

## TWO NEW SPECIES OF *LABIDOCERA* (COPEPODA, CALANOIDA) FROM THE WESTERN TROPICAL NORTH ATLANTIC REGION

*A. Fleminger and E. Moore*

### ABSTRACT

Two new species of Pontellidae assignable to the *Labidocera jollae* species group, a uniquely American radiation of coastal planktonic copepods, are described. The new species originate from Barbados (*L. barbadiensis*) and the Caribbean coast off Panama (*L. panamae*). They are most similar to the Bahamian congener, *wilsoni*. Of the nine confirmed species of *Labidocera* now known from the western tropical Atlantic *wilsoni*, *mirabilis* (southern Florida and the Florida Keys) and the two new species comprise an American east coast lineage related to and apparently derived from the American west coast lineage of the *jollae* group.

The tropical west Atlantic lineage provides an excellent subject for intensive comparative analysis of planktonic speciation and character divergence. The species occupy a geographical region for which recent geological chronology is reasonably well established. The four species show close phylogenetic relationship, as evidenced by uniformity in morphology and habitat, and, with adequate sampling, geographical relationships may be defined with an unusually high level of precision. However, the distribution and density of this group is at present based on localized and scattered zooplankton sampling of coastal waters within the region. To utilize this promising opportunity to examine evolution in marine zooplankton widespread systematic sampling of coastal zooplankton in the Caribbean region is required and advocated.

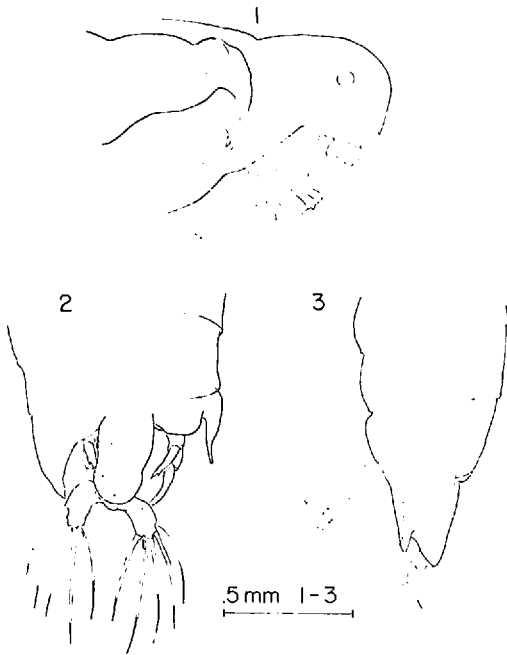
Species of the genus *Labidocera*, family Pontellidae, are prominent constituents of coastal water zooplankton in lower latitudes of the World's Oceans. They are common and often abundant, relatively large in size, tend to be pigmented at least ventrally in soft hues of blue or aqua and are also characterized by a distinctive pair of spherical lenses overlying the dorsal cephalic eyes.

Their role in the planktonic ecosystem is not widely appreciated. Evidence from a number of published and unpublished observations show them to be typically the largest sized omnivorous copepods in tropical coastal plankton communities where they are found day and night in the surface layer usually beneath the neuston to a depth of about 10 to 15 m. They are opportunistic generalists with respect to feeding, showing the ability to filter a wide variety of particle sizes (Barnett, 1974) as well as raptorially capture prey (Lillelund and Lasker, 1971).

In this paper we are describing two new species of *Labidocera* to be added to the

known planktonic fauna of the Caribbean region. The existence of the new species is surprising in view of the considerable diversity of *Labidocera* already known from American tropical marine waters (Fleminger, 1975). To provide biogeographical perspective the *Labidocera taxocene* found in the western tropical North Atlantic region is reviewed briefly, and description of the new species follows thereafter.

Seven species of *Labidocera* occur in various geographical or ecological segments of the Caribbean Sea and adjacent areas connected by the prevailing tropical currents (Björnberg, 1963, 1972; Bowman, 1971; Calef and Grice, 1967; Coker and González, 1960; de la Cruz, 1966; Fleminger, 1957, 1975; Fleminger and Tan, 1966; Grice, 1960; Legaré, 1964; Owre and Foyo, 1964, 1967, 1972; Suárez-Caabro, 1959; Wickstead, 1956; Wilson, 1942, 1950; Woodmansee, 1958). Two, *L. acutifrons* (Dana) and *L. nerii* Kröyer, are essentially oceanic warm water forms that span the Atlantic



Figures 1-3. *L. barbadiensis*: 1, forehead, right lateral, ♀ to right, ♂ to left; 2, ♀ Th V and urosome, dorsal; 3, ♀ Th V and urosome, left lateral.

Ocean (Weikert, 1975). The other five occupy coastal waters. Four, namely *L. fluviatilis* Dahl, *L. mirabilis* Fleminger, *L. scotti* Giesbrecht and *L. wilsoni* Fleminger and Tan, occur along tropical coastlines, while the fifth, *L. aestiva* Wheeler, has a temperate distribution.

Four other species are purported to have been observed in or near the Caribbean Sea. However, general knowledge of the distribution and probable habitat requirements of the species raise doubts as to the accuracy of these identifications. Pending verifiable discoveries confirming their presence in the region they should not be grouped with the copepod taxocene of the western tropical North Atlantic. The questionable records include a neritic Indo-Pacific species, *L. acuta* reported (Björnberg, 1965) from a collection taken off the tropical Brazilian coast. This unique record may be a typographical error, having been cited inadvertently when the author intended

to list *acutifrons*; *acutifrons* is ubiquitous throughout the region considered by Björnberg (1965) but is notably absent from her 1965 list of species. Suárez-Caabro (1959) recorded *L. brunescens* Czerniavsky and *L. wollastoni* (Lubbock) from the vicinity of the Isle of Pines off the south coast of Cuba; both species are typically restricted to temperate coastal waters off North Africa and Europe. Wilson (1942, 1950) also reported *wollastoni* as well as the Indo-Pacific tropical oceanic species, *L. detruncata* (Dana) from Caribbean Sea localities. These determinations by Wilson have been discussed and questioned by Fleminger (1965) who also pointed out that *L. agilis* (Dana), another species listed by Wilson (1950) from the Caribbean, is referable to *acutifrons*.

The two new species share numerous morphological similarities with the Bahamian species, *wilsoni*, and to a somewhat lesser degree with its Floridian cognate, *mirabilis*. These four species in turn may be shown to relate most closely to a parallel lineage occupying the western North American coast (Fleminger, 1967); the two lineages comprise the two known branches of the jollae species group. Biogeographical and morphological evidence favors the proposition that the diversity of the jollae group accumulated from speciation episodes which were confined to coastal water zones of the Americas and that the east coast lineage was derived from the west coast lineage.

Geographical distribution and divergence of diagnostic characters in *Labidocera* (Fleminger, 1975 and present data) suggest the radiation of the eastern American branch has a Pleistocene history though not necessarily a simple one. Disclosure of the details requires widespread sampling of coastal plankton throughout the western tropical North Atlantic. The results should yield a rich microcosm of diversity within a planktonic genus, a situation ideally suited for intensive comparative study of planktonic marine biogeography and speciation relative to environment, circulation and geological history.

***Labidocera barbadiensis* new species**  
(Figs. 1–24)

*Material*.—Adults: 27 ♀♀, 25 ♂♂; juveniles: 5 ♂♂ st. V cop., 1 ♀ st. V cop., 15 st. IV cop., 5 st. III cop. Collected off the west coast of Barbados at about lat. 13°11'N, long. 59°39'W by means of a 1/2 m plankton net towed at 0 to 5 m between 0900 and 1000 hrs on the following dates: 1.12.71, 13.1.72, 1.8.74, 29.8.74, 26.10.74, 30.1.75, 4.4.75, 16.10.75, 20.10.75, 23.10.75, 27.10.75, 1.11.75, 5.11.75, 13.11.75, 14.11.75, and after sunset on 2.11.72, 2.12.72, 3.1.73, 23.1.73, and 4.11.73.

*Measurements*.—Following procedures and nomenclature of Fleminger (1967)

	Total Length, mm		s.d.	No.	Prosome-Urosome Length Ratio	
	Mean	Range			med.	range
Adult ♀	2.893	2.81–3.15	.0708	23	4.3:1	4.0–5.1:1
♂	2.837	2.68–3.03	.0750	24	5.9:1	5.3–6.1:1
St. V cop. ♀	2.37			1	5.1:1	
♂	2.259	2.12–2.32	.0718	5	5.2:1	4.8–5.4:1

*Description*.—With characters of genus; closely resembling *wilsoni* in habitus of cephalon (Fig. 1), in segmentation, setation and spination of swimming legs (P1–4), in mensural characteristics and in dentition of mandibular gnathobase. Distinguished from *wilsoni* by a suite of differences in sexually modified structures.

**ADULT FEMALE.** Body segments Th IV and V fused dorsally but articulating laterally and ventrally. Th V corners strongly asymmetrical (Fig. 2), left side more robust and uniformly conical (Fig. 3) extending posteriad to distal end of genital segment, apex pointed; right Th V corner slender, strongly pinched off from thoracic segment and weakly sinusoidal in dorsal view (Figs. 2, 4).

Genital segment elongate and cylindrical, devoid of knobs or pronounced swellings (Figs. 2–4). Genital pore asymmetrically located in anterior half on left ventrolateral side of segment (Fig. 5).

Furcal rami weakly asymmetrical, left ramus larger with proximal end enlarged laterally; maximum width of furca exceeding that of genital segment (Figs. 2–4); opposite

proportions prevail in *wilsoni* and in new species, *panamae*, described below.

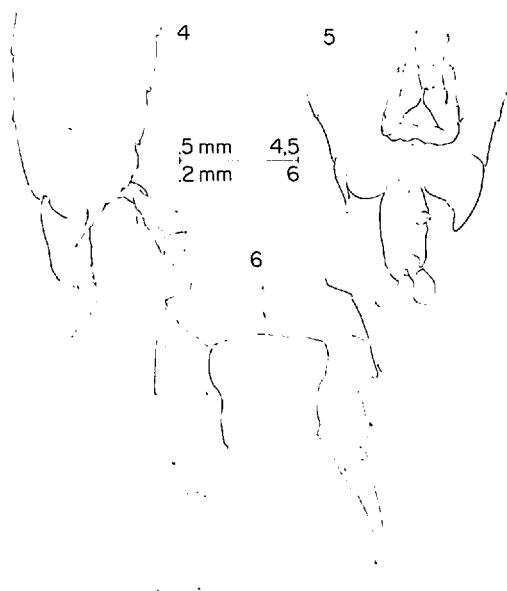
P5 similar to that of *wilsoni* but exopods usually with lateral prong in addition to two dissimilar distal prongs (Fig. 6); endopods relatively symmetrical and with distal end curving mediad.

Spermatophore (Fig. 7) cemented to dorsal side of genital segment (Figs. 8–10); arms of coupler extending ventrad but more

extensively on right side and embracing genital segment on both sides; coupler extending dorso-antieriad over cephalothorax in a robust lanciform process with triangular cross section (Fig. 8); margins of process may appear variably frayed. Sperm chamber, also referred to as the spermatophore sac by Fleminger (1967), ventral to right furcal ramus and extending posteriad; neck of sac crossing under furca and terminating in vicinity of genital pore, latter partially obscured by a process from the coupler (Fig. 10).

**ADULT MALE.** Th V corners rounded (Figs. 11, 12); right corner in *wilsoni* pointed. Right first antenna (Fig. 13) with anterior process extending from segment 17 exceeding anterior-posterior length of segment omitting anterior process; fused segments 19–21 longer than segment 18; teeth on segments 18 and 19–21 few and irregularly spaced; distal lobe on segment 19–21 protruding anteriad; segment 22 with spur extending distally; spur longer than combined lengths of more distal segments.

P2 with lateral spine on second segment



Figures 4-6. *L. barbadiensis* ♀: 4, Th V and urosome, right lateral; 5, Th V and urosome, ventral; 6, P5, posterior.

of right exopod (Re2) greatly elongated and tubular as in *wilsoni* but curving laterally in an arc of about 90° (Fig. 14), more than twice the curvature of that in *wilsoni*. Right P3 with lateral spine of Re2 enlarged (Fig. 15). Right P4 with spines of both Re1 and Re2 truncated and flaring at distal end (Fig. 16), in *wilsoni* lateral spine of Re2 typically spiniform.

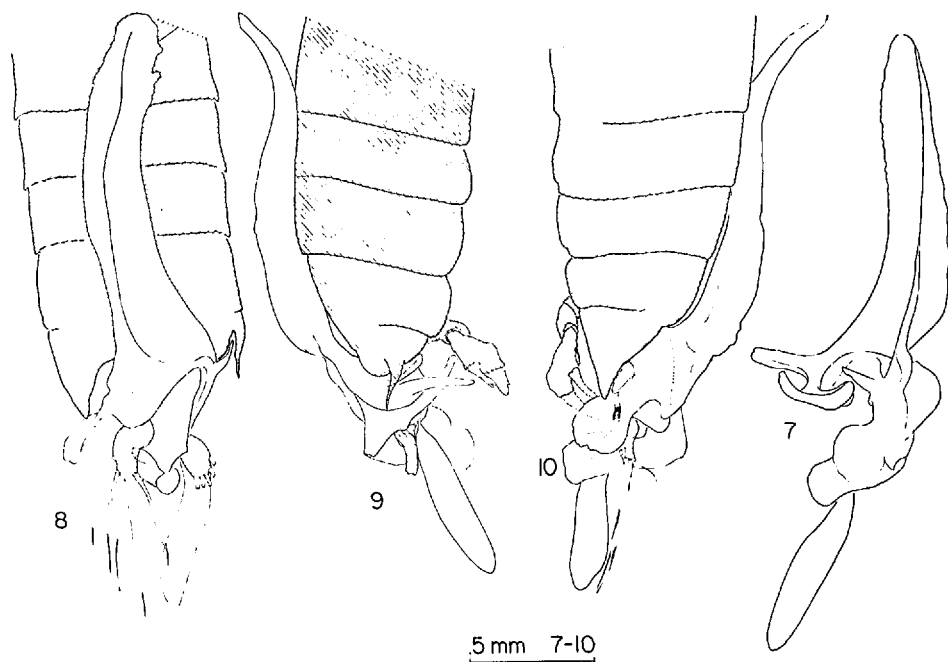
P5 (Fig. 17) with length of left and right members proportionally similar to those of *wilsoni* as shown by Fleminger (1975). Chela on right P5 with proximal end of proximal segment bearing two opposing processes which together form a crotch that receives distal end of opposing, movable, distal segment when adducted to proximal segment to close chela; proximal segment with small lobe near base of crotch; *wilsoni* with similar lobe but with only one proximal process; one more distal scimitar-like process found on proximal segment in *wilsoni* lacking in new species. As in other *Labidocera* coxa of

right leg (B1) elongated, left B1 short, left and right B1 partially fused medially and articulating in common with sternum of thoracic segment above. Basis (B2) bearing a seta proximally on posterior side; right B2 elongate, longer than left B2, latter strongly expanded medially, segment triangular in posterior view (Fig. 17). Proximal segment of left exopod more strongly curved than in *wilsoni* with curvature beginning in proximal half of segment; in *wilsoni* weak bend in left exopod limited to distal half of segment; distal segment of left leg with prominent tumid thumb-like process set off distally on medial side; in *wilsoni* similar process located on lateral side distal to three small spines common to both species; posterior face of distal exopodal segment of left P5 with a band of fine hairs reaching distal end of lateral process opposing thumb-like process.

Stage V copepodid ♂. Right first antenna, P5 length relative to urosome and right Th V corner (Fig. 20) like those of *wilsoni* but differing from those of *mirabilis* (cf. Fleminger and Tan, 1966, Fig. 3). Left P5 (Fig. 21) with four prongs; prong located between larger proximal prong and distal pair in *barbadiensis* lacking in *wilsoni*.

Stage V copepodid ♀. Resembling that of *wilsoni* generally in habitus but Th V corners longer, extending posteriad to cover about two-thirds of genital segment length and strongly curved mediad in dorsal view (Figs. 22, 23); P5 (Fig. 24) as in *wilsoni* but apex of right endopod not curving mediad.

*Remarks.*—The female P5 in this species and in its three sister species, *wilsoni*, *mirabilis* and the new species, *panamae*, described below differ markedly from all other known *Labidocera*. The exopod is shorter than the endopod, while the B2 is unusually wide and projecting anteriad in lateral view. The endopods are paddle-like and curve mediad, right and left endopods together assuming the form of a ring clamp that could function to clasp a circular or cylindrical object such



Figures 7-10. *L. barbadiensis*: 7, spermatophore, left ventro-lateral; 8, ♀ (incomplete and shaded) with spermatophore, dorsal; 9, ♀ (incomplete and shaded) with spermatophore, right lateral; 10, ♀ (incomplete and shaded) with spermatophore, left lateral.

as a spermatophore or the male urosome during mating.

Sexually mature individuals of *barbadiensis* are readily separable from their congeners. Females are distinguished by their Th V corners and urosome. Males are relatable to the Caribbean branch of the jollae group by the morphology of their geniculated right first antenna and differ from their sister species in both the left and right P5.

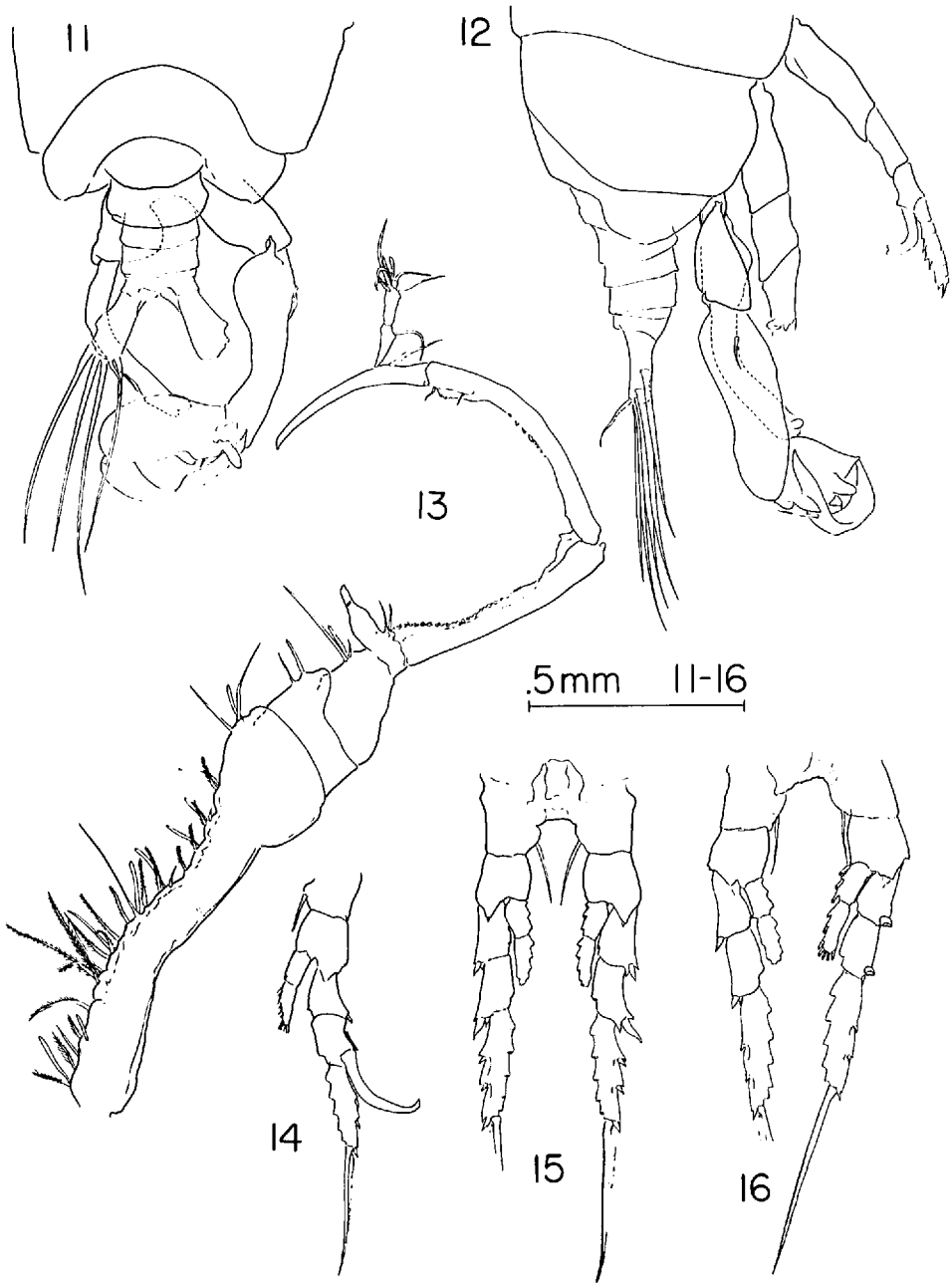
The species is named for its habitation, the coastal waters of Barbados.

*Types*.—Types have been deposited with the United States National Museum, Smithsonian Institution, Washington, D.C. Female, holotype, USNM, cat. no. 156228. Male, allotype, USNM, cat. no. 156229, reference specimen, USNM, cat. no. 156230. Reference specimens have been deposited

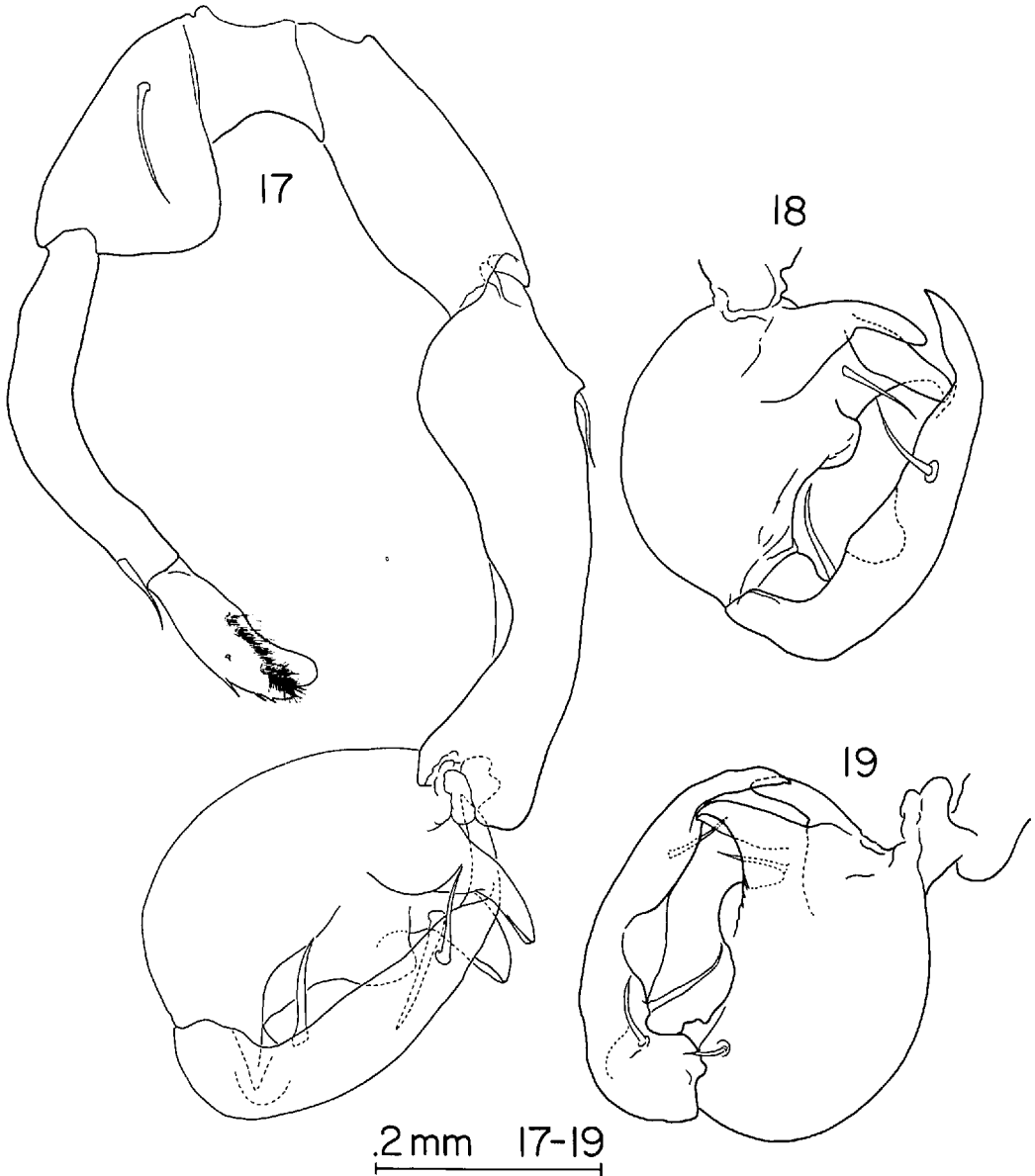
with the Bellairs Research Institute of McGill University, St. James, Barbados.

*Natural History*.—In the course of obtaining specimens for this study, *Labidocera* were found in 46 zooplankton samples; in most cases the entire sample was sorted. The samples were collected between 1971 and 1975 at the coastal station about 450 m off the west coast of Barbados (lat. 13°11'N, long. 59°39'W) monitored by The Bellairs Research Institute.

The new species appeared in twenty samples, *L. nerii* in 31; only five of the samples contained both species. The independent occurrence of the two species ( $\chi^2 = 29.09$ , 1df,  $p < .005$ ) attests to their mutually exclusive habitats. *L. nerii* has an oceanic distribution, being most common in the near surface layer of the tropical Atlantic and ad-



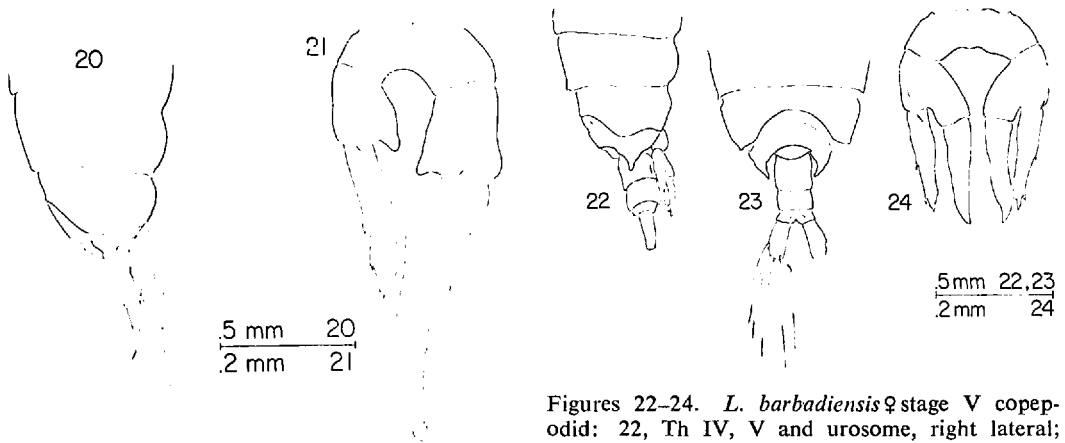
Figures 11-16. *L. barbadiensis* ♂: 11, Th V and urosome, dorsal; 12, Th V and urosome, right lateral; 13, right first antenna, dorsal; 14, right P2, setae omitted, posterior; 15, P3, setae omitted, posterior; 16, P4, setae omitted, posterior.



Figures 17-19. *L. barbadiensis* ♂: 17, P5, posterior; 18, P5 chela, posterior, another specimen; 19, P5 chela, anterior, another specimen.

jaçant seas (Fleminger 1957, Weikert 1975). Thus the presence of *nerii* at this coastal station may represent intrusions of offshore water with or without mixing with Barbadian

coastal waters. The new species belongs to an obligate coastal lineage (Fleminger, 1975). It is known only from Barbados where it appears in the near-surface layer



Figures 20–21. *L. barbadiensis* ♂ stage V copepodid: 20, Th V, urosome and P5, right lateral; 21, P5, posterior.

over shallow banks on the lee side of the island in conditions resembling those at which its cognates have been found, *L. wilsoni* in the Bahamas Islands and *L. mirabilis* off southern Florida and the Florida Keys.

*Labidocera panamae* new species  
(Figs. 25–30)

**Material.**—1 adult ♀ collected in coastal water off Colon, Panama (lat. 09°27'N, long. 79°47'W, La Creuse Expedition, sta. 13) Apr. 24, 1962, 1955–2010 hrs., in a horizontal tow taken between 0–5 m with a 1/2 m net.

**Measurements.**—Total length, 2.56 mm; Prosome-Urosome Length Ratio 5.2:1.

**Description.**—Adult female resembles *wilsoni*, *mirabilis* and *barbadiensis* in body size and proportions, in appearance of cephalon (Fig. 25), rostrum, in segmentation, setation and spination of swimming legs and first antenna and in dentition of mandibular gnathobase; differs from these and other *Labidocera* in appearance of sexually modified features of Th V and shape of genital segment.

Genital segment distinguished by large unevenly bilobed swelling extending from right

Figures 22–24. *L. barbadiensis* ♀ stage V copepodid: 22, Th IV, V and urosome, right lateral; unusually large articulating membrane between Th IV and V in this specimen probably due to splitting of the exoskeleton at the onset of moulting into stage VI as indicated by the advanced state of the preformed stage VI cuticle seen within appendages of the stage V exoskeleton (not shown); 23, Th IV, V and urosome, dorsal, same specimen as in 22, setae of right furcal ramus omitted; 24, P5, posterior.

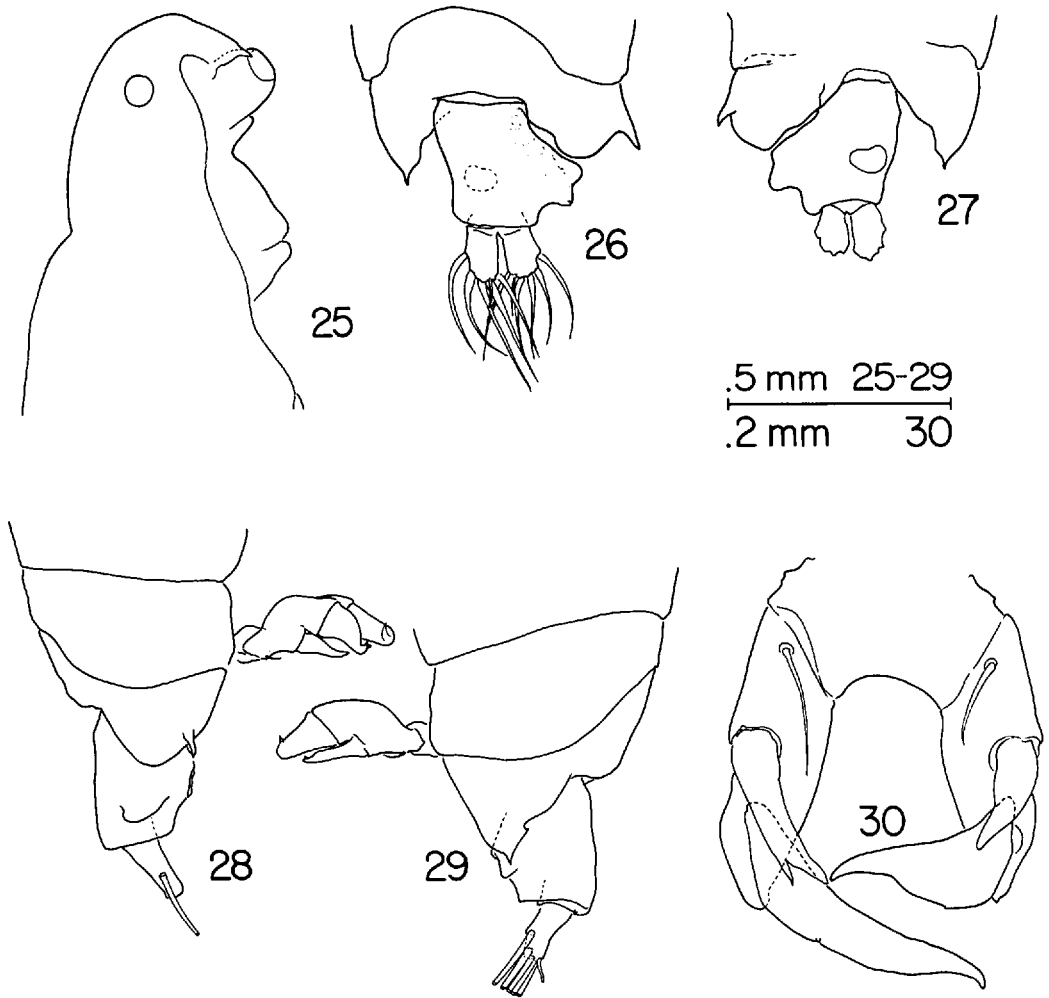
side (Fig. 26); genital pore ventral but weakly left of center (Fig. 27) as in *wilsoni*; in dorsal view epidermis of bilobed swelling glandular in appearance.

Left and right Th V corners apically pointed but two sides strongly asymmetrical (Fig. 26); right side tumid and bearing a slender spine extending postero-laterad (Fig. 28); left side conical, pointed apex extended posteriad, in lateral view (Fig. 29) dorsal margin of left Th V corner with small unique notch anterior to apex.

Caudal furca (Fig. 26) almost symmetrical, furcal rami and P5 (Fig. 30) resemble those of *wilsoni*.

**Remarks.**—*Panamae* is most like *wilsoni*, departing from it in the shape of the Th V corners and in the conspicuous swelling from the right side of the genital segment; knowledge of the male is needed, however, to confirm the apparent relationship. The new species differs markedly from *mirabilis* and *bar-*





Figures 25–30. *Labidocera panamae* ♀: 25, cephalon, right lateral; 26, Th V and urosome, dorsal; 27, Th V and urosome, ventral; 28, Th V and urosome, right lateral; 29, Th V and urosome, left lateral; 30, P5, posterior.

*badiensis* in the shape of the genital segment and the caudal furca.

The species is named for its occurrence in coastal water off Panama.

*Type*.—The type has been deposited with the United States National Museum, Smithsonian Institution, Washington, D.C. Female, holotype, USNM, cat. no. 156227.

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## LITERATURE CITED

- Barnett, A. M. 1974. The feeding ecology of an omnivorous neritic copepod, *Labidocera tri-spinosa* Esterly. Ph.D. dissertation, University of California, San Diego.
- Björnberg, T. K. S. 1963. On the marine free-living copepods off Brazil. *Bol. Inst. Oceanogr.* 13: 3-142.
- . 1965. The study of planktonic copepods in the South West Atlantic. *Anais Acad. Bras. Cienc.* No. 37, supl.: 219-230.
- . 1972. Developmental stages of some tropical and subtropical planktonic marine copepods. *Stud. Fauna Curaçao*, 60: 1-185.
- Bowman, T. E. 1971. The distribution of calanoid copepods off the southeastern United States between Cape Hatteras and Southern Florida. *Smithsonian Contrib. Zool.* 96: 1-58.
- Calef, G. W., and G. D. Grice. 1967. Influence of the Amazon River outflow on the ecology of the western tropical Atlantic. II. Zooplankton abundance, copepod distribution, with remarks on the fauna of low-salinity areas. *J. Mar. Res.* 25: 84-94.
- Coker, R. E., and J. G. González. 1960. Limnetic copepod populations of Bahía Fosforescente and adjacent waters, Puerto Rico. *J. Elisha Mitchell Scient. Soc.* 76: 8-28.
- Cruz, S. A. de la. 1966. Estudios de plancton en la plataforma sur de Cuba. Instituto Nacional de la Pesca, Cuba. *Centro Invest. Pesq.* 22: 1-76.
- Fleminger, A. 1957. New calanoid copepods of *Pontella* Dana and *Labidocera* Lubbock with notes on the distribution of the genera in the Gulf of Mexico. *Tulane Stud. Zool.* 5: 19-34.
- . 1965. On some pacific species of *Labidocera* and *Stephos* reported by C. B. Wilson. *Crustaceana* 3: 121-130.
- . 1967. Taxonomy, distribution, and polymorphism in the *Labidocera jollae* group with remarks on evolution within the group (Copepoda: Calanoida). *Proc. U.S. Natl. Mus.* 120(3567): 1-61.
- . 1975. Geographical distribution and morphological divergence in American coastal-zone planktonic copepods of the genus *Labidocera*. Pp. 392-419 in E. R. Cronin, ed. *Estuarine Research, I: Chemistry, Biology and the Estuarine System*. Academic Press, New York.
- , and E. Tan. 1966. The *Labidocera mirabilis* species group (Copepoda, Calanoida) with description of a new Bahamian species. *Crustaceana* 11: 291-301.
- Grice, G. D. 1960. Calanoid and cyclopoid copepods collected from the Florida Gulf Coast and Florida Keys in 1954 and 1955. *Bull. Mar. Sci. Gulf Caribb.* 10: 217-226.
- Legaré, J. E. H. 1964. The pelagic Copepoda of eastern Venezuela. I: The Cariaco Trench. *Bol. Inst. Oceanogr. Univ. Oriente* 3: 15-81.
- Lillelund, K., and R. Lasker. 1971. Laboratory studies of predation by marine copepods on fish larvae. *Fish. Bull.* 69: 655-667.
- Owre, H. B., and M. Foyo. 1964. Report on a collection of Copepoda from the Caribbean Sea. *Bull. Mar. Sci. Gulf Caribb.* 14: 359-372.
- . 1967. Copepods of the Florida Current. *Fauna Caribaea I. Crustacea*, pt. 1: Copepoda. Univ. Miami Inst. Mar. Sci., Miami. 137 pp.
- . 1972. Studies on Caribbean zooplankton. Description of the program and results of the first cruise. *Bull. Mar. Sci.* 22: 483-521.
- Suárez-Caabro, J. A. 1959. Salinidad, temperatura y plancton de las aguas costeras de isla de Pinos. Universidad Católica de Santo Tomás de Villanueva, Cuba. *Laboratorio de Biología Marina. Monografía* 7: 1-30.
- Weikert, H. 1975. Distribution and occurrence of pontellids (Copepoda, Calanoida) in the Central and South Atlantic Ocean. *Ber. dt. wiss. Kommn. Meeresforsch* 24: 134-150.
- Wickstead, J. H. 1956. A note on some pelagic copepods from the West Indies. *J. Barbados Mus.* 24: 3-28.
- Wilson, C. B. 1942. The copepods of the plankton gathered during the last cruise of the *Carnegie*. *Scient. Results Cruise VII Carnegie. Biol. I. Publ.* 536: 1-237.
- . 1950. Copepods gathered by the U.S. Fisheries steamer *Albatross* from 1887 to 1909, chiefly in the Pacific Ocean. *Bull. U.S. Natl. Mus.*, 100, 14, pt. 4: 144-441.
- Woodmansee, R. A. 1958. The seasonal distribution of the zooplankton off Chicken Key in Biscayne Bay, Florida. *Ecology*, 39: 247-262.

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ADDRESSES: (A.F.) University of California, San Diego, Scripps Institution of Oceanography A-001, La Jolla, California 92093; (E.M.) University of the West Indies, Care Hill Campus, P.O. Box 64 Bridgetown, Barbados, W.I.