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NEW SANDHOPPERS (CRUSTACEA: AMPHIPODA) FROM THE GULF COAST OF THE UNITED STATES

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ABSTRACT Three species of sand-burrowing semi-terrestrial amphipod crustaceans are newly described from sandy beaches of the North American coast of the Gulf of Mexico. They (and two related species from the open Atlantic coast of North America) are removed from the genus *Talorchestia* Dana 1853, and placed in a new genus, *Americorchestia*. *Americorchestia salomani*, new species, and *A. heardi*, new species, occur from northwestern Florida to the Mississippi Delta. They are morphological counterparts of the well-known sandhoppers from the open Atlantic coast, *A. megalophthalma* (Bate) and *A. longicornis* (Say) respectively. *Americorchestia barbarae*, new species, related to *A. salomani*, occurs on open beaches west of the Mississippi Delta. Sandhopper species of the Gulf coast are smaller, have different food resources available to them, and are exposed to different physical and biological survival factors than their counterparts from the North Atlantic coastal region.

INTRODUCTION

The intertidal talitrid amphipod fauna of the North American Atlantic region has been generally known for some time (e.g. Holmes, 1904; Bousfield, 1958, 1973). From the coast of the Gulf of Mexico, studies on palustral talitrids, beach fleas, and landhoppers of the genera *Uhlorchestia*, *Chelorchestia*, *Tethorchestia*, *Platorchestia*, and *Talitroides* have been made principally by Shoemaker (1936), Bousfield (1984), and Bousfield and Heard (1986). However, very few records and no detailed studies have been made on primary sandhoppers of this region. This hiatus is now being filled on the basis of material collected personally from various Gulf coast beaches since 1963, and specimens on loan from other sources. In this material, that had provisionally been assigned to the genus *Talorchestia* (sens. lat.), the writer has identified three distinct new species of sandhoppers. Analysis of the systematics and distributional-ecology of these and related species form the basis of this report.

SYSTEMATICS

Family Talitridae Stebbing 1906 emend Bulycheva 1957

Taxonomic commentary: Bousfield (1984) divided the family into four semi-phyletic but essentially pragmatic (morphological-ecological) groups. His study encompassed the primitive palustral group, the more advanced landhopper group, and the most advanced beachflea group. The sandhopper group was left untreated, but like the other three groups, it appears to be

polyphyletic, and comprised of at least two major sub-groups. In his initial treatment of the sandhopper group, based mainly on North American Pacific species, Bousfield (1982) more fully defined some of the existing genera including *Orchestoidea* Nicolet, *Megalorchestia* Brandt, and *Talitrus* Bosc. He formally proposed the new genera *Trinorchestia*, with a single northwestern Pacific species, and *Pseudorchestoidea*, consisting mainly of slender-bodied, tropical and warm-temperate species, and hinted that other species groups would be formally recognized later. Most of these undesignated species groups have, until very recently, been lumped under the name *Talorchestia* Dana. Morino and Miyamoto (1988), however, have restricted this name quite properly to a group of slender-bodied tropical Indo-Pacific species of which *T. gracilis* Dana is the type. The writer has therefore elevated the group of relatively large, stout-bodied, North American Atlantic species, also formerly assigned to the genus *Talorchestia*, to a newly proposed genus, *Americorchestia*, as described and keyed below.

KEY TO NORTH AMERICAN GENERA OF SAND-BURROWING TALITRIDAE*

1. Gnathopod 1 (both sexes), propod with distinct palm, dactyl not projecting past it in male; uropods 1 & 2, peduncles and rami weakly spinose, margins with 0-4 spines only; uropod 3 short, ramus cylindrical, tapering, apex sub-acute..... *Platorchestia* Bousfield

*Genera *Megalorchestia*, *Pseudorchestoidea*, *Platorchestia*, *Talorchestia* and *Americorchestia*, partly after Bousfield, 1982.

Gnathopod 1, palm of propod lacking in female, lacking or small and greatly surpassed by dactyl in male; uropods 1 & 2, peduncles and rami usually very strongly spinose, margins with 5-15 spines (rarely fewer); uropod 3, ramus laterally compressed, not tapering, apex rounded.....2.

2. Gnathopod 1 (both sexes), propod lacking distinct palm, but (in male) may have a small postero-distal blister greatly surpassed by the dactyl; telson usually short, wider than long, apex entire, rarely notched.....3.

Gnathopod 1 in female, palm of propod lacking, in male, with small but distinct palm, in addition to a postero-distal tumescence or blister; telson slightly longer than broad, apically notched4.

3. Pleopod rami very reduced, 1-3 segmented, shorter than basally broadened peduncles; peraeopod 5, dactyl normal in size and form; peraeopods 6 & 7 stout, heavily spinose, subequal in length*Megalorchestia* Brandt (N. Pacific coast).

Pleopod rami slightly reduced, multi-segmented (4-12 segments) peduncles slender; peraeopod 5, dactyl very shortened and basally swollen, nail minute; peraeopods 6 & 7 slender, normally spinose, P7 distinctly the longer*Pseudorchestoidea* (Central Pacific coast).

4. Body small, slender (males 11-14 mm); uropod 1, outer ramus usually lacking marginal spines; uropod 2, rami subequal, weakly spinose; uropod 3, ramus shorter than peduncle.....*Talorchestia* Dana (Caribbean shores and Indo Pacific).

Body large, robust (males 14-25 mm); uropod 1, outer ramus usually with numerous stout marginal spines; uropod 2, outer ramus distinctly the shorter, strongly spinose; uropod 3, ramus usually longer than peduncle.....*Americorchestia* (N. Atlantic and Gulf Coasts)

Americorchestia, new genus

Talorchestia Stebbing, 1906, p. 257 (partim)
Barnard, 1969, p. 472 (partim)
Bousfield, 1973, p. 162 (partim)

Component species

Americorchestia longicornis (Say, 1817) - TYPE SPECIES

A. heardi, new species
A. megalophthalma (Bate, 1862)
A. salomani, new species
A. barbarae, new species

Diagnosis

Medium to large, heavy bodied, large eyed, strongly sexually dimorphic, fossorial talitrids. Eyes usually very large, often bulging from the lateral head margins.

Antenna 1: Short, not reaching peduncle 5 of antenna 2, peduncular segment 2 not longer than 3.

Antenna 2 (male): Strongly developed, elongate, distal flagellar segments often toothed.

Buccal mass: Medium-deep, not prognathous.

Mandible: Left lacinia 5-dentate.

Maxilliped: Palp, segments 2 & 3 short, broad, spinose, segment 2 with pronounced disto-medial lobe, segment 4 lacking.

Coxa 1: Short, with inner spinose "shelf" anterior to junction with basis; coxae 2-4 medium-deep, hind marginal cusps weak.

Gnathopod 1: Strong, spinose, fossorial; propod (male) with small but distinct palm, exceeded by dactyl, postero-distal "blister" or tumescence conspicuous on propod and carpus, faint or lacking on merus; propod (female) totally lacking palm, distal segments without postero-distal tumescence.

Gnathopod 2 (male): Very strongly subchelate, powerful; palm of propod oblique, convex, or with tooth-like prominence near hinge.

Gnathopod 2 (female): Small, basis broadly expanded anteriorly; propod mitten-shaped, shorter than carpus; merus usually lacking posterior lobe.

Peraeopods 3 & 4: Dactyls slender, 4th constricted behind.

Peraeopod 5: Short; coxa broad, shallow; basis broad; segments 4, 5, and 6 subequal, 4 slightly expanded or thickened behind, 5 & 6 may have anterior marginal club-shaped spines; dactyl not shortened or modified.

Peraeopods 6 & 7: Elongate, sub-equal; bases broad, rounded behind, regular; dactyls slender, smooth.

Pleon plates 1-3: Regular, hind corners weakly acuminate.

Pleopods: Rami multi-segmented, little shortened or modified; peduncle slightly broadened, esp. basally, outer margin spinose.

Uropods 1 & 2: Stout, ramal margins strongly spinose.

Uropod 1: Pre-peduncle short, rami and peduncles subequal, outer ramus marginally spinose, ramal apical spines may be spade-shaped.

Uropod 2: Outer ramus distinctly the shorter.

Uropod 3: Ramus laterally compressed, longer than peduncle, rounded apically, margins spinose.

Telson: Short, broad, apically notched, distally spinose.

Coxal gills: Small, sac-like on P3-5, longer but sinuous on P2 and P6.

Brood plates-Medium-broad, margins with numerous simple setae.

Etymology

A combining form denoting generic endemicity to North America.

Relationships

Americorchestia differs from other genera of sandhoppers by characters provided in the generic key (below). It is clearly separable from *Talorchestia* Dana (as revised by Morino & Miyamoto 1988) in the large heavy body, short peduncular segment 2 of antenna 1, elongate dactyls of peraeopods 3 & 4, subequal peraeopods 6 & 7, spinose broadened pleopod peduncles, heavily spinose uropod rami that are markedly unequal in uropod 2, and elongate ramus of uropod 3 (longer than peduncle).

In balance of character states, *Americorchestia* appears most closely similar to *Trinorchestia* and to the "*Talorchestia*" *sinensis* group of the northwestern Pacific region. It is less closely related to other primary sandhopper genera such as *Pseudorchestoidea*, *Talorchestia*, and *Megalorchestia*. It is remote from *Talitrus*, *Orchestoidea*, and other undesigned groups that are centred mainly in the southern hemisphere, and from beachhopper groups such as *Platorchestia* that may secondarily be classified as sandhoppers (see Bousfield 1982).

KEY TO NORTH AMERICAN ATLANTIC SPECIES OF AMERICORCHESTIA*

1. Peraeopod 5, segment 6 distinctly longer than 5, with 4-6 (5) groups of anterior marginal spines, segment 4 subtriangular, widest distally; pleon plate 1, lower margin continuous with hind margin; eyes not bulging from sides of head (viewed dorsally); uropod 2, inner margin of outer ramus lacking spines; pleopod rami weak, 10-segmented *longicornis* group 2.

Peraeopod 5, segment 6 not distinctly longer (usually shorter) than segment 5; segment 4 sub-rectangular, not broadening distally; pleon plate 1 with weakly acuminate hind corner; eyes very large, prominently bulging from sides of head; uropod 2, inner margin of outer ramus usually armed with short spines; pleopods normally developed, not reduced *megalophthalma* group 3.

2. Peraeopod 5, segment 6 about 1/3 longer than 5, anterior marginal spines long, similar to those of segment 5; uropod 2, marginal spines of outer ramus very long, about twice width of ramus *A. longicornis* (Say, 1818) (fig. 7B).

Peraeopod 5, segment 6 about 1/6 longer than 5, anterior marginal spines much shorter than in segment 5; uropod 2, marginal spines of outer ramus short, not more than 1 1/2 times width of ramus *A. heardi*, new species (figs. 5, 6)

3. Peraeopod 5, segment 5 with acuminate spines; uropod 2, inner margin of outer ramus smooth; uropod 3 ramus short, broad, about 2 1/2 times width; coxa 5, posterior lobe acute below; uropod 1, marginal spines of outer ramus about twice width of ramus *A. megalophthalma* (Bate, 1862) (fig. 7A).

Peraeopod 5, segment 5 with blunt-tipped (club-shaped) anterior marginal spines; uropod 2, inner margin of outer ramus armed with a few short spines; uropod 1 marginal spines of outer ramus about equal to width of ramus; coxa 5, posterior lobe rounded below; uropod 3 ramus longer, tip less blunt, weakly armed 4.

4. Peraeopod 5, segment 6 more than 2/3 length of segment 5, anterior margin with 3 pairs of acuminate spines; uropod 2, inner margin of outer ramus with 3-4 short weak spines; uropod 3, ramus with 3-4 subapical spines only *A. barbarae*, new species (figs. 3,4)

Peraeopod 5, segment 6 less than 2/3 segment 5 anterior margin with 2 pairs of blunt-tipped (slender) spines; uropod 2, inner margin of outer ramus with 2 spines, length about half width of ramus; uropod 3, ramus with 6+ sub-apical spines *A. salomani*, new species (figs. 1, 2)

*Both sexes and larger immatures.

Americorchestia salomani, new species (Figs. 1, 2)

Talorchestia sp. - Bousfield, 1970, p. 150 (partim)

Material Examined

Panama City, Florida, open sand beach at HW level, August 6, 1938 - HOLOTYPE male, 16.0 mm., USNM NO. 161453.

The following material, ELB coll., is housed in CMN collections, Ottawa: Horn I., Miss., outer beach coarse to medium sand at HW level, March 23, 1967 - ALLOTYPE female ov., 15 mm.; *Ibid* - 12 males, 8 females; Dauphin I. outer beach, Miss., at HW, April 4, 1978 - 3 females; Gulf Shores (Florida), on steep medium coarse sand beach at HW level - 2 males, 10 females ov.; St. Andrews State Park, outer beach west of jetty at HW level, March 17, 1977 - 6 specimens (males and females)

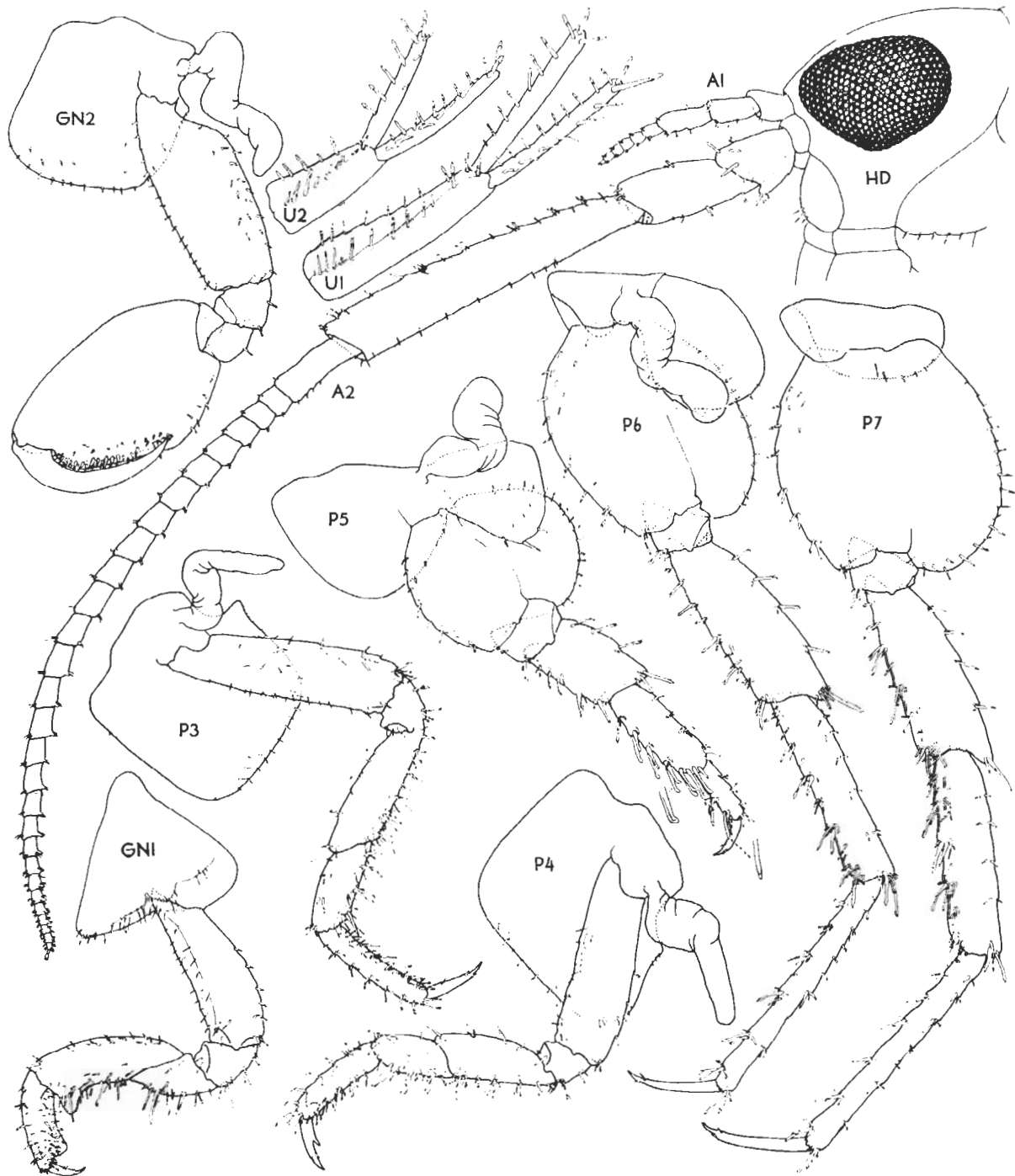


Figure 1. *Americorchestia salomani*, new species. Male, 16.0 mm. Near Panama City, Florida, August 6, 1938.

photographed); St. Andrews Bay near Alligator Pt., in sand at HW level, March 18, 1977 - 15 adult specimens; Panama City beach, in fine white surf-exposed sand at HW level, April 20, 1966 - several adult specimens; St. Joe, Florida, outer beach, in white sugar sand at HW

level, March 21, 1977 - several specimens, including mature males; Alligator Pt., Co., Florida outer sand beach at HW level, March 21, 1977 - numerous adult specimens.

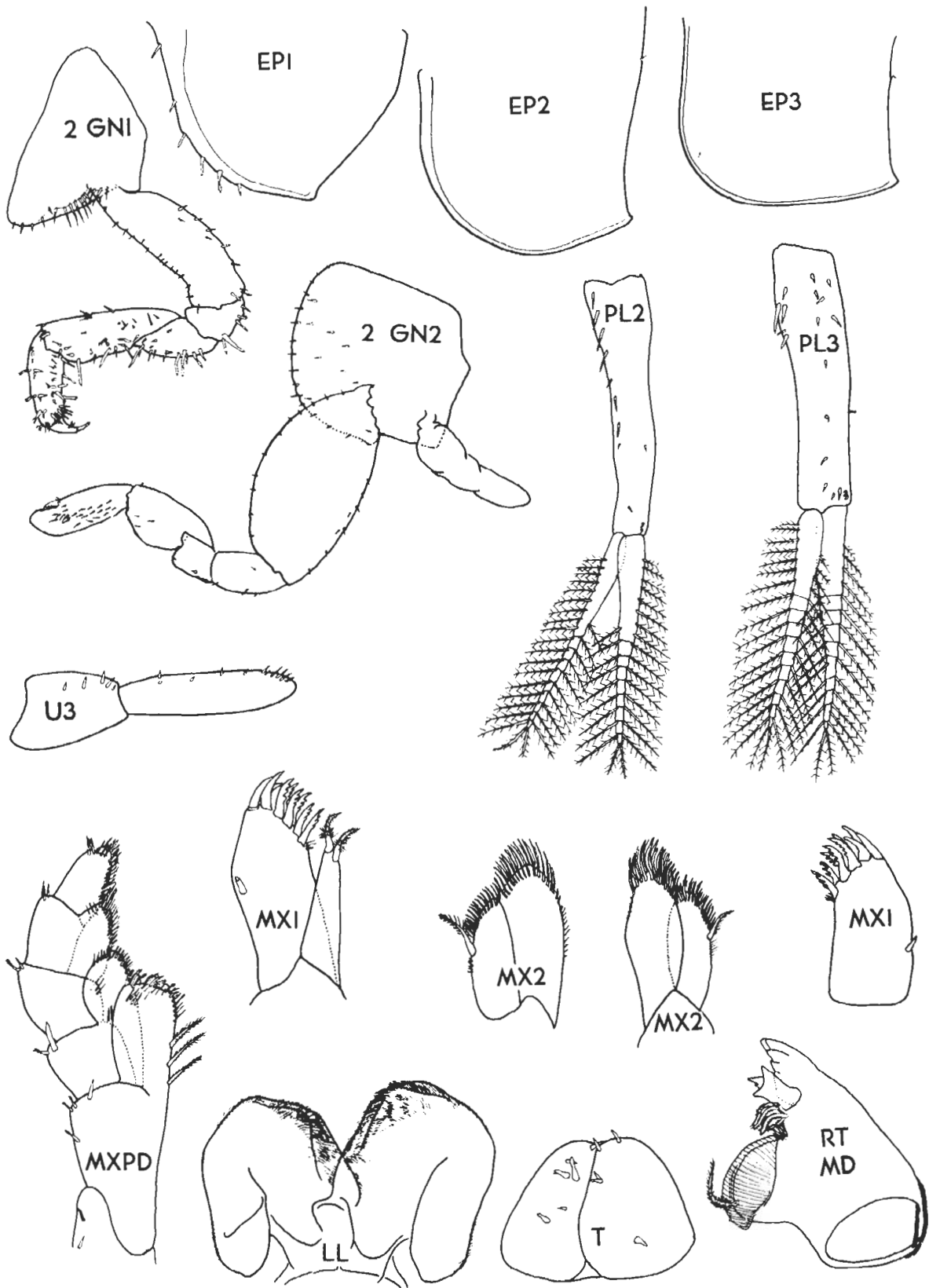


Figure 2. *Americorchestia salomani*, new species. 1. Male, 16.0 mm. Near Panama City, Florida. 2. Female, 15.0 mm. Horn Island, Miss., March 23, 1967.

Diagnosis

(Male, 16.0 mm)

A slender, medium-sized member of the *megalophthalmalma* group. Eyes very large, subrectangular, bulging laterally from head margin.

Antenna 1: Flagellum 6-segmented.

Antenna 2: Peduncle 4 distinctly less than half length of segment 5, flagellum about 28-segmented, distal segments weakly toothed.

Maxilliped: Inner plate with weak distal inner marginal setae and 3 stout medial marginal setae; segment 4 minute, vestigial.

Gnathopod 1: Palm short, vertical, tumescent lobe subacute.

Gnathopod 2: Propod slightly broadening distally, palm oblique, distinctly convex.

Peraeopod 4: Distinctly shorter than 3, segment 6 distinctly the shorter in peraeopod 4.

Peraeopod 5: Coxa wide, shallow, anterior lobe very gently rounding below; basis broader than wide, strongly

rounded behind; segment 4 broadened, subrectangular; segment 5 nearly 1/3 longer than 6, anterior margin with 5-6 groups of club-tipped spines.

Peraeopods 6 & 7: Slender, subequal in length; basis of P6 ovate, of P7 slightly broader, hind margin with numerous short spines.

Pleopod: Peduncles with single row of outer marginal spines, marginal spines short; rami closely subequal, each with 9-10 distal free segments.

Pleon plate 1: With acuminate hind corner, plate 3 virtually smooth.

Uropod 1: Rami and peduncle subequal in length, marginal spines short, about equal to width of ramus; paired apical spines with spade-shaped tips.

Uropod 2: Rami longer than peduncle, armature about as in 1, inner margin of outer ramus with 2 short spines distally.

Uropod 3: Ramus slender, about 1/3 longer than peduncle, with 5-6 slender postero-apical spines.

Telson: Narrowing to slightly notched apex, each lobe

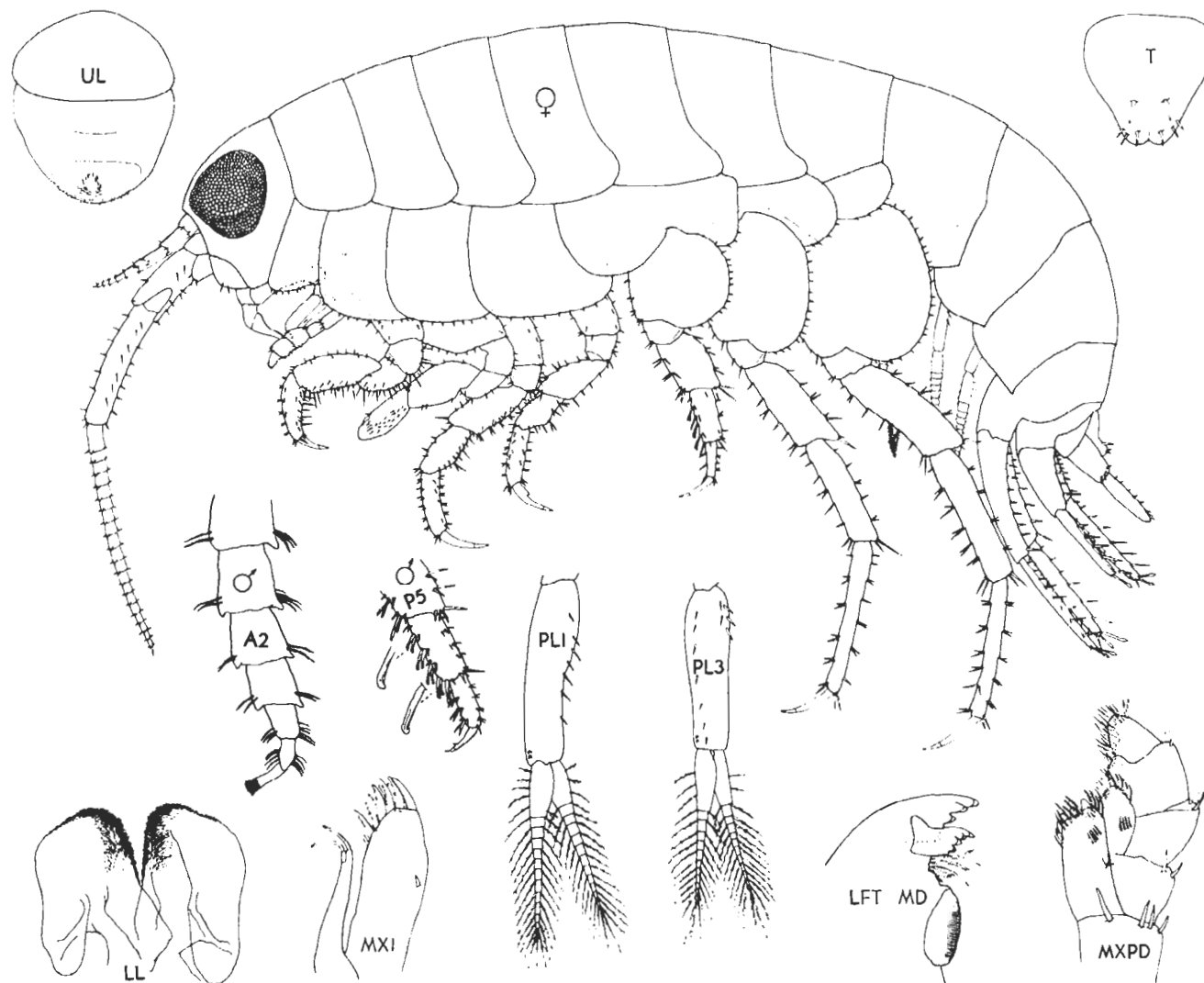


Figure 3. *Americorchestia barbarae*, new species. Female, 13.0 mm. West of Sabine Pass, Texas, March 31, 1967.

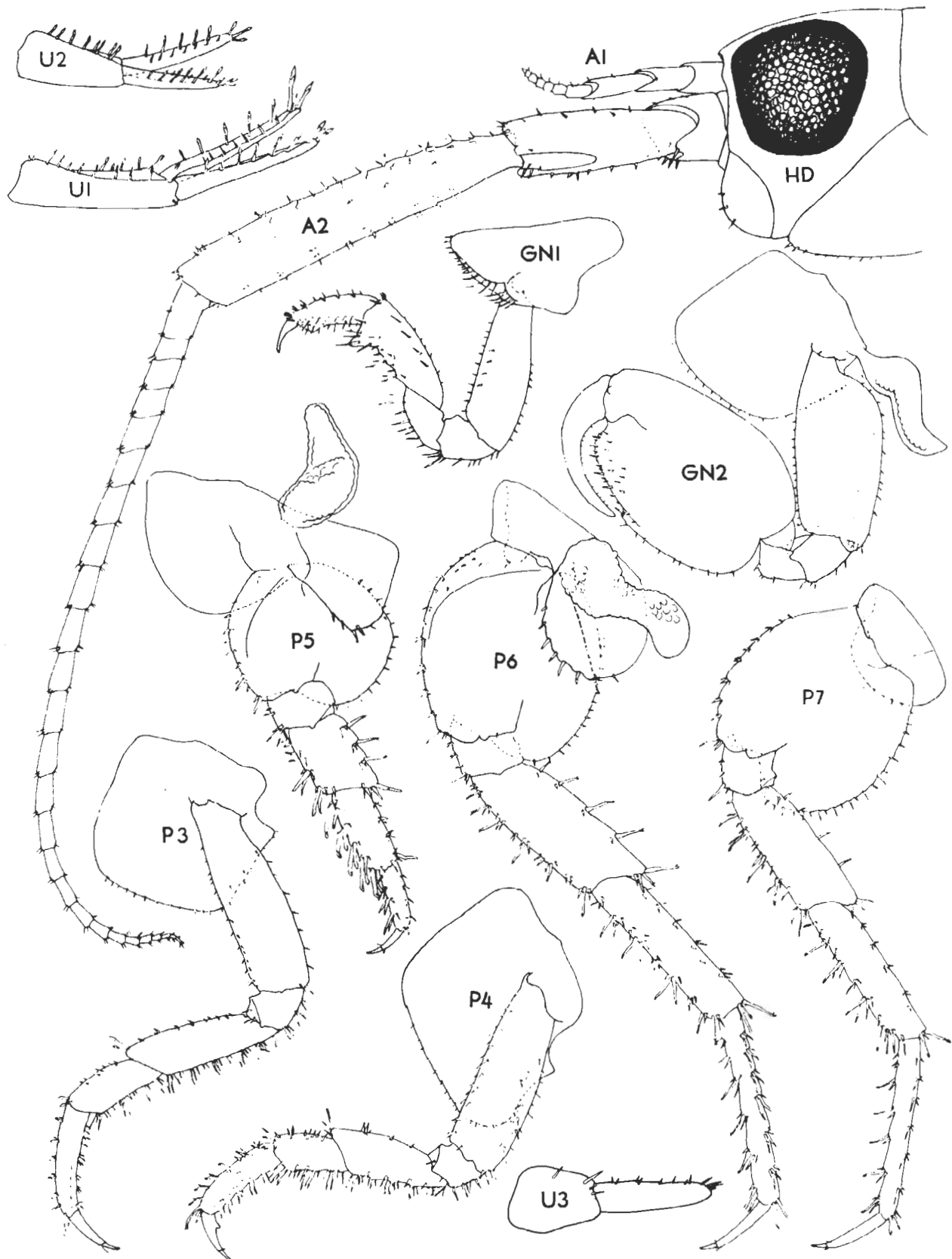


Figure 4. *Americorchestia barbarae*, new species. Male, 14.0 mm. West of Sabine Pass, Texas, March 31, 1967.

with 2 apical and 3 subapical short spines.

(Female ov., 15.0 mm)

Gnathopod 1: Carpus and propod nearly straight, not arched, propod little narrowing distally; dactyl curved.

Gnathopod 2: Basis strongly expanded anteriorly, width greater than half its length; merus slightly bulging posterodistally.

Brood plates: On pereopods 2-4 little broadened, each with 15-20 marginal simple setae.

Etymology

Named in honour of Dr. Carl H. Saloman who has pioneered studies on population biology of sand-burrowing marine and estuarine organisms in the west Florida region.

Distributional Ecology

A. salomani burrows in sand at or near the HW level of surf exposed beaches, from the Appalachicola region of western Florida to the barrier islands of the Mississippi Delta.

Americorchestia barbarae, new species
(Figs. 3, 4)

Material Examined

Sand beach about 10 miles west of Sabine Pass, Galveston Co., Texas, burrowing near HW level in somewhat silty sand, E. L. and Barbara Bousfield coll., March 31, 1967 - HOLOTYPE male, 14.0 mm., ALLOTYPE female br. II, 13.0 mm., slide mounts; *Ibid* - 1 subadult male, 6 subadult females, 1 immature female (PARATYPES), all in CMN collections, Ottawa.

Diagnosis

(male, 14.0 mm)

A relatively small and slender member of the *megalophthalma* subgroup. Eyes very large, bulging laterally, slightly narrowing below.

Antenna 1: Flagellum 7-segmented.

Antenna 2: Peduncle 4 about half length of segment 5, flagellum about 25-segmented, distal segments very weakly toothed.

Maxilliped: Inner plate with weak distomedial marginal setae, segment 4 lacking.

Gnathopod 1: Palm very short, oblique, tumescence shallow.

Gnathopod 2: Propod not broadening distally, margins subparallel, palm oblique, strongly convex.

Pereopod 4: Slightly shorter than 3, segment 6 subequal.

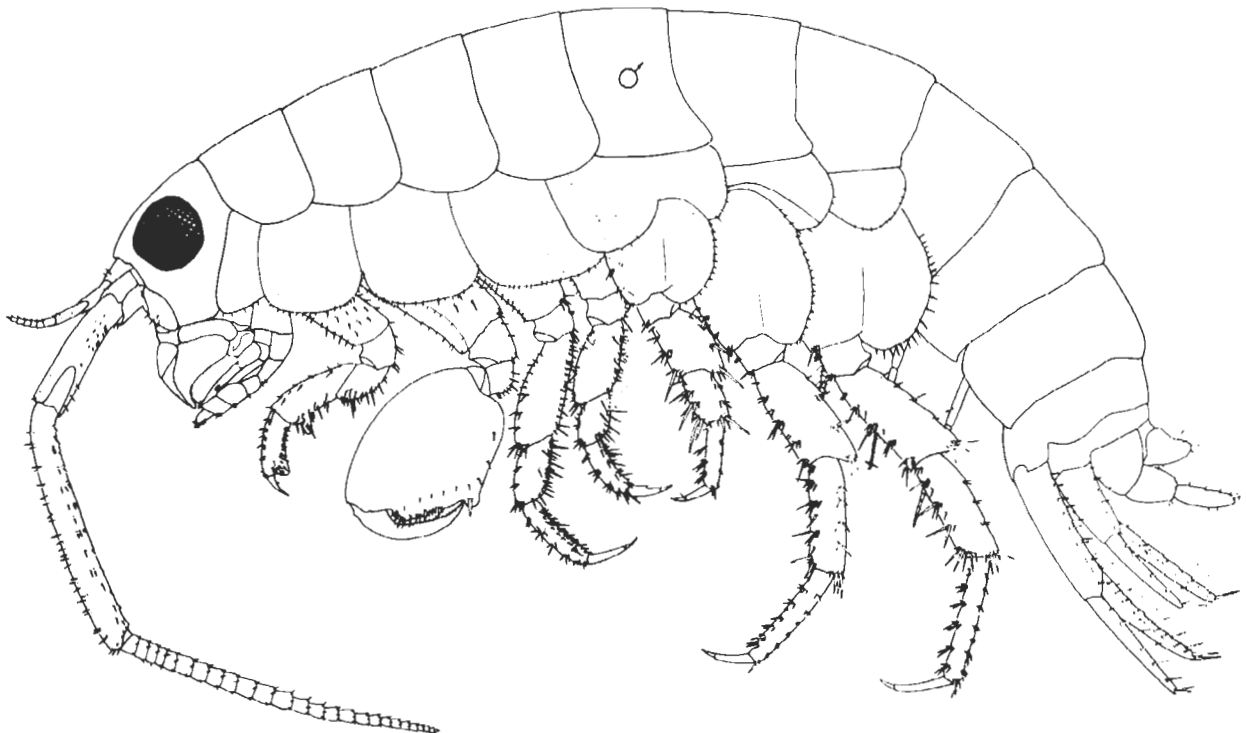


Figure 5. *Americorchestia heardi*, new species. Male, 16.0 mm. Horn Island, Miss., April 4, 1944.

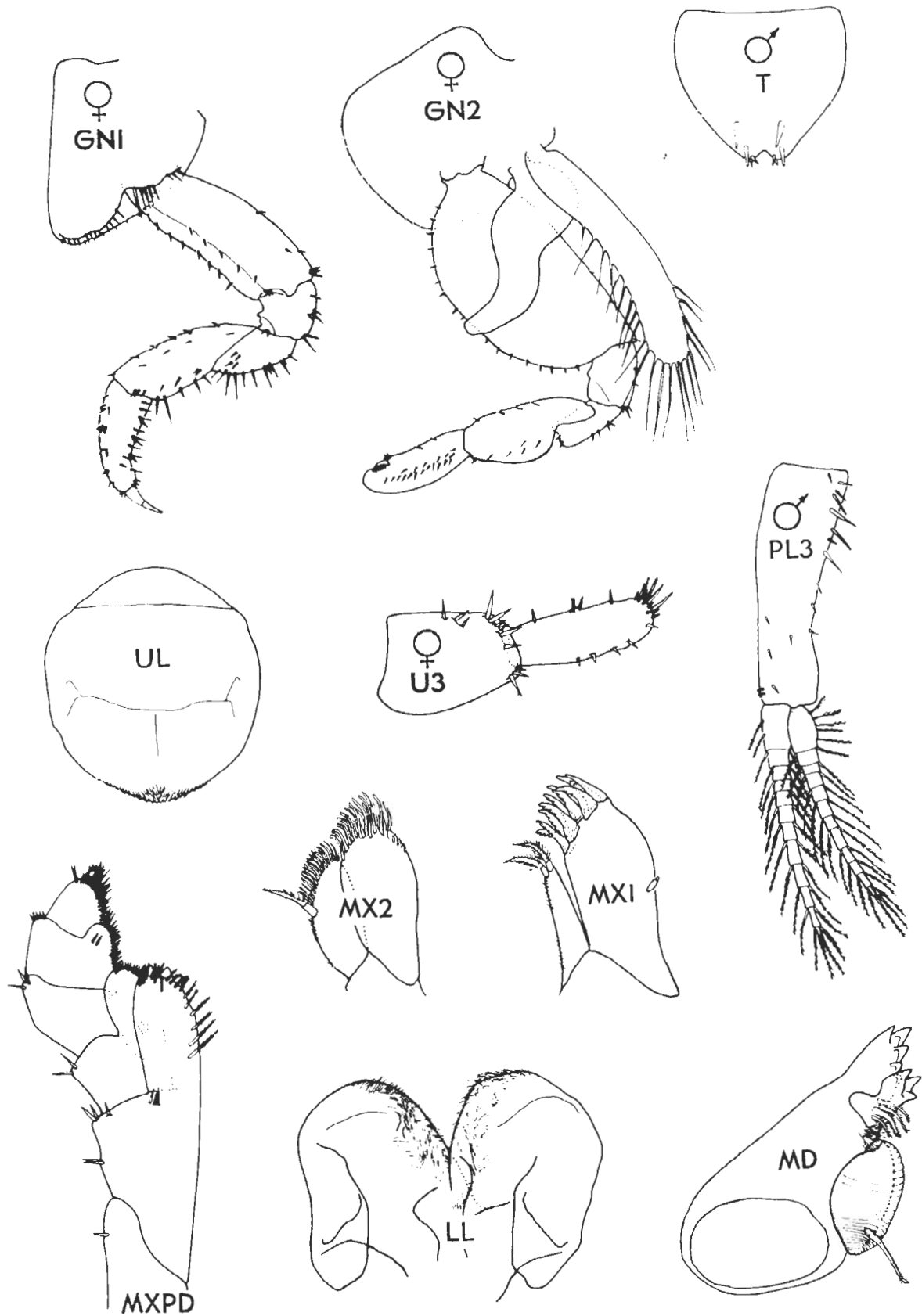


Figure 6. *Americorchestia heardi*, new species. Horn I., Miss. 1. Male, 16 mm. 2. Female ov., 12.0 mm.

Peraeopod 5: Coxa shallow distinctly wider than deep, lower margins rounded; basis smoothly rounded behind; segment 4 slightly broadened, subrectangular, distinctly longer than wide; segment 5 with 4-5 groups of anterior marginal club-spines; segment 6 slightly shorter than 5.

Peraeopods 6 & 7: Closely subequal in length; basis of P7 much broader, marginal spines minute; dactyls much longer than P5.

Pleopod: Peduncles with single row of outer marginal spines; rami subequal, each with 10-12 distal free segments.

Pleon plate 3: With 2-3 minute posterior marginal spines, hind corner acuminate.

Uropod 1: Rami longer than peduncle, marginal spines short, about equal to width of ramus: paired apical spines with spade-shaped tips.

Uropod 2: Rami longer than peduncle, armature similar, but slightly stronger than in uropod 1, inner margin of outer ramus with 3-4 short spines.

Uropod 3: Ramus slender, about 25% longer than peduncle, posterior margin weakly spinose, with 3-4 subapical spines only.

Telson: Narrowing to slightly notched apex, each lobe with 3 apical, and 1 stronger dorsal subapical, spines.

(Female, 13.0 mm)

Antenna 1: Slightly exceeding peduncle 4 of A2.

Antenna 2: Peduncle 4 more than half length of peduncle 5, flagellum 18-20 segmented, distal segments not toothed.

Gnathopod 1: Propod slightly arched, narrowing distally, dactyl nearly straight.

Gnathopod 2: Basis moderately expanded in front, width about half its length; merus lacking any trace of postero-distal lobe.

Brood plates: Not developed.

Etymology

Named in honour of my late wife, Barbara Bousfield, whose help was vital to the success of our field expeditions to the southeastern and Gulf coasts of the United States.

Distributional Ecology

Known only from the type locality, west of the Mississippi delta, but probably occurring along the entire Gulf coast of Texas. The entrance to the burrow is oval-shaped, similar to that of some species of *Megalorchestia*.

Taxonomic Commentary

The spade-shaped apical spines of uropods 1 and 2

resemble those of the American Pacific genus *Pseudorchestoidea*.

Americorchestia heardi, new species (Figs. 5, 6)

Talorchestia sp. - Bousfield, 1970, p. 150 (partim)

Material Examined

Horn Island., Miss., opp. old U.S. Army Biological Station, in sand at HW level, April 20, 1944 - HOLOTYPE male 16.0 mm, ALLOTYPE female ov. 12.0 mm. USNM No. 222855.

Little Deer I., west end, medium fine sand at HW level, ELB coll., March 23, 1967 - 2 females ov., CMN coll.; Ibid, April 10, 1978 - 2 males, 1 female. CMN collections; Belle Fontaine Beach, Miss., HW sand above muddy sand flats, ELB coll., March 24, 1967 - several specimens including males; Pensacola Point, at Fair Pt. in sand at HW level, ELB coll., March 23, 1977 - numerous adults, including males. Cedar Key, Florida, public beach, in sand at HW level, ELB coll., April 16, 1966 - many females and immatures but no adult males.

Diagnosis

(male, 16.0 mm)

A relatively small member of the longicornis group. Eyes medium large, subrotund, not bulging laterally from head margin.

Antenna 1: Flagellum 7-segmented.

Antenna 2: Peduncle slightly incrassate, longer than flagellum, peduncular segment 4 about half length of segment 5; flagellum about 25-segmented, distal segments very weakly toothed.

Maxilliped: Inner plate with 6+ stout inner marginal plumose setae; segment 4 lacking.

Gnathopod 1: Propod slightly curved, palm vertical, tumescence prominent, sharply rounded, dactyl slightly exceeding palm.

Gnathopod 2: Propod slightly broadening distally, palm oblique, irregular, with low prominence near hinge, and rounded process and single stout spine at postero-distal angle.

Peraeopod 4: Segments 4 & 5 distinctly smaller than in peraeopod 3.

Peraeopod 5: Anterior coxal lobe medium deep, broadly rounded below; basis broad, smoothly rounded behind; segment 4 broadening distally; segment distinctly shorter than 6, with 3-4 groups of simple, stout, anterior marginal spines; dactyl strong, simple.

Peraeopods 6 & 7: Strong, subequal, distal segments not elongate; basis of 6 ovate, of 7 broad, with subacute posterior proximal corner, hind margin with numerous medium spines.

Pleopods: Slightly reduced in size; peduncles broad-

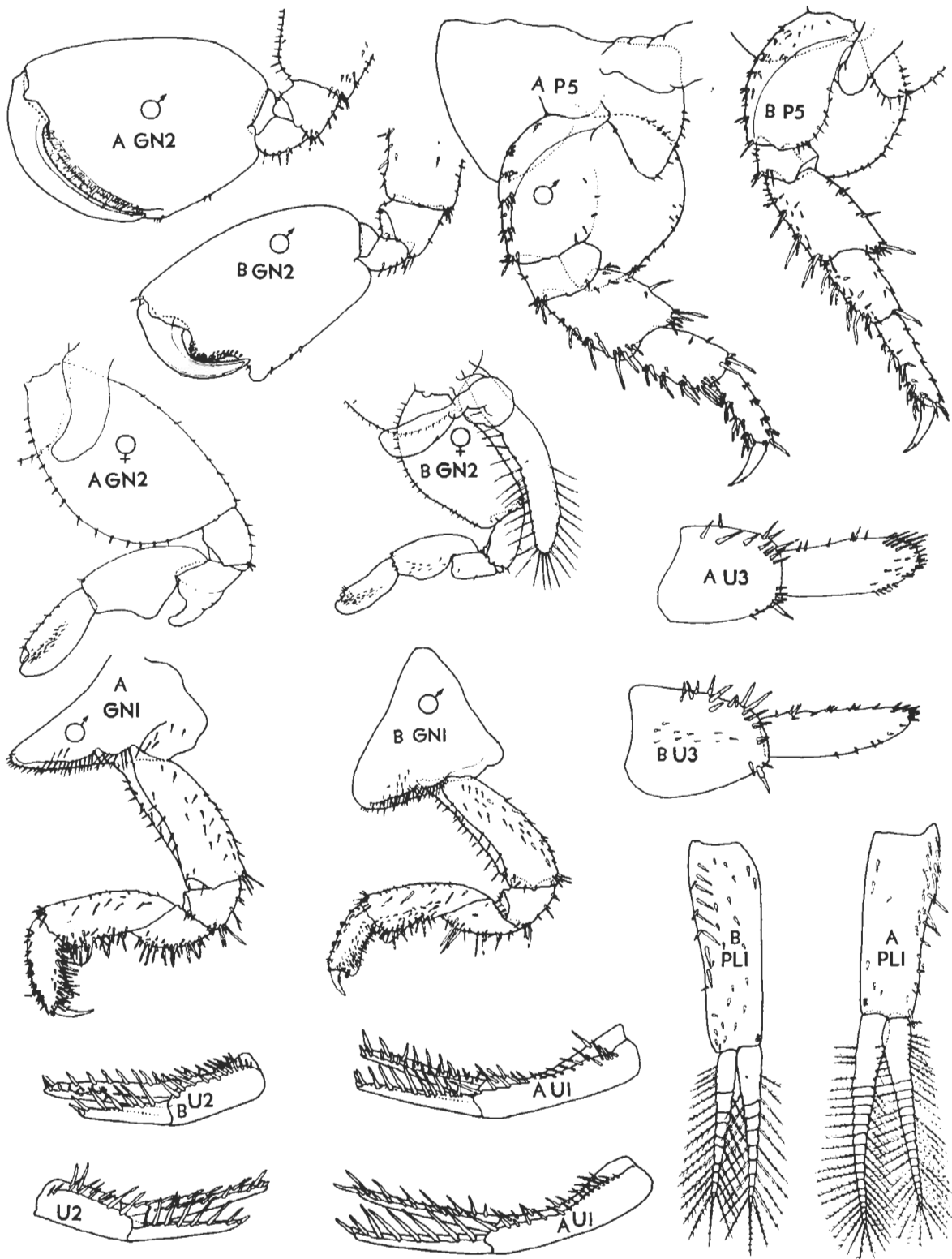


Figure 7. A. *Americorchestia megalophthalma* (Bate) Lockeport Beach, N.S. Male, 22.0 mm., Female, 18.0 mm.
 B. *Americorchestia longicornis* (Say). Langan Beach, N.S. Male, 23.0 mm., Female ov., 20 mm.

ened proximally, outer margin proximally with diverse slender spines; rami subequal, each with 10-11 segments, basal segment short.

Pleon plate 3: Smooth behind, hind corner acuminate.

Uropod 1: Rami slightly shorter than peduncle, apical spines simple, outer marginal spines of outer ramus medium strong, longer than width of ramus.

Uropod 2: Rami much longer than peduncle, inner margin of outer ramus lacking spines, outer marginal and terminal spines simple.

Uropod 3: Ramus slightly longer than peduncle, upper and lower margins spinose, apex with stout spines.

Telson: Short, narrowing to notched apex, each lobe with minute apical spines and 2 subapical dorsal spines.

(Female ov., 12.0 mm)

Gnathopod 1: Propod curved, narrowing distally; dactyl short, slightly curved.

Gnathopod 2: Basis evenly broadened in front, width slightly more than half its length; merus slightly tumescent postero-distally.

Brood plates: On pereopods 2-4 little broadened, margins distally lined with about 20 simple setae.

Etymology

Named in honour of Dr. Richard W. Heard, whose contributions to the systematics, ecology, and parasitology of Gulf coast crustaceans have been outstanding.

Distributional Ecology

Burrowing at HW drift line of surf-protected sand beaches, in somewhat lowered salinities, from western Florida to Louisiana, east of the Mississippi Delta.

Distributional - Ecological Commentary

Basic information on the distributional ecology and life histories of Talitridae, including sandhoppers, has been summarized by Wildish (1988). The Florida "thumb", marked by non-terrestrial (coralline) sand beaches, and subtropical marine temperatures, poses a significant post-Pleistocene biogeographic "barrier" to populations of igneous sand-burrowing temperate-zone amphipod groups such as haustoriids and sandhoppers (Bousfield, 1970). Thus the northern big-eyed sandhopper, *A. megalophthalma*, is dominant on surf-exposed sand beaches of Atlantic Canada to southern New England (less commonly southward to Georgia (Bousfield, 1973). This species (Fig. 7A) has a large, powerfully fossorial body that can burrow deeply (>60 cm.), and also presumably more easily handle larger food items. Sandhoppers feed, mainly nocturnally, directly on wavecast wrack that consists primarily of dead plant material. The beach wrack on northern surf-exposed beaches is composed mainly of large fucoid algae (*Ascophyllum*), kelp (*Laminaria*) and some *Chondrus*. Summers are relatively short and cool but winters are severe, usually ac-

compained by heavy shore icing and deeply penetrating frost action in the upper berm. The berm may also be heavily denuded of sand by winter storms.

Along the Gulf coast, the eastern Gulf sandhopper, *A. salomani*, is regionally endemic and separated by the Mississippi delta from its taxonomic and ecological counterpart, the western Gulf sandhopper, *A. barbarae*. Both species have smaller, less powerful, but more agile bodies than *A. megalophthalma*. Their food supply is more limited since the sea wrack of open Gulf beaches consists mainly of turtle grass (*Thalassia*) and small algae (*Sargassum*, etc), seldom in large quantities. On Gulf beaches, rapid saltation away from nocturnal predators such as the ghost crab (*Ocypode*) that does not occur north of Cape Cod, may be a more important survival factor than deep-burrowing ability. Moreover, relatively shallow burrowing by the desiccation-prone sandhoppers is presumably sufficient to avoid the effects of both light winter frosts, on the one hand, and, on the other, the lethally high daytime summer surface temperatures that characterize sand beach microclimates in the Gulf region. Also, except for the effects of sporadic hurricanes, wave-denudation of the berm sand along Gulf beaches is presumably less severe year-round than it is along the open North Atlantic coast.

Similarly in the *longicornis* group, the common Atlantic sandhopper, *A. longicornis* (Fig. 7B), occurs on outer beaches (with *A. megalophthalma*), but is dominant on inner protected beaches, from the Gulf of St. Lawrence to northern Florida (Bousfield, 1973). It is common on estuarine beaches, in summer salinities as low as 3‰ and tends to hide under logs and other objects and burrow less deeply than does *A. megalophthalma* (see Bousfield, 1958). In these habitats, it may subsist on dead eel grass (*Zostera*), *Sargassum*, and organic material of terrestrial origin. Its complementary species, the common Gulf sandhopper, *A. heardi*, is endemic to protected sand beaches east of the Mississippi Delta. A counterpart species might occur on protected beaches or in lagoons west of the Delta, especially along the coasts of southwestern Louisiana and southeastern Texas, but has not yet been found.

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ABBREVIATIONS FOR FIGURES

| | | |
|-------------------------------|--------------------|----------------------|
| A1-2 - antennae 1-2 | RT - right | MD - mandible |
| EP1-3 - pleon side plates 1-3 | T - telson | MX1 - maxilla 1 |
| LFT - left | UL - upper lip | MX2 - maxilla 2 |
| GN1-2 - gnathopods 1-2 | U1-3 - uropods 1-3 | MXPD - maxilliped |
| HD - head | ♂ - male | P1 - pereopods 1-7 |
| LL - lower lip | ♀ - female | PL1-3 - pleopods 1-2 |

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