly and slightly tapers posteriorly. Cephalosome nearly as long as broad. Rostrum small and triangular. Urosome 4-segmented. Caudal rami longer than broad and nearly twice as long as anal segment. Each ramus bears 1 dorsal bristle, 1 short terminolateral plumose seta, 2 apical plumose setae and an inner denticulate spine from which it derives the specific name.

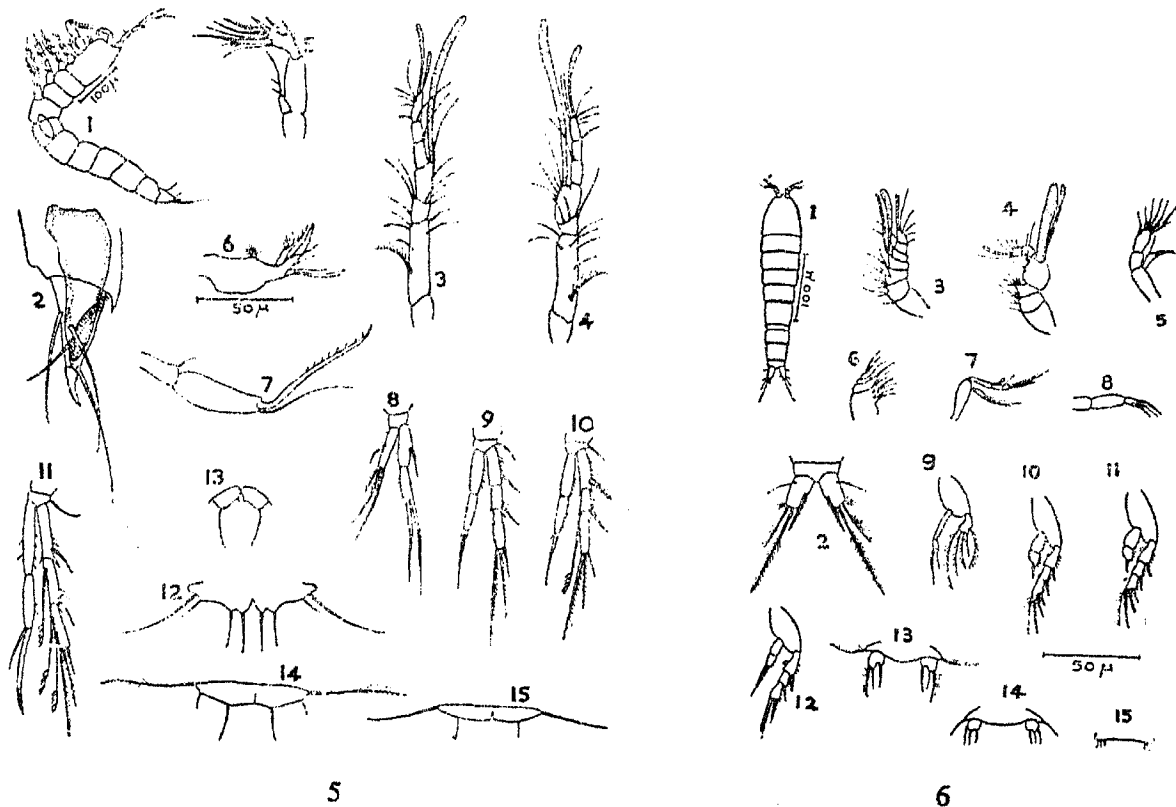


FIG. 5. *Psammastacus spinicaudatus* n.sp. 1 = Adult ♂; 2 = CR; 3 = A1 ♀; 4 = A1 ♂; 5 = A2; 6 = Mx; 7 = Mxp; 8 = P1; 9 = P2; 10 = P3; 11 = P4; 12 = P5 ♀; 13 = GF ♀; 14 = P5 ♂; 15 = P6 ♂.

FIG. 6. *Paramesochra denticulata* n.sp. 1 = Adult ♀; 2 = CR; 3 = A1 ♀; 4 = A1 ♂; 5 = A2; 6 = Mx; 7 = Md. P; 8 = Mxp; 9 = P1; 10 = P2; 11 = P3; 12 = P4; 13 = P5 ♀; 14 = P5 ♂; 15 = P6 ♂.

Antennule 7-segmented, basal segment being largest. Fourth and terminal segments carry 2 and 1 aesthete respectively. Antenna biramous.

Single-segmented exopod attached to apex of basal segment and bears a dorsal seta and an apical spine. Terminal endopod segment bears 1 lateral and 5 apical geniculate setae. Mandible has biramous palp with 1-segmented proximal ramus and 3-segmented distal ramus. Maxillule, maxilla and maxilliped of generic type. First leg: Exopod 1-segmented and bears 1 outer and 4 apical pectinate setae. Endopod slender and 2-segmented, short terminal segment bearing 2 apical geniculate setae of unequal length. Legs II-IV with 3-segmented exopods and 2-segmented endopods. Second leg: First two exopod segments bear a spine each while terminal segment carries 3 apical spines and 1 pectinate seta. First endopod segment naked while the second tipped with a short spine. Third leg resembles second leg. Fourth leg similar to second leg except that terminal exopod segment carries only 2 apical spines while terminal endopod segment armed with a long apical spine. In fifth leg, basal segment carries an outer pectinate seta and its inner side not produced. Distal segment bears 3 setae, the outermost being longest and pectinate. Egg-sac single with 2-3 eggs.

Male.—Length 0.28 mm. Resembles female in shape of body. Urosome 5-segmented. Antennule 6-segmented and geniculate between fourth and fifth segments. Fourth segment largest and bears 2 aesthetes of unequal size. Terminal segment tipped with a short aesthete. Fifth leg resembles that of female except that setae are naked. Sixth pair of legs with small lamina bearing a row of 3 short setae on either side.

Remarks.—Among species of the genus *Paramesochra* T. Scott, the new species resembles *P. helgolandica* Kunz (1938) and *P. ornata* Krishnaswamy (1957) in the structure of endopod of legs II-IV but differs from both of them in the armature of several appendages.

Family: DIOSACCIDAE

GENUS: *Schizopera* Sars

Schizopera indica n.sp. (Fig. 7)

Occurrence.—Both sexes frequent in coarse sand near low watermark, Lawson's Bay, Waltair.

Female.—Length 0.60-0.62 mm. Body cylindrical, slightly compressed laterally, anteriorly broad and posteriorly tapering. Rostrum triangular and curved. Cephalosome as long as broad and nearly twice the length of succeeding segments. Urosome 4-segmented. Posterior border of anal operculum fringed with minute setae on dorsal side. Caudal rami longer than broad and slightly shorter than anal segment. Each ramus bears 1 dorsal

seta borne on two basal joints, an apical spine and 4 apical setae of varying length.

Antennule 8-segmented, second segment being longest and bearing a pectinate seta. Fourth and terminal segments bear an aesthete each. Antenna 3-segmented, the 2-segmented exopod attached to basal segment. First exopod segment bears an apical seta while the second has 1 dorsal seta and an apical spine. Mandible palp 2-segmented. Maxillule and maxilla as shown in figure. Maxilliped well-developed, prehensile and bears an apical claw. Legs I-IV with both rami 3-segmented and their seta formula as follows:

	<i>Exopod</i>			<i>Endopod</i>		
	1	2	3	1	2	3
First leg ..	1	1	4	1	1	2
Second leg ..	1	2	4	0	1	5
Third leg ..	1	2	4	1	1	5
Fourth leg ..	1	2	5	1	1	4

Fifth leg 2-segmented. Outer expansion of basal segment bears a long plumose seta while inner expansion has 1 inner spine and 1 plumose seta and 2 apical setae of varying length. Distal segment long and bears 1 inner, 1 apical and 3 outer setae. Egg-sac double, each with 4-6 eggs arranged in 1-2 rows.

Male.—Length 0.56 mm. Shape of body resembles that of female. Urosome 5-segmented. Antennule resembles that of female and geniculate between fifth and sixth segments. Sixth segment bears a curved hook on ventral side. Basis of first leg and terminal exopod segment of third leg bear characteristic hyaline laminar structure. Modified endopod of second leg of usual shape with 2 plumose setae on second segment. Fifth leg resembles that of female except for smaller size. Inner expansion of basal segment bears 1 pectinate and 1 naked spine while the outer carries a long plumose seta. Distal segment bears 1 inner, 2 apical and 2 outer setae. Sixth leg is a small semicircular lamina with an inner spine and an outer seta. Other appendages resemble those of female.

Remarks.—Among species of the genus *Schizopera* Sars, the present form approaches *S. brusinae* Petkovski (1954) in the structure of walking legs but markedly differs from it in the armature of caudal ramus, antennule and fifth leg.

Family: AMEIRIDAE

Genus: *Ameira* Boeck*Ameira bengalensis* n.sp. (Fig. 8)

Occurrence.—Four female specimens collected in coarse sand between low and mid-water levels, Palm Beach, Waltair.

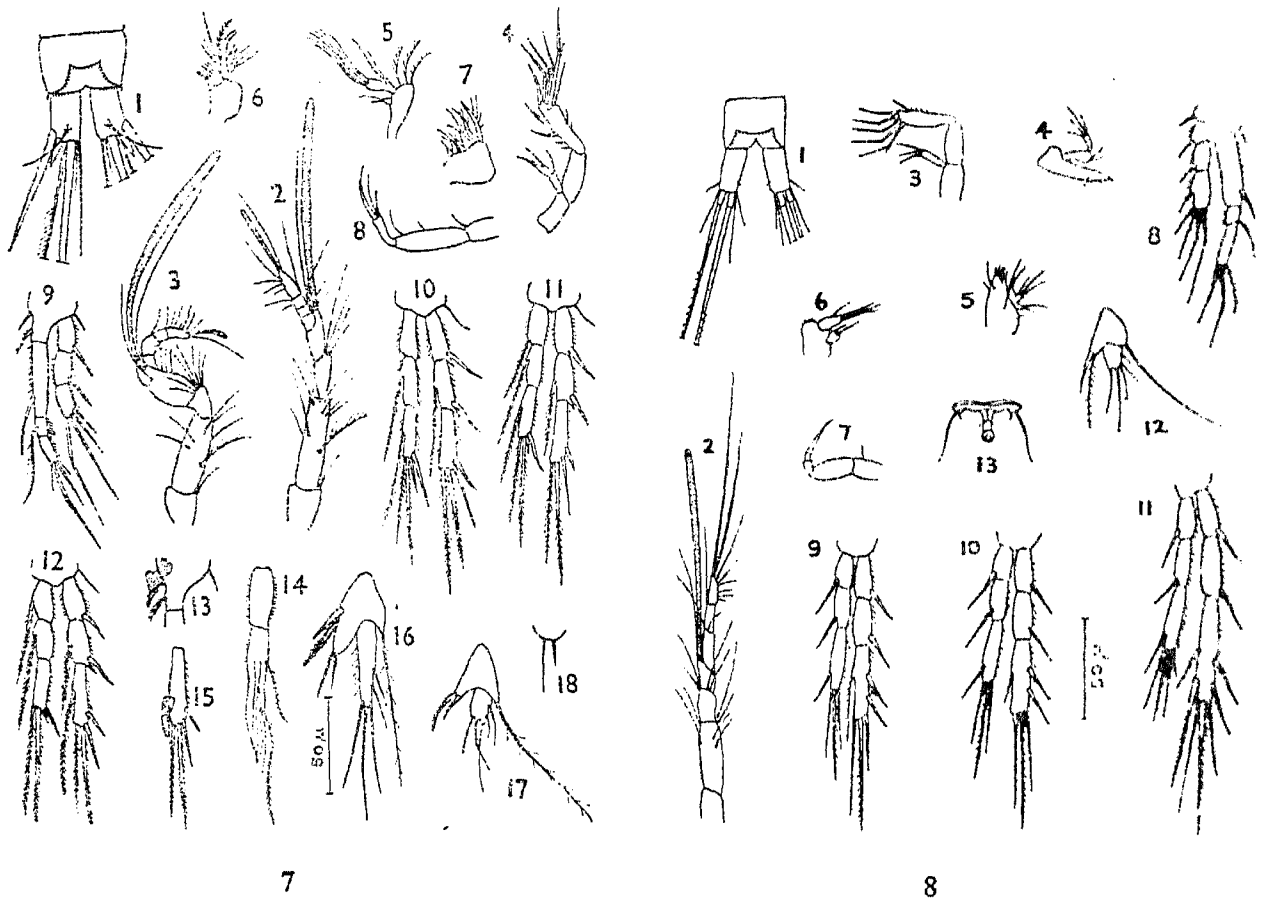


FIG. 7. *Schizopera indica* n.sp. 1 = CR; 2 = A1 ♀; 3 = A1 ♀; 4 = A2; 5 = Md. P; 6 = Mxl; 7 = Mx; 8 = Mxp; 9 = P1 ♀; 10 = P2 ♀; 11 = P3 ♀; 12 = P4 ♀; 13 = Basis P1 ♂; 14 = End. P2 ♂; 15 = 3rd Exp. segment P3 ♂; 16 = P5 ♂; 17 = P5 ♂; 18 = P6 ♀.

FIG. 8. *Ameira bengalensis* n.sp. Female. 1 = CR; 2 = A1; 3 = A2; 4 = Md; 5 = Mxl; 6 = Mx; 7 = Mxp; 8 = P1; 9 = P2; 10 = P3; 11 = P4; 12 = P5; 13 = GF.

Female.—Length 0.52 mm. Body cylindrical and slightly compressed laterally. Rostrum prominent and triangular. Cephalosome longer than broad and nearly twice the length of succeeding segments. Urosome 4-segmented. Posterior border of anal operculum fringed with minute setae on dorsal side. Caudal rami twice as long as wide and as long as anal segment. Each ramus bears 1 outer and 2 apical setae and 3 short terminal bristles.

Antennule 7-segmented, second segment being longest and fourth segment bearing an aesthete. Antenna 3-segmented. Single-segmented exopod attached to basal endopod segment and bears 3 apical setae of nearly equal length. Terminal endopod segment bears 1 lateral spine and 5 apical geniculate setae. Mouth parts of usual type. Legs I-IV with 3-segmented rami and their seta formula as follows:

	<i>Exopod</i>			<i>Endopod</i>		
	1	2	3	1	2	3
First leg ..	1	1	5	1	1	3
Second leg ..	1	1	6	1	1	4
Third leg ..	1	1	6	1	1	4
Fourth leg ..	1	1	7	1	1	4

Fifth leg 2-segmented. Inner expansion of basal segment bears a spine and a plumose seta while the outer carries a long seta. Distal segment bears 3 outer and 2 apical setae. Genital field with short lamina bearing a short and a long filament on either side. Egg-sac single with 3-5 eggs one behind other.

Male.—Unknown.

Remarks.—Among species of the genus *Ameira* Boeck, the new species approaches *A. longicauda* Nicholls (1940) and *A. pestae* Petkovski (1955) in the structure of caudal ramus, antenna and legs I-IV but differs from both of them in the 7-segmented nature of antennule and armature of fifth leg.

SUMMARY

The present paper describes eight new species of marine interstitial Copepoda from the beach sands of Waltair coast.

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ABBREVIATIONS USED IN FIGURES

CR, Caudal ramus; A₁, Antennule; A₂, Antenna; Md, Mandible; Md. P, Mandible palp;
Mxl, Maxillule; Mx, Maxilla; Mxp, Maxilliped; P₁-P₆: Legs I-VI; GF, Genital field.