Shrimps of the Pasiphaeid Genus *Leptochela* with Descriptions of Three New Species (Crustacea: Decapoda: Caridea)

FENNER A. CHACE, JR.

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY · NUMBER 222

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ABSTRACT

Chace, Fenner A., Jr. Shrimps of the Pasiphaeid Genus *Leptochela* with Descriptions of Three New Species (Crustacea: Decapoda: Caridea). *Smithsonian Contributions to Zoology,* number 222, 51 pages, 37 figures, 1976.—Twelve species of *Leptochela* are described and illustrated, including *L. hawaiiensis,* new species, from Hawaii; *L. irrobusta,* new species, from the Red Sea to the Marshall and Samoa islands; and *L. papulata,* new species, from the Carolinas, Georgia, and the eastern Gulf of Mexico. *Proboloura,* new subgenus, is proposed for the types-species *L. carinata* Ortmann. The geographic distribution and sexual dimorphism of the species are discussed.

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Contents

Shrimps of the Pasiphaeid Genus *Leptochela* with Descriptions of Three New Species (Crustacea: Decapoda: Caridea)

Fenner A. Chace, Jr.

Introduction

ZOOGEOGRAPHY.—The little shrimps of the genus *Leptochela,* ranging in adult size from carapace lengths of less than three to nearly ten mm, are often abundant in certain parts of the world, especially near the sea surface at night. Seven of the 12 species recognized in this review are known from the Indo-West-Pacific region: from the Red Sea eastward to the Marshall and Samoa islands and from Japan and Korea southward to South Australia and Tasmania (Figure 1). An eighth species has been found only in Hawaii. The remaining four species occur in the western Atlantic from the latitude of Massachusetts to northern Brazil near the mouth of the Amazon River. Two of the species occurring in the Red Sea apparently have invaded the eastern Mediterranean, and another species wide ranging in the western Atlantic has been taken in the eastern Pacific near the southern tip of Baja California. It seems apparent that *Leptochela* has a disjunct distribution. Except for three possible migrants through man-made canals, the genus is unknown until now from the west coasts of North, Central, and South America; most of the east coast of South America; and the coasts of Europe and most of Africa. More intensive collecting in some of these areas will almost certainly expand the known range of *Leptochela,* but it is unlikely that the genus occurs naturally in the eastern Atlantic, where advanced collecting techniques have been widely used for a long time.

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SYSTEMATIC DISCUSSION.—The species of *Leptochela* are so consistently distinct from the other genera of the Pasiphaeidae that they have sometimes been assigned to a separate family, the Leptochelidae Paulson, 1875. There is little justification for such discrimination, however, for the mouthparts and pereopods of *Leptochela* are characteristically pasiphaeid. On the other hand, this study, the first worldwide survey of the genus, suggested rather convincingly that one of the species is sufficiently distinct from the others to be accorded subgeneric rank.

Another clarification disclosed by the study is that the sexual dimorphism first noticed by Kemp (1925:250) and represented by a longitudinally tricarinate carapace in breeding females only, occurs in the majority, but not all, of the species of *Leptochela.* In two species, the carapace is tricarinate in both sexes, while in two other species it is not so modified in either sex (see *L. sydniensis,* Remarks).

Thanks to the rather extensive series of *Leptochela* in the Smithsonian collections and to the kind cooperation of colleagues mentioned below, I have been able to examine specimens of all of

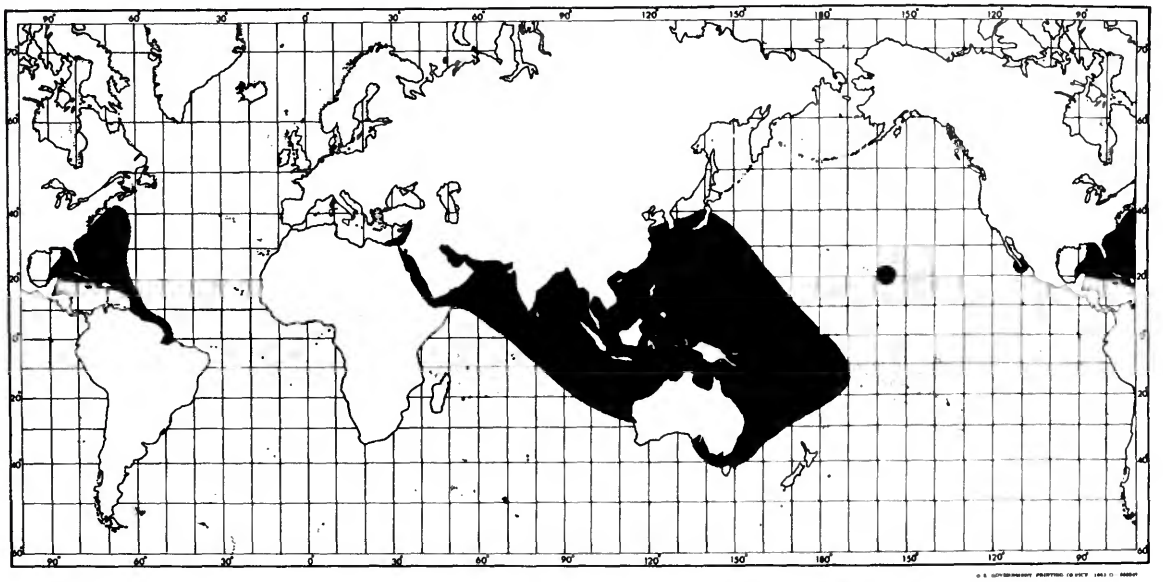

FIGURE 1.—World distribution of the genus *Leptochela* as suggested by available records.

the described species except *L. hainanensis* Yu, 1936. I believed at first that this name was available for the Indo-Pacific species generally misidentified as *L. aculeocaudata,* but certain of the characters ascribed to *L. hainanensis* disagree with those in material that I have seen of the misidentified species. Only the comparison of specimens of *L. hainanensis* with those described below under the name *L. sydniensis* can decide whether these species are distinct or whether *L. hainanensis* should take precedence as a senior synonym of *L. sydniensis.*

The postorbital carapace lengths of the specimens listed in the "Material" section of each of the species descriptions are shown in parentheses. The indicated magnifications of the illustrations are reasonably but not always precisely accurate.

ACKNOWLEDGMENTS.—This study was initially motivated and continuously nurtured by John C. Yaldwyn of the National Museum of New Zealand; his profound knowledge of the other pasiphaeid genera was especially valuable during the entire progress of the investigation. Also, I take this opportunity to thank Keiji Baba of the Kumamoto University Faculty of Education for translating pertinent Japanese literature; Harold S. Feinberg of the American Museum of Natural History for arranging the loan of study material; Takahiro Fujino of the Kyushu University Faculty of Medicine for translating Japanese literature and for sending comparative material of *Leptochela sydniensis* on loan; D. J. G. Griffin of the Australian Museum for the loan of all *Leptochela* specimens in that institution; L. B. Holthuis of the Rijksmuseum van Natuurlijke Historie, Leiden, for permitting the examination of more than 1800 specimens from the Red Sea; Richard L. Wigley of the National Marine Fisheries Service, Woods Hole, for checking the documentation of a unique specimen; Austin B. Williams of the Systematics Laboratory of the National Marine Fisheries Service, Washington, D.C., for making available material in the Institute of Marine Science, Morehead City, North Carolina; and my Smithsonian colleagues Horton H. Hobbs, Jr., and Raymond B. Manning for reviewing the manuscript.

Genus *Leptochela* Stimpson

Leptochela Stimpson, 1860:42.

DEFINITION.—Pasiphaeid with conventional rostrum. Carapace and rostrum unarmed dorsally. Branchiostegal tooth and branchiostegal sinus absent. Sixth abdominal somite with transverse cari-

nate ridge near anterior end of dorsal surface and long fixed posteriorly directed spine near posterior end of ventrolateral margin. Telson with mesial pair of movable spines anteriorly, 1 or 2 pairs of dorsolateral movable spines, and 5 pairs of prominent posterior movable spines, all but lateral pair (perhaps actually belonging to dorsolateral series) of latter minutely serrate on one or both lateral and mesial margins (minute additional pair of spines sometimes present between bases of median pair). Mandibular palp broad, flattened, and undivided. Third maxilliped with 2 arthrobranchs. Fourth pereopod shorter than 3rd, longer than 5th. Exopods of pleopods not unusually long. Both branches of uropod with series of movable lateral spines.

TYPE-SPECIES (selected by Kemp, 1915:310).—*Leptochela gracilis* Stimpson.

Key to the Species

1. Sixth abdominal somite bearing movable lappet near anterior end of dorsal surface; telson with anterior pair of dorsolateral spines nearly in line with anteriorly placed mesial pair; antennal scale usually at least ¾ as long as carapace; 3rd pereopod with exopod reaching nearly or quite to distal end of ischium; 5th pereopod noticeably reduced, about ⅔ as long as 4th. Subgenus *Proboloura*. One species ..... 12. ***L. (P.) carinata***

   Sixth abdominal somite without dorsal lappet; telson with anterior pair of dorsolateral spines arising considerably posterior to mesial pair; antennal scale usually less than ⅔ as long as carapace; 3rd pereopod with exopod not nearly reaching distal end of ischium; 5th pereopod at least ¾ as long as 4th. Subgenus *Leptochela* 2

2.(1) Telson armed with 1 pair of dorsomesial and 2 pairs of dorsolateral spines in addition to 5 pairs of prominent spines in posterior series; orbit armed with mesially directed tooth on ventral margin or with tooth at suborbital angle 3

   Telson armed with 1 pair of dorsomesial and 1 pair of dorsolateral spines in addition to posterior series; ventral margin of orbit and suborbital angle unarmed (except in *L. pugnax*) 5

3.(2) Suborbital angle dentate; orbital margin serrate dorsolaterally; telson usually with pair of minute spines between bases of median pair of large posterior spines ..... 10. ***L. (L.) serratorbita***

   Suborbital angle rounded, unarmed; orbital margin usually entire dorsolaterally; telson without pair of minute spines between bases of median pair of large posterior spines ... 4

4.(3) Appendix masculina (not including spines) on second male pleopod rarely overreaching appendix interna; size small, ovigerous females with postorbital carapace length less than 5 mm ..... 5. ***L. (L.) irrobusta***

   Appendix masculina (not including spines) far overreaching appendix interna; size large, ovigerous females with postorbital carapace length more than 6 mm ....9. ***L. (L.) robusta***

5.(2) Suborbital angle dentate ..... 8. ***L. (L.) pugnax***

   Suborbital angle rounded 6

6.(5) Dorsal margin of 5th abdominal somite slightly or prominently uneven in lateral view 7

   Dorsal margin of 5th abdominal somite regularly convex or nearly straight in lateral view 8

7.(6) Fifth abdominal somite with dorsal margin very uneven in lateral view; telson without pair of minute spines between bases of median pair of large posterior spines ..... 6. ***L. (L.) japonica***

   Fifth abdominal somite with 1 to 3 low prominences on dorsal margin; telson with pair of minute spines between bases of median pair of large posterior spines ..... 7. ***L. (L.) papulata***

8.(6) Fifth abdominal somite armed with prominent sharp posteromedian tooth; size large, ovigerous females with postorbital carapace length more than 7 mm ....3. ***L. (L.) gracilis***

   Fifth abdominal somite without posteromedian tooth; size small, ovigerous females with postorbital carapace length less than 5 mm 9

9.(8) Telson with pair (sometimes fused) of minute spines between bases of median pair of large posterior spines 10

   Telson without pair of minute spines between bases of median pair of large posterior spines 11

10.(9) Dorsal margin of orbit entire; endopod of 1st male pleopod with distolateral angle produced; appendix masculina (not including spines) far overreaching appendix interna .... 2. ***L. (L.) bermudensis***

Dorsal margin of orbit finely serrate under high magnification; endopod of 1st male pleopod subsymmetrically rounded distally; appendix masculina (not including spines) not overreaching appendix interna .... 4. ***L. (L.) hawaiiensis***

11.(9) Rostrum usually rather broadly lanceolate in lateral view; carapace with 3 longitudinal dorsal ridges in both males and females; basal antennal segments concealed by carapace; movable finger of 1st pereopod bearing 14–22 spines on opposable margin, that of 2nd pereopod with 17–26 spines; ovigerous females with postorbital carapace length 2.4–2.6 mm .... 1. ***L. (L.) aculeocaudata***

Rostrum narrower in lateral view, dorsal margin usually sinuous in lateral view; carapace with dorsolateral longitudinal ridges only in breeding females; basal antennal segments not concealed by carapace; movable finger of first pereopod bearing 20–44 spines on opposable margin, that of second pereopod with 21–46 spines; ovigerous females with postorbital carapace length 2.6–4.4 mm .... 11. ***L. (L.) sydniensis***

Subgenus *Leptochela* Stimpson

DEFINITION.—Sixth abdominal somite without dorsal lappet. Telson with origins of anterior pair of dorsolateral spines and of anterior dorsal pair separated by distance amounting to at least $\frac{1}{5}$ length of telson, not including posterior spines. Antennal scale usually less than $\frac{2}{3}$ as long as carapace. Third pereopod with exopod not reaching nearly so far as distal end of ischium. Fifth pair of pereopods at least $\frac{3}{4}$ as long as 4th pair.

1. *Leptochela (Leptochela) aculeocaudata* Paulson

FIGURES 2–4

Leptochela aculeocaudata Paulson, 1875:100, pl. 16: figs. 1–1*s* [translation, 1961:106, pl. 15: figs. 1–1*s*].—Nobili, 1906:28, fig. 4.—Balss, 1936:4, 57, 64, fig. 3.—Gurney, 1939:428, 429, 433.

Leptochela aculeocaudata hainanensis.—Armstrong, 1941:1.

DIAGNOSIS.—Rostrum lanceolate, dorsal margin convex posteriorly, straight or slightly concave anteriorly. Carapace with 3 longitudinal dorsal ridges in both males and females. Orbital margin entire, not serrate, without mesially directed tooth on ventral portion; suborbital angle unarmed. Fifth abdominal somite entire, without dorsal elevations or posterior tooth. Telson with 1 pair of dorsolateral spines in addition to anterior mesial pair; posterior margin without pair of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale less than $\frac{1}{2}$ as long as carapace. First pereopod with 16 to 23 spines on opposable margin of movable finger. Second pereopod with 17 to 26 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of 1st pleopod of male obliquely rounded distally, lateral margin slightly concave but not flared distally. Appendix masculina, excluding spines, usually not overreaching appendix interna. Maximum carapace length 2.9 mm.

DESCRIPTION.—Rostrum (Figure 2*a–c*) lanceolate, rather high proximally, dorsal margin straight or slightly concave anteriorly, usually overreaching basal segment of antennular peduncle. Carapace with median carina extending posteriorly barely to midlength and paired blunt dorsolateral ridges extending to posterior $\frac{1}{4}$ in males and nonbreeding females, both median carina and dorsolateral ridges extending at least to posterior $\frac{1}{5}$ of carapace length in breeding females; dorsolateral ridges elevated in both sexes, characteristically concealing all of dorsal midline except rostral crest from lateral view; carapace usually completely concealing basal segment of antennal peduncle from lateral view. Orbital margin (Figure 2*b,c*) entire, not spinulose, without mesially directed tooth on ventral portion; suborbital angle broadly rounded, unarmed.

Abdominal terga (Figure 2*d*) usually rounded on all somites, sometimes with suggestion of blunt carina on 5th somite. Fifth somite entire, without dorsal prominences or posterodorsal tooth. Sixth somite nearly twice as long as high, with low transverse carinate swelling at extreme anterior end usually concealed beneath posterior margin of 5th somite; rather short, slightly curved spine on ventrolateral surface and distinct acute tooth on pos-

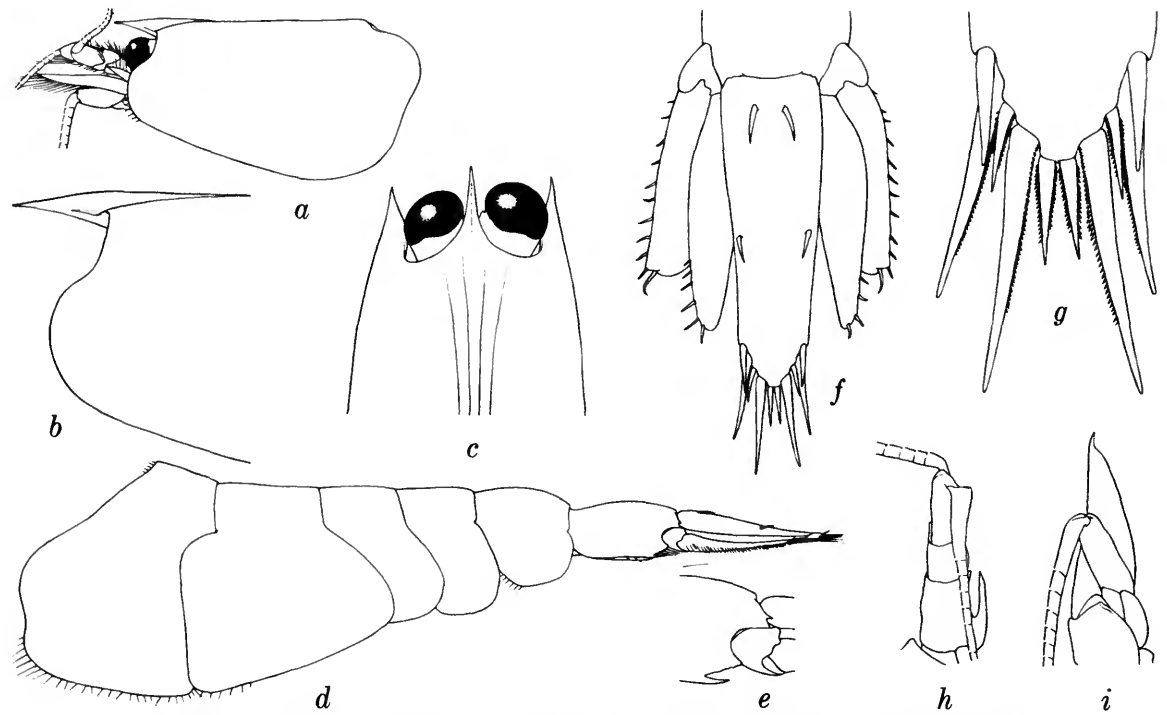

FIGURE 2.—*Leptochela* (*Leptochela*) *aculeocaudata*, ovigerous female from Red Sea off Sinai Peninsula, carapace length 2.4 mm: *a*, carapace and anterior appendages; *b*, anterior part of carapace and rostrum, lateral aspect; *c*, anterior part of carapace and eyes, dorsal aspect; *d*, abdomen; *e*, posterior end of 6th abdominal somite; *f*, telson and uropods; *g*, posterior margin of telson; *h*, right antennule, dorsal aspect; *i*, right antenna, ventral aspect. (Magnifications: *a*, *d*, × 12; *b*, *c*, *e*, *f*, *h*, *i*, × 25; *g*, × 62.)

terodorsal margin of posterolateral lobe (Figure 2*e*). Telson (Figure 2*f*) nearly 1½ times as long as 6th somite, about 3 times as long as wide, armed with 1 pair of dorsolateral spines at about midlength, in addition to anterior mesial pair; posterior margin (Figure 2*g*) without pair of minute spines between bases of mesialmost of usual 5 pairs of prominent spines.

Eye (Figure 2*c*) with indistinct papilla on mesial surface of stalk near juncture with cornea, cornea little swollen, barely wider than stalk.

Antennular peduncle (Figure 2*h*) with stylocerite reaching as far as distolateral margin of basal segment; 2nd segment about as long as distal segment in ventromesial aspect, much shorter in dorsal aspect.

Antennal scale (Figure 2*i*) less than ½ as long as carapace, 3.0 to 4.0 times as long as wide, lateral margin distinctly concave near midlength, blade forming oblique shoulder at base of distal tooth. Distal segments of antennal peduncle less than ⅔ as wide as scale, extending distinctly beyond midlength of scale; basal segment bluntly produced distoventrally, without acute tooth.

Mouthparts as illustrated (Figure 3*a–f*). Third maxilliped (Figure 3*f*) usually not overreaching antennal scale, distal segment nearly ¾ as long as penultimate segment.

First pereopod (Figure 3*g*) occasionally overreaching antennal scale by more than length of fingers; fingers 1.8 to 2.0 times as long as palm; dactyl (Figure 3*h*) armed with 16 to 23 spines on opposable margin. Second pereopod (Figure 3*i*) overreaching antennal scale by at least ⅔ length of fingers; fingers 2.0 to 2.4 times as long as palm; dactyl (Figure 3*j*) armed with 17 to 26 spines on

FIGURE 3.—*Leptochela* (*Leptochela*) *aculeocaudata*, ovigerous female from Red Sea off Sinai Peninsula, carapace length 2.4 mm: *a*, right mandible; *b*, right 1st maxilla; *c*, right 2nd maxilla; *d*, right 1st maxilliped; *e*, right 2nd maxilliped; *f*, right 3rd maxilliped; g, right 1st pereopod; *h*, same, fingers; *i*, right 2nd pereopod; *j*, same, fingers; *k*, right 3rd pereopod; *l*, right 4th pereopod; *m*, right 5th pereopod. (Magnifications: *f*, *g*, *i*, *k-m*, × 25; *a-e*, *h*, *j*, × 62.)

opposable margin. Third pereopod (Figure 3*k*) overreaching extreme anterior margin of carapace by length of dactyl and about ½ of propodus; exopod not nearly reaching distal end of ischium; ischium bearing 2 spines near flexor margin; merus with 3 spines; carpus with 1 spine; dactyl much shorter than propodus. Fourth pereopod (Figure 3*l*) reaching to about distal end of ischium of 2nd pereopod when both extended anteriorly; dactyl longer than propodus. Fifth pereopod (Figure 3*m*) similar to and little shorter than 4th, reaching about midlength of ischium of 2nd pereopod when both extended anteriorly; dactyl fully as long as propodus.

Endopod of 1st pleopod of male (Figure 4*a,b*) obliquely rounded distally, lateral margin slightly

concave but not flared distally. Appendix masculina (Figure 4*c*,*d*) bearing 6 long spines and, excluding latter, usually not overreaching appendix interna. Lateral branch of uropod (Figure 2*f*) armed with 10 to 14 movable spines.

SIZE.—Carapace lengths of males, 2.0–2.9 mm; of females without eggs, 2.0–2.6 mm; of ovigerous females, 2.4, 2.6 mm; of juvenile, 1.4 mm.

MATERIAL.—RED SEA. Sinai Peninsula: 1 ♂ (2.8) 1 ovig. ♀ (2.4) (Rijksmuseum van Natuurlijke Historie, Leiden). QUEENSLAND, AUSTRALIA. Bustard Bay (24°05'S, 151°48'E); 19 September 1938; Haul 46/38 (old number), Net 200; K. Sheard: 1 ♂ (2.9) 2 ♀ (2.1+, 2.6) (1 ovig. (2.6)) (Australian Museum).

SAMOA ISLANDS. Apia Harbour, Upolu; 12 October 1936: submerged light; Second Templeton Crocker–American Museum Expedition: 24 ♂ (2.0–2.6) 2 ♀ (2.4, 2.6) 1 juv. (1.4) (American Museum of Natural History).

HABITAT.—Balss (1936:5) recorded *L.* (*L.*) *aculeocaudata* from off Alexandria, Egypt, in depths of 51 to 88 meters on muddy bottoms with and without vegetation. The Samoan collection was made at the surface over a submerged light.

TYPE-LOCALITY.—Red Sea.

DISTRIBUTION.—Known with reasonable certainty only from the Red Sea and the two regions recorded here: Queensland, Australia, and the Samoa Islands. Also, there is little doubt that the specimens recorded by Balss (1936:5) from off Alexandria, Egypt, in 51 to 88 meters were correctly identified as belonging to this species.

REMARKS.—Although only one pair—a male and an ovigerous female—of the species described above was found in the more than 1800 specimens of *Leptochela* kindly made available by L. B. Holthuis in advance of the preparation of his report on Red Sea collections in his custody, I have little hesitation in identifying this pair as *L.* (*L.*) *aculeocaudata*. The elevated dorsolateral ridges that conceal the midline of the carapace, except for the rostral crest, from lateral view (well illustrated in Paulson's Figure 1*a*) and the small size of adult specimens seem to characterize the species sufficiently.

The specimens from the Samoa Islands identified as *L. aculeocaudata hainanensis* by Armstrong (1941) and made available by H. S. Feinberg of the American Museum of Natural History are so poorly preserved that positive identification is difficult, but the presence of highly elevated dorsolateral ridges on the carapace in both males and females seems to establish their identity with this species. The only noticeable difference between these specimens and those from the Red Sea and Queensland is that the basal segment of the antenna is not concealed by the carapace in the Samoan material, but I am inclined to believe that this is an artifact resulting from the skeletonized condition of the latter specimens, in which all of the appendages are very loosely articulated.

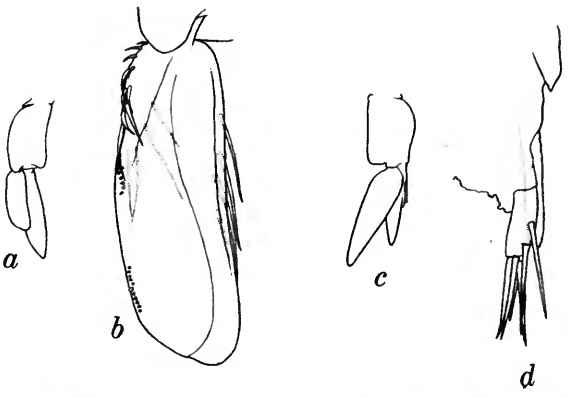

FIGURE 4.—*Leptochela* (*Leptochela*) *aculeocaudata*, male from Red Sea off Sinai Peninsula, carapace length 2.8 mm: *a*, right 1st pleopod; *b*, same, endopod; *c*, right 2nd pleopod; *d*, same, appendix masculina and appendix interna. (Magnifications: *a*, *c*, × 12; *b*, *d*, × 62.)

See *L.* (*L.*) *sydniensis* for discussion of material that I believe to have been misidentified with *L.* (*L.*) *aculeocaudata*.

2. *Leptochela* (*Leptochela*) *bermudensis* Gurney

FIGURES 5–7

?*Leptochela carinata* Ortmann, 1893:41 [part, not pl. 4: fig. 1].
Leptochela carinata.—Schmitt, 1924:69.—Gurney, 1936:786, pl. 1: figs. 1–5, pl. 2: figs. 7–12, pl. 3: figs. 14–18, pl. 4: figs. 19–30, pl. 5: figs. 33–34. [Not *L. carinata* Ortmann, 1893, pl. 4: fig. 1.]
·*Leptochela bermudensis* Gurney, 1939:427, figs. 1–10.—Chace, 1940:131, fig. 10.—Holthuis, 1955: fig. 15b.—Springer and Bullis, 1956:10.—Chace, 1972:16.

DIAGNOSIS.—Rostrum with dorsal margin usually straight or concave, occasionally sinuous or even convex throughout. Carapace with 3 longitudinal dorsal ridges in breeding females only. Orbital margin entire, not serrate, without mesially di-

rected tooth on ventral portion; suborbital angle rounded, rarely with minute denticle. Fifth abdominal somite entire, without dorsal elevations or posterior tooth. Telson with 1 pair of dorsolateral spines in addition to anterior mesial pair; posterior margin with pair (rarely fused) of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale little more than ½ as long as carapace. First pereopod with 11 to 30 spines on opposable margin of movable finger. Second pereopod with 18 to 37 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of 1st pleopod of male flared distolaterally. Appendix masculina, not including spines, distinctly overreaching appendix interna. Maximum carapace length 4.5 mm.

DESCRIPTION.—Rostrum (Figure 5*a*) with dorsal margin somewhat variable, usually nearly straight or concave, occasionally sinuous or even slightly convex from base to tip, rarely overreaching basal segment of antennular peduncle. Carapace with median dorsal carina on anterior ¼ to ½ of length but without paired dorsolateral carinae in males and nonbreeding females, dorsally tricarinate over most of length in breeding females. Orbital margin (Figure 5*b*) entire, not serrate, ventral portion without mesially directed tooth; suborbital angle rounded, rarely with minute marginal denticle.

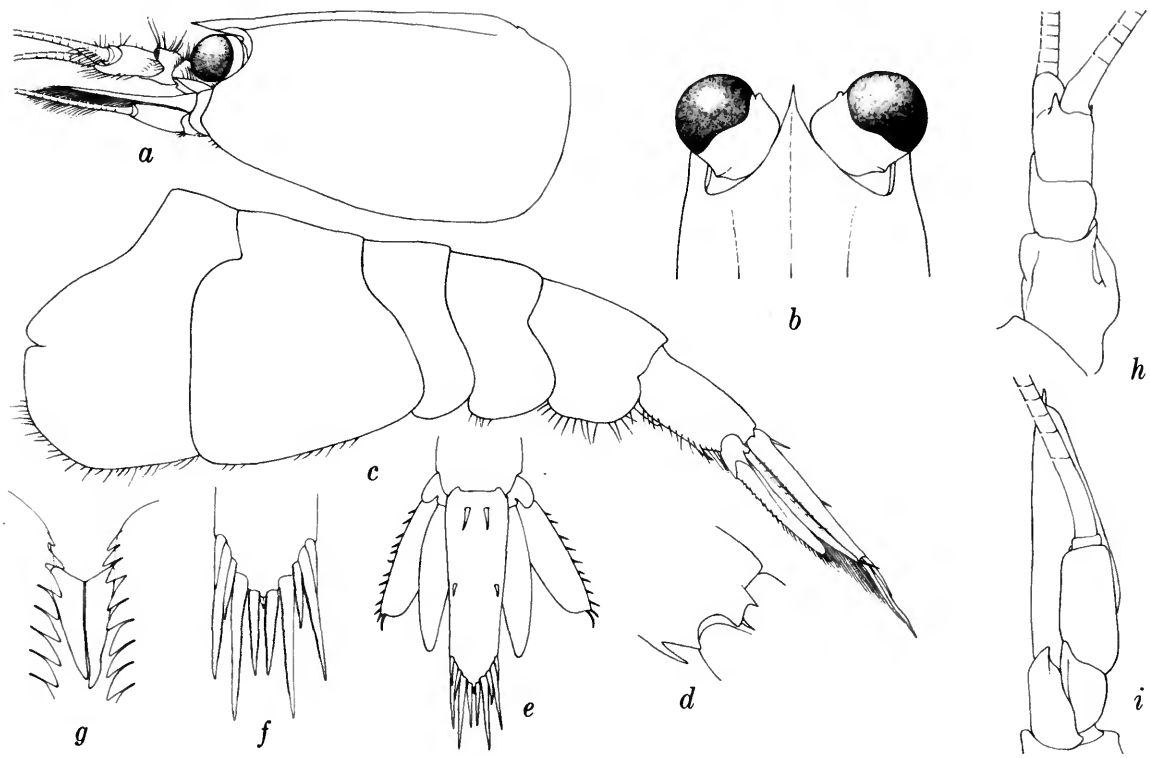

FIGURE 5.—*Leptochela* (*Leptochela*) *bermudensis*, ovigerous female from Barbuda, Leeward Islands, carapace length 3.0 mm: *a*, carapace and anterior appendages; *b*, anterior part of carapace and eyes, dorsal aspect; *c*, abdomen; *d*, posterior end of 6th abdominal somite: *e*, telson and uropods; *f*, posterior margin of telson; *g*, same, mesial spines; *h*, right antennule, dorsal aspect; *i*, right antenna, ventral aspect. (Magnifications: *a*, *c*, *e*, × 12; *b*, *d*, *f*, *h*, *i*, × 25; *g*, × 260.)

Abdominal terga (Figure 5*c*) regularly rounded on 3 anterior somites and all but posterior part of 4th. Fifth somite bluntly, sometimes obscurely, carinate dorsally, entire, without dorsal prominences of any kind and without posterodorsal tooth. Sixth somite nearly twice as long as high, with usual transverse swelling and carina near anterior end of dorsal surface, long slender spine on ventrolateral surface and usually distinct, rarely obscure, acute tooth (Figure 5*d*) on posterodorsal margin of posterolateral lobe. Telson (Figure 5*e*), not including posterior spines, about 1.6 times as long as 6th somite, little more than 3 times as long as wide, armed with 1 pair of dorsolateral spines at about midlength, in addition to anterior mesial pair; posterior margin (Figure 5*f*) bearing pair (rarely fused) of minute mesial spines (Figure 5*g*) between bases of mesial pair of usual 5 pairs of prominent spines.

Eye (Figure 5*b*) with papilla on mesial surface of stalk proximal to cornea, cornea little if at all wider than stalk.

Antennular peduncle (Figure 5*h*) with stylocerite reaching nearly as far as distolateral margin of basal segment; 2nd segment longer than distal segment in mesial aspect but distinctly shorter in dorsal aspect.

Antennal scale (Figure 5*i*) little more than ½ as long as carapace, 2.8 to 3.7 times as long as wide, lateral margin slightly sinuous, blade forming rather distinct shoulder at base of distal tooth. Distal segments of antennal peduncle about ⅔ as wide as scale, not reaching midlength of scale.

Mouthparts as illustrated (Figure 6*a–f*). Third maxilliped (Figure 6*f*) rarely overreaching antennal scale, distal segment about ¾ as long as penultimate segment.

First pereopod (Figure 6*g*) overreaching antennal scale by slightly more or slightly less than length of fingers; fingers 1.2 to 1.7 times as long as palm; dactyl (Figure 6*h*) armed with 11 to 30 spines on opposable margin. Second pereopod (Figure 6*i*) rarely overreaching antennal scale by as much as length of fingers; fingers 1.7 to 2.2 times as long as palm; dactyl (Figure 6*j*) armed with 18 to 37 spines on opposable margin. Third pereopod (Figure 6*k*) overreaching extreme anterior margin of carapace by about ½ length of dactyl; exopod falling considerably short of distal end of ischium; ischium armed with row of about 6 slender spines near extensor margin and 4 subequally spaced stouter spines on lateral surface; merus with 5 blunt spines on lateral surface; dactyl shorter than propodus. Fourth pereopod (Figure 6*l*) reaching to about midlength of ischium of 2nd pereopod when both extended anteriorly; dactyl usually shorter than propodus. Fifth pereopod (Figure 6*m*) similar to and little shorter than 4th, reaching nearly to midlength of ischium of 2nd pereopod when both extended anteriorly; dactyl shorter than propodus.

Endopod of 1st pleopod of male (Figure 7*a,b*) with lateral margin distinctly flared distally. Appendix masculina (Figure 7*c,d*) bearing 9 long spines, far overreaching appendix interna, without including spines. Lateral branch of uropod (Figure 5*e*) armed with 8 to 15 movable spines, in addition to setae.

SIZE.—Carapace lengths of males, 2.1–3.0 mm; of nonbreeding females, 2.1–3.0 mm; of nonovigerous breeding female, 2.7 mm; of ovigerous females, 2.4–3.0 mm; of juveniles, 1.6–1.9 mm. In contrast, Chace (1940) recorded males with a maximum carapace length of 4.5 mm and ovigerous females of 3.2 mm from off Bermuda.

MATERIAL.—GULF OF MEXICO. Cayos Arcas, Bahía de Campeche; 18 m; 11 December 1952; from bonefish stomach; *Oregon:* 1 ♀ (2.2) 2 juv. (1.6, 1.8). Cayos Arcas, Bahía de Campeche; 20°12′N, 91°59′W; 11 m; 18 July 1957; traplift net with light; *Oregon* Sta. 1848: 2 juv. (1.6, 1.9).

PUERTO RICO. Playa de Fajardo; 23 February 1933: 8-foot circular net under cargo light; Johnson-Smithsonian Deep-sea Expedition: 1 ♀ (2.5). Cayo Icacos; 24 February 1933; 8-foot circular net with cargo light and submarine light; Johnson-Smithsonian Deep-sea Expedition: 9 ♂ (2.1–2.5) 2 ♀ (2.1–2.4). Canal de Luis Peña, Isla de Culebra; 25 February 1933; 8-foot circular net under cargo light; Johnson-Smithsonian Deep-sea Expedition: 3 ♂ (2.3–2.5). Same; 3-foot net towed from port launch: 21 ♂ (2.3–2.6).

VIRGIN ISLANDS. Brewers Bay, Saint Thomas; 1 March 1933; 8-foot circular net under cargo light; Johnson-Smithsonian Deep-sea Expedition: 10 ♂ (2.4–2.7) 5 ♀ (2.6–3.0).

LEEWARD ISLANDS. Off Oyster Pond Landing, Barbuda; 5 April 1956; 7:00–8:30 P.M.; light over side at anchorage in 5.5 m; Smithsonian-Bredin Caribbean Expeditions Sta. 84–56: 2 ♂ (3.0) 1 ovig. ♀ (3.0). Prince Rupert Bay, Dominica: 28 March 1956; 8:45–9:30 P.M.; light over side at anchorage in 7 m; Smithsonian-Bredin Caribbean Expeditions Sta. 64–56: 1 ♂ (2.5).

WINDWARD ISLANDS. West by north of telegraph station, Barbados, little more than ½ mile off; 55–119 m; rocks and sand; 5 June 1918; University of Iowa Barbados-Antigua

FIGURE 6.—*Leptochela (Leptochela) bermudensis,* ovigerous female from Barbuda, Leeward Islands, carapace length 3.0 mm: *a,* right mandible; *b,* right 1st maxilla; *c,* right 2nd maxilla; *d,* right 1st maxilliped; *e,* right 2nd maxilliped; *f,* right 3rd maxilliped; g, right 1st pereopod; *h,* same, fingers; *i,* right 2nd pereopod; *j,* same, fingers; *k,* right 3rd pereopod; *l,* right 4th pereopod; *m,* right 5th pereopod. (Magnifications: *c-g, i, k-m,* × 25; *a, b, h, j,* × 62.)

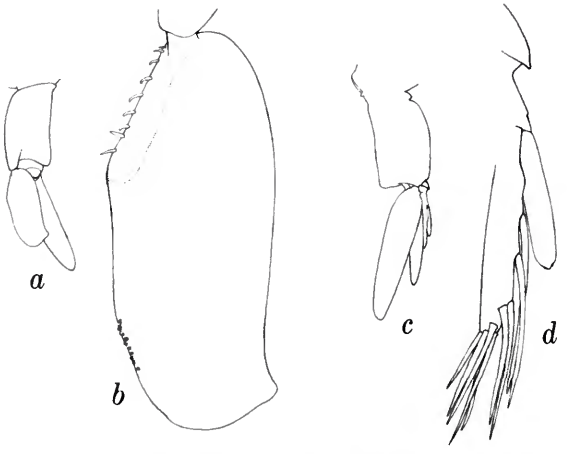

FIGURE 7.—*Leptochela* (*Leptochela*) *bermudensis*, male from Barbuda, Leeward Islands, carapace length 3.0 mm: *a*, right 1st pleopod; *b*, same, endopod; *c*, right 2nd pleopod; *d*, same, appendix masculina and appendix interna. (Magnifications: *a*, *c*, × 12; *b*, *c*, × 62.)

Expedition Sta. 79: 1 ovig.♀ (2.5). Off Lazaretto, Barbados; 37 m; bottom rough; 6 June 1918; University of Iowa Barbados-Antigua Expedition Sta. 87: 1 ovig.♀ (2.4).

HABITAT.—Although most of the specimens listed above were taken in relatively shallow water (5.5–18 m), the type-series (Gurney, 1939) and material subsequently collected off Bermuda (Chace, 1940) were taken in the open ocean between the surface and 1200m.

Seven of the 11 lots currently available to me were obtained at night under a light, yet there is some evidence that *L.* (*L.*) *bermudensis* may be less strongly photopositive than is *L.* (*L.*) *serratorbita*, which is sympatric with it over much of its range. At five stations where a light was used and both species were collected, *L.* (*L.*) *serratorbita* outnumbered *L.* (*L.*) *bermudensis* 676 to 33. At only one station (Cayo Icacos, Puerto Rico) was the latter more numerous (11 to 8), while at two stations (Playa de Fajardo, Puerto Rico, and Barbuda) *L.* (*L.*) *serratorbita* outnumbered *L.* (*L.*) *bermudensis* by about 150 to 1. On the other hand, the lot collected with a townet in Canal de Luis Peña, Puerto Rico, contained 21 *L.* (*L.*) *bermudensis* and only 4 *L.* (*L.*) *serratorbita*, whereas a light station at that locality on the same night produced 27 *L.* (*L.*) *serratorbita* and only 3 *L.* (*L.*) *bermudensis*. Such evidence must be treated with caution, however, because of the probability that swarming occurs in both species.

TYPE-LOCALITY.—Seven miles south of Bermuda between 1000 meters and the surface.

DISTRIBUTION.—Bermuda to Barbados and southwestern Gulf of Mexico, between 1000 meters or more and the surface in the open ocean and in inshore depths as shallow as 5.5 meters.

REMARKS.—Differences and similarities between this species and *L.* (*L.*) *papulata* are discussed under the latter species.

It seems apparent from Ortmann's (1893) description of *L. carinata* that two species were represented in the type-series collected by the Plankton-Expedition off Baía de Marajó, Estado do Pará, Brazil, in 50–100 meters. Ortmann's name should certainly be assigned to the species represented by the largest, figured specimen. The identity of the three smaller specimens without dorsal teeth on the fifth abdominal somite and without a lappet on the sixth (which Ortmann believed to be characters associated with sex or age) is uncertain, but the description is applicable to *L.* (*L.*) *bermudensis*.

3. *Leptochela* (*Leptochela*) *gracilis* Stimpson

FIGURES 8–10

Leptochela gracilis Stimpson, 1860:42.—Bate, 1888:860, pl. 139: fig. 2.—Balss, 1914:19.—Kemp, 1915: 310.—Urita, 1921:216.—Kemp, 1925:251.—Urita, 1926:424.—Yokoya, 1933:13, 212.—Yu, 1936:86, 99.—Yokoya, 1939:263.—Miyadi, 1940a:7, 8, 11.—Yoshida, 1941:21, pl. 4: fig. 4.—Kubo, 1955:99, figs. 1–3.—Liu, 1955:23, pl. 8: figs. 6–14.—Fujino and Miyake, 1970:242.

Leptochela pellucida Boone, 1935:105, pls. 26, 27.

DIAGNOSIS.—Rostrum with dorsal margin straight or sinuous, rarely convex throughout. Carapace without dorsolateral ridges in either males or females. Orbital margin entire, not serrate, without mesially directed tooth on ventral portion; suborbital angle unarmed. Fifth abdominal somite entire, without dorsal elevations but with sharp posterior tooth. Telson with 1 pair of dorsolateral spines in addition to anterior mesial pair; posterior margin without pair of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale about ⅔ as long as carapace. First pereopod with 47 to 60 spines on opposable mar-

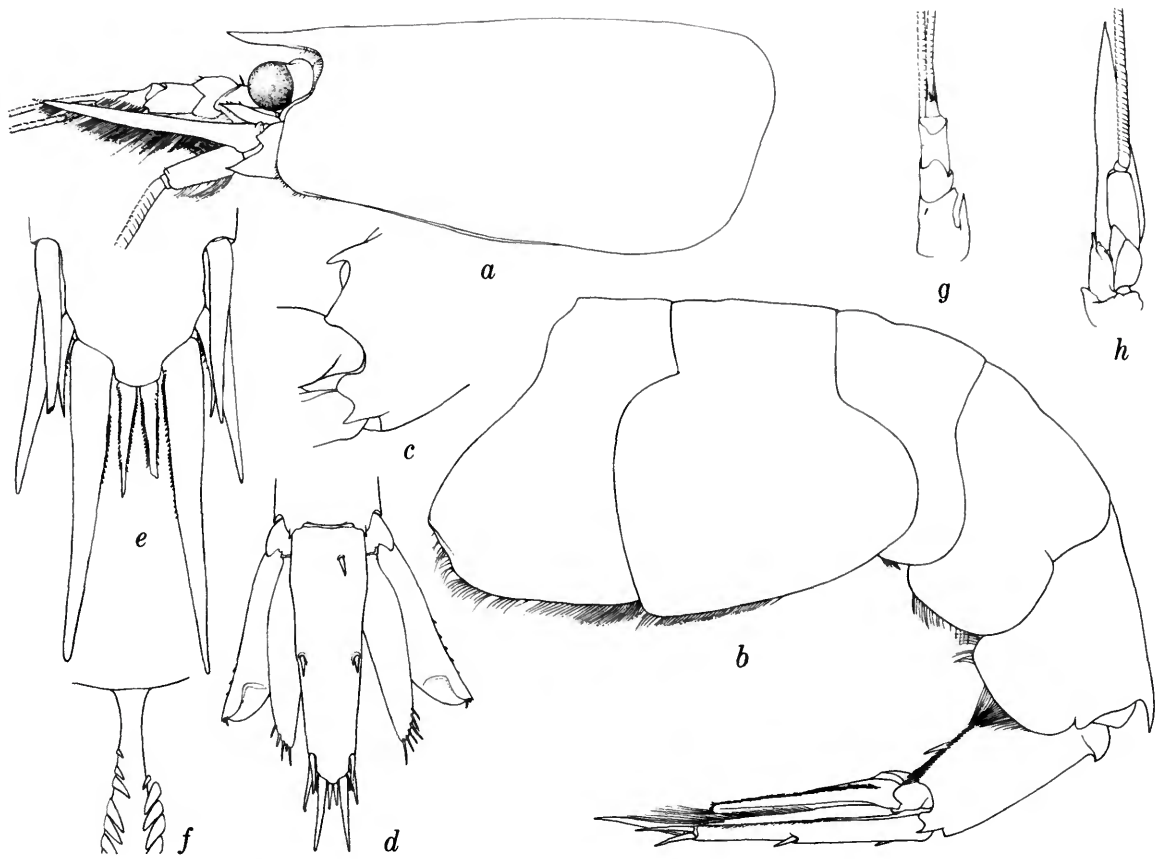

FIGURE 8.—*Leptochela* (*Leptochela*) *gracilis*, ovigerous female from Fukien, China, carapace length 9.6 mm: *a*, carapace and anterior appendages; *b*, abdomen; *c*, posterior end of 6th abdominal somite; *d*, telson and uropods; *e*, posterior margin of telson; *f*, same, mesial part; *g*, right antennule, dorsal aspect; *h*, right antenna, ventral aspect. (Magnifications: *a*, *b*, *d*, *g*, *h*, × 6; *c*, × 12; *e*, × 25; *f*, × 260.)

gin of movable finger. Second pereopod with 48 to 76 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of 1st pleopod of male rounded distally, not flared distolaterally. Appendix masculina, not including spines, not overreaching appendix interna. Maximum carapace length 9.6 mm.

DESCRIPTION.—Rostrum (Figure 8*a*) with dorsal margin straight or sinuous, rarely convex throughout, usually reaching to or beyond level of distal end of basal segment of antennular peduncle. Carapace with median dorsal carina on anterior $\frac{1}{10}$ to $\frac{2}{3}$ of length, not tricarinate in either males or females. Orbital margin entire, not serrate, without mesially directed tooth on ventral portion; suborbital angle rounded.

Abdomen (Figure 8*b*) regularly rounded dorsally on 3 anterior somites, usually carinate on posterior part of 4th. Fifth somite carinate, without dorsal prominences but with sharp median tooth projecting from posterior margin. Sixth somite with dorsal tranverse swelling near anterior end pronounced and produced slightly posteriorly, posterolateral lobe (Figure 8*c*) with distinct acute tooth on posterodorsal margin. Telson (Figure 8*d*), not including posterior spines, about 1.4 times as long as 6th somite, about 3.3 times as long as wide,

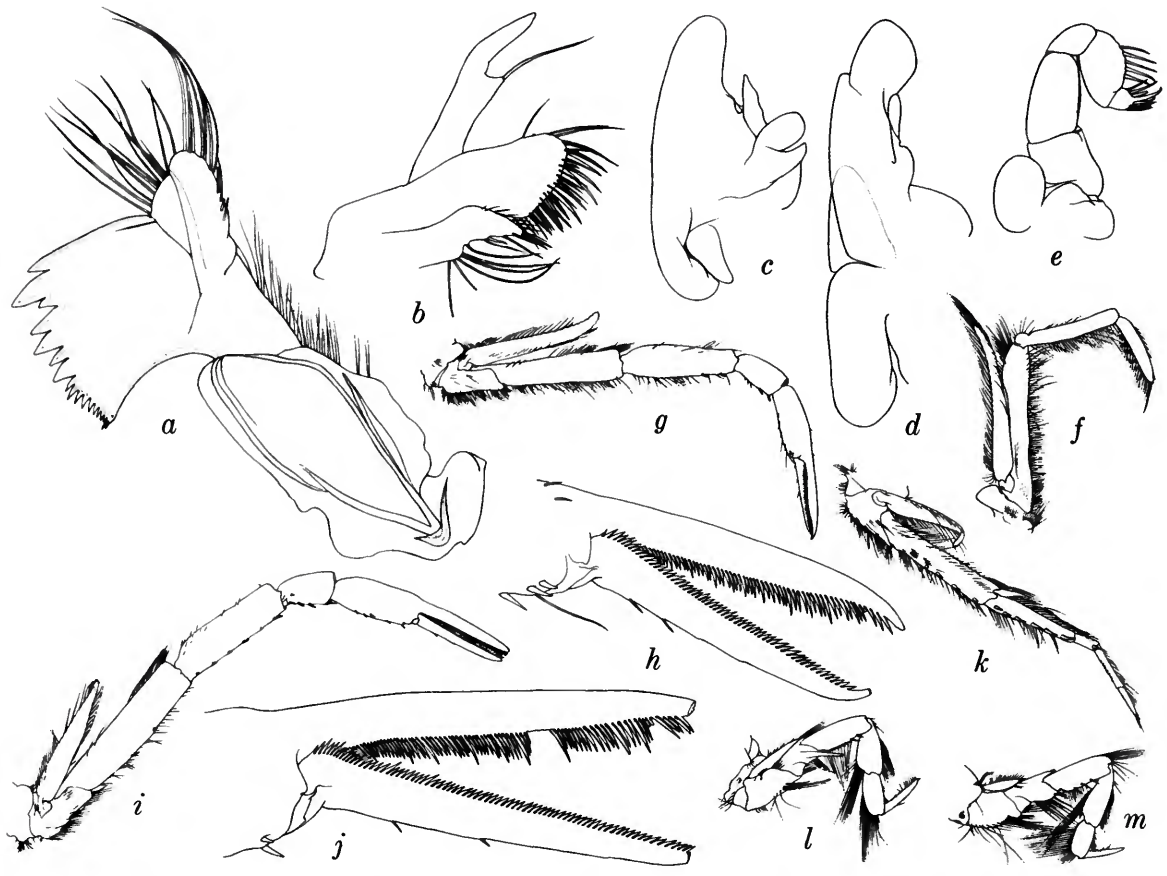

FIGURE 9.—*Leptochela* (*Leptochela*) *gracilis*, ovigerous female from Fukien, China, carapace length 9.6 mm: *a*, right mandible; *b*, right 1st maxilla; *c*, right 2nd maxilla; *d*, right 1st maxilliped; *e*, right 2nd maxilliped; *f*, right 3rd maxilliped; *g*, right 1st pereopod; *h*, same, fingers; *i*, right 2nd pereopod; *j*, same, fingers; *k*, right 3rd pereopod; *l*, right 4th pereopod; *m*, right 5th pereopod. (Magnifications: *f*, *g*, *i*, *k–m*, × 6; *c–e*, × 12; *a*, *b*, *h*, *j*, × 25.)

margins somewhat sinuous anteriorly, armed with 1 pair of dorsolateral spines near midlength, in addition to anterior mesial pair; posterior margin (Figure 8*e*) without pair of minute spines between bases of mesial pair of usual 5 pairs of prominent spines (Figure 8*f*).

Eye with rather slender papilla on mesial surface of stalk proximal to cornea, cornea slightly wider than stalk.

Antennular peduncle (Figure 8*g*) with stylocerite reaching nearly as far as distolateral margin of basal segment; 2nd segment nearly as long as distal segment in mesial aspect but distinctly shorter in dorsal aspect in spite of pronounced lobe on distal margin.

Antennal scale (Figure 8*h*) 0.6 to 0.7 as long as carapace, 4.4 to 5.0 times as long as wide; lateral margin noticeably sinuous, distal tooth continuous with mesial margin of blade, with barely discernible convexity suggesting subdistal shoulder in latter. Distal segments of antennal peduncle slightly more than ½ as wide as scale, reaching to middle ⅓ of scale; basal segment with distinct ventral spine.

Mouthparts as illustrated (Figure 9*a–f*). Third maxilliped (Figure 9*f*) not overreaching antennal

scale, distal segment about 2.3 times as long as penultimate segment.

First pereopod (Figure 9*g*) overreaching antennal scale by no more than length of fingers; fingers 0.9 to 1.3 times as long as palm; dactyl (Figure 9*h*) armed with 47 to 60 spines on opposable margin. Second pereopod (Figure 9*i*) overreaching antennal scale by no more than length of fingers; fingers 1.1 to 1.4 times as long as palm; dactyl (Figure 9*j*) armed with 48 to 76 spines on opposable margin. Third pereopod (Figure 9*k*) overreaching extreme anterior margin of carapace by about length of dactyl; exopod falling considerably short of distal end of ischium; ischium with row of setae but no spines near extensor margin but with about 5 spines near flexor margin; merus with row of about 6 similar spines near flexor margin; dactyl shorter than propodus. Fourth pereopod (Figure 9*l*) reaching nearly to distal end of ischium of 2nd pereopod when both extended anteriorly; dactyl longer than propodus. Fifth pereopod (Figure 9*m*) similar to and little shorter than 4th, reaching nearly to midlength of ischium of 2nd pereopod when both extended anteriorly; dactyl longer than propodus.

Endopod of 1st pleopod of male (Figure 10*a,b*) subsymmetrically rounded distally, lateral margin slightly concave but not flared distally. Appendix masculina (Figure 10*c,d*) bearing 7 long spines, not overreaching appendix interna, not including spines. Lateral branch of uropod (Figure 8*d*) armed with 8 to 15 movable spines (some not visible in figure).

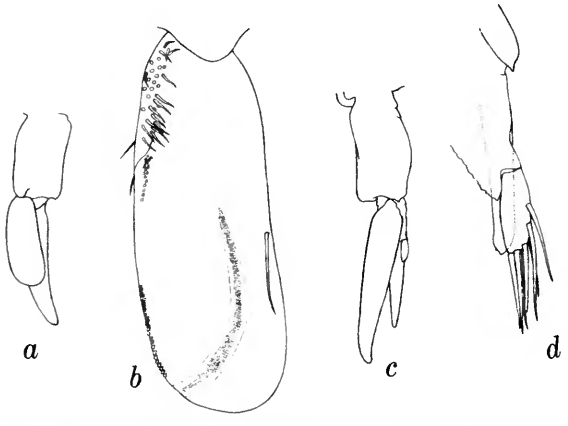

FIGURE 10.—*Leptochela* (*Leptochela*) *gracilis*, male from Fukien, China, carapace length 8.8 mm: *a*, right 1st pleopod; *b*, same, endopod; *c*, right 2nd pleopod; *d*, same, appendix masculina and appendix interna. (Magnifications: *a*, *c*, × 6; *b*, *d*, × 25.)

SIZE.—Carapace lengths of males, 7.1–8.8 mm; of nonovigerous females, 8.6, 8.8 mm; of ovigerous females, 8.0–9.6 mm.

MATERIAL.—CHINA. Ch'ingtao, Shantung: 1924; C. T. Urita: 1 ♂ (7.1). Fukien; S. F. Light: 4 ♂ (7.8–8.8) 17 ♀ (8.0–9.6) (15 ovig. (8.0–9.6)).

HABITAT.—Although *L.* (*L.*) *gracilis* is of economic importance in parts of its range and has been mentioned in the literature more frequently than any of the other species of the genus, I am unaware of any discussion of its habits or ecological relationships. This may be due to the fact that much of the important literature is in Japanese or Chinese. It seems to have been taken most commonly on or near the bottom in depths of about 30 to 194 meters, and no record of its occurrence at the surface is known to me.

TYPE-LOCALITY.—Kagoshima Wan, Kyushu, Japan.

DISTRIBUTION.—Off the coasts of China, Korea, and the Japanese islands of Kyushu, Shikoku, and Honshu, except northern end of latter, to a depth of 194 meters. The occurrence of this species in 25 meters southeast of Singapore (Boone, 1935) seems to be considerably beyond its usual range.

REMARKS.—There is no reason to believe that what might be construed as a dorsal lappet near the anterior end of the sixth abdominal somite in the illustration given by Bate (1888) is other than an artist's error. In his description, Bate referred to this structure only as "a small tooth or tubercle," and the specimen came from Osaka Wan, where *L.* (*L.*) *gracilis* should be expected.

Although the type-locality of *L. pellucida* is well beyond the limits of the recorded range of *L.* (*L.*) *gracilis*, there is little doubt that it is a synonym of the latter species. Boone (1935) does not compare her unique ovigerous female with any other species, and her description and figures do not reveal any characters that might distinguish it from *L.* (*L.*) *gracilis*, which is one of only two known species in which the carapace is not tricarinate in breeding females and the only species having a posterior spine and an otherwise entire dorsal margin on the fifth abdominal somite.

4. *Leptochela* (*Leptochela*) *hawaiiensis*, new species

FIGURES 11–13

Leptochela robusta.—Rathbun, 1906:929. [Not *L. robusta* Stimpson, 1860.]

DIAGNOSIS.—Rostrum with dorsal margin variable, straight, convex, concave, or sinuous. Carapace with 3 longitudinal dorsal ridges in breeding females only. Orbital margin minutely serrate dorsolaterally, without mesially directed tooth on ventral portion; suborbital angle unarmed. Fifth abdominal somite entire, without dorsal elevations or posterior tooth. Telson with 1 pair of dorsolateral spines in addition to anterior mesial pair; posterior margin usually with pair (frequently fused) of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale more than ½ but less than ⅔ as long as carapace. First pereopod with 21 to 30 spines on opposable margin of movable finger. Second pereopod with 25 to 36 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of 1st pleopod of male faintly obtuse but not flared distolaterally. Appendix masculina, not including spines, not overreaching appendix interna. Maximum carapace length 3.0 mm.

DESCRIPTION.—Rostrum (Figure 11*a,b*) with dorsal margin variable, straight, convex, concave, or sinuous, rarely overreaching eyes. Carapace usually without median or dorsolateral carinae in males and nonbreeding females, dorsally tricarinate over most of length in breeding females. Orbital margin (Figure 13*a,b*) minutely serrate dorsolaterally, ventral portion without mesially directed tooth; suborbital angle rounded.

Abdomen (Figure 11*c*) usually rounded dorsally on all somites, rarely with suggestion of blunt carina on 5th somite. Fifth somite entire, without dorsal prominences or posterodorsal tooth. Sixth somite fully twice as long as high, bearing usual transverse swelling near anterior end of dorsal surface, slender slightly curved spine on ventrolateral surface, and distinct acute tooth on pos-

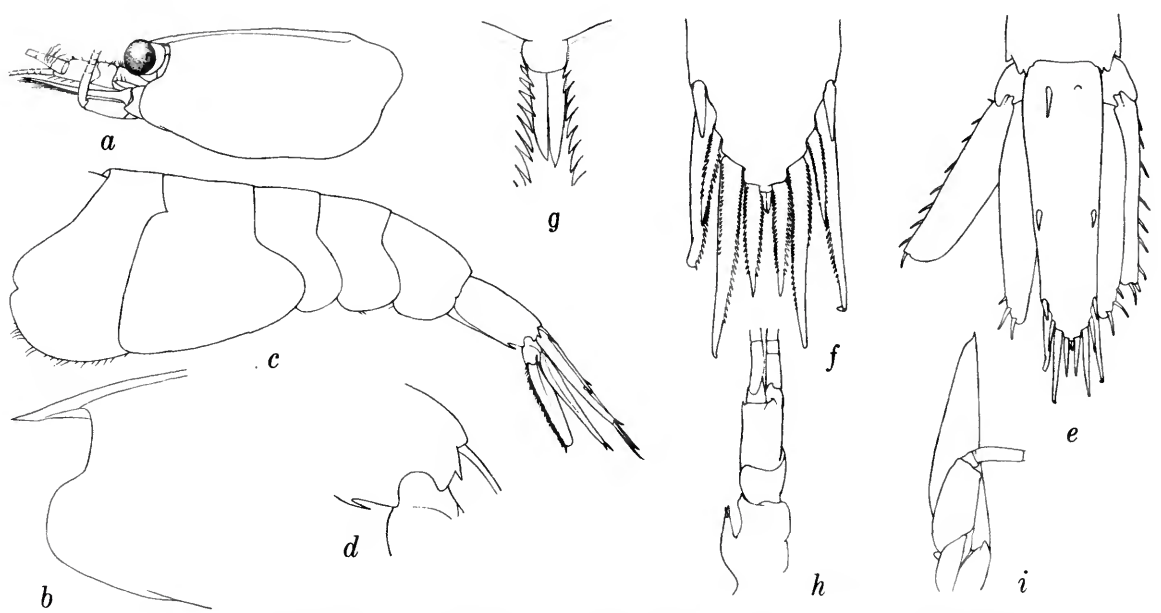

FIGURE 11.—*Leptochela* (*Leptochela*) *hawaiiensis*, holotype, female: *a*, carapace and anterior appendages; *b*, anterior part of carapace and rostrum, lateral aspect; *c*, abdomen; *d*, posterior end of 6th abdominal somite; *e*, telson and uropods; *f*, posterior margin of telson; *g*, same, mesial spines; *h*, left antennule, dorsal aspect; *i*, left antenna, ventral aspect. (Magnifications: *a*, *c*, × 12; *b*, *e*, *h*, *i*, × 25; *d*, × 45; *f*, × 62; *g*, × 260.)

FIGURE 12.—*Leptochela* (*Leptochela*) *hawaiiensis*, holotype, female: *a*, left and right mandibles, dorsal (oral) aspect; *b*, right 1st maxilla; *c*, right 2nd maxilla; *d*, right 1st maxilliped; *e*, right 2nd maxilliped; *f*, right 3rd maxilliped; *g*, right 1st pereopod; *h*, same, fingers; *i*, right 2nd pereopod; *j*, same, fingers; *k*, right 3rd pereopod; *l*, right 4th pereopod; *m*, right 5th pereopod. (Magnifications: *f*, *g*, *i*, *k–m*, × 25; *a–e*, *h*, *j*, × 62.)

terodorsal margin of posterolateral lobe (Figure 11*d*). Telson (Figure 11*e*) about 1½ times as long as 6th somite, about 2⅔ times as long as wide, armed with 1 pair of dorsolateral spines slightly posterior to midlength, in addition to anterior mesial pair; posterior margin (Figures 11*f*, 13*c*) bearing pair (frequently fused, very rarely absent) of minute mesial spines (Figures 11*g*, 13*d*, *i*) between bases of mesial pair of usual 5 pairs of prominent spines.

Eye (Figure 13*a*) with papilla on mesial surface of stalk at juncture with cornea, cornea little if at all wider than stalk.

Antennular peduncle (Figure 11*h*) with stylocerite not reaching so far as distolateral margin of basal segment; 2nd segment about as long as distal segment in ventromesial aspect but much shorter in dorsal aspect.

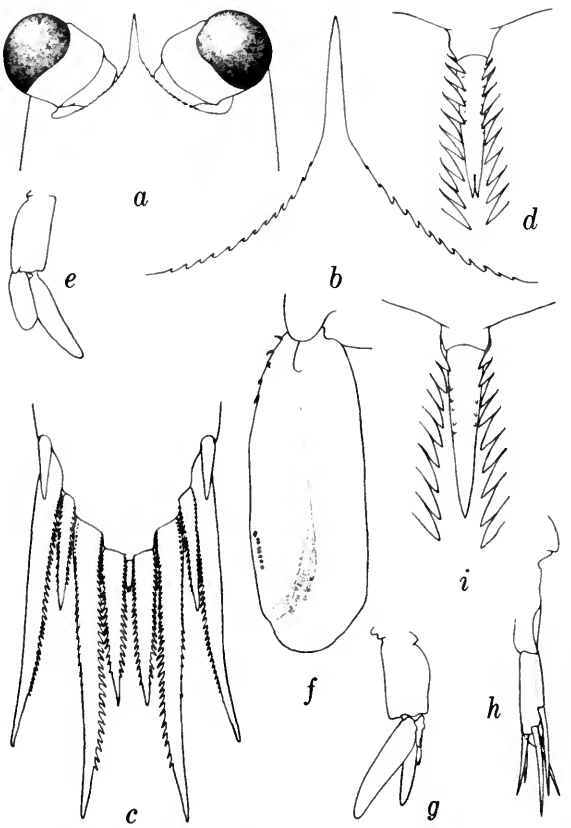

FIGURE 13.—*Leptochela* (*Leptochela*) *hawaiiensis*, paratype, male from *Albatross* Sta. 3921, carapace length 2.9 mm: *a*, anterior part of carapace and eyes, dorsal aspect; *b*, rostrum and orbital margin, dorsal aspect; *c*, posterior margin of telson; *d*, same, mesial spine; *e*, right 1st pleopod; *f*, same, endopod; *g*, right 2nd pleopod; *h*, same, appendix masculina and appendix interna. Paratype, male from *Albatross* Sta. 3921, carapace length 2.8 mm: *i*, mesial posterior spine of telson. (Magnifications: *e*, *g*, × 12; *a*, × 25; *b*, *c*, *f*, *h*, × 62; *d*, *i*, × 260.

Antennal scale (Figure 11*i*) 0.5 to 0.6 as long as carapace, 3.6 to 4.6 times as long as wide, lateral margin concave at about midlength, blade forming rather distinct shoulder at base of distal tooth. Distal segments of antennal peduncle about ⅘ as wide as scale, falling considerably short of midlength of scale; ventral tooth on basal segment neither prominent nor very sharp.

Mouthparts as illustrated (Figure 12*a–f*). Third maxilliped (Figure 12*f*) rarely reaching as far as distal end of antennal scale, distal segment nearly ¾ as long as penultimate segment.

First pereopod (Figure 12*g*) rarely overreaching antennal scale by more than length of fingers; fingers 1.2 to 1.5 times as long as palm; dactyl (Figure 12*h*) armed with 21 to 30 spines on opposable margin. Second pereopod (Figure 12*i*) rarely overreaching antennal scale by as much as length of fingers; fingers 1.4 to 2.0 times as long as palm; dactyl (Figure 12*j*) armed with 25 to 36 spines on opposable margin. Third pereopod (Figure 12*k*) overreaching extreme anterior margin of carapace by length of dactyl and about ⅔ of propodus; exopod not nearly reaching distal end of ischium; ischium bearing row of stout setae near extensor margin and 3 slender spines near flexor margin; merus armed with about 5 slender spines near flexor margin; dactyl distinctly shorter than propodus. Fourth pereopod (Figure 12*l*) reaching nearly to distal end of ischium of 2nd pereopod when both extended anteriorly; dactyl usually shorter than propodus. Fifth pereopod (Figure 12*m*) similar to and little shorter than 4th, reaching to about midlength of ischium of 2nd pereopod when both extended anteriorly; dactyl usually shorter than propodus.

Endopod of 1st pleopod of male (Figure 13*e,f*) faintly obtuse but not flared distolaterally. Appendix masculina (Figure 13*g,h*) bearing 5 long spines and not overreaching appendix interna, without including spines. Lateral branch of upopod (Figure 11*e*) armed with 5 to 11 movable spines, in addition to setae.

SIZE.—Carapace lengths of males, 2.6–3.0 mm; of nonbreeding females, 2.5–2.8 mm; of nonovigerous breeding females, 2.2, 2.4 mm; of ovigerous females, 2.4, 2.7 mm.

MATERIAL.—HAWAII. South coast of Oahu; Diamond Head Light, S 63°, E 1.3′; 12 m; coral and coral sand; 23.3°C (surface); 27 March 1902; 7:30 P.M.; electric light and dip net at surface at night anchorage; *Albatross* Sta. 3812: 4♂ (2.6–2.8) 1♀ (2.7). Same; Diamond Head Light, S 62°, E 3.9′; 24 m; coral sand and broken shell; 24°C (surface); 6 May 1902; 8:45 P.M.; electrical light and dip net at surface; *Albatross Sta.* 3921: 36♂ (2.6–3.0) 17♀ (2.2–2.8) (2 ovig. (2.4–2.7)), 1♀ (2.2) is holotype. South coast of Molokai; Avalu Point, Lanai, S 3/4′; 37 m; hard sand; 24°C (surface); 1 April 1902; 7:40–8:10 P.M.; electric light and dip net or surface tow net; *Albatross* Sta. 3829: 2♂ (2.6, 2.7).

HABITAT.—All of the specimens were taken at the surface in early evening over bottoms of coral,

coral sand, broken shell, or hard sand in depths of 12 to 37 meters.

TYPE-LOCALITY.—Off Honolulu Harbor entrance, Oahu, Hawaii; surface at night over 24 meters.

DISPOSITION OF TYPES.—The female holotype (USNM 30750) and the rest of the type-series are deposited in the National Museum of Natural History, Smithsonian Institution, under the catalog numbers of the United States National Museum (USNM).

DISTRIBUTION.—Known only from the type-series collected at the surface at night south of Oahu and south of Molokai, Hawaii, over depths of 12 to 37 meters.

ETYMOLOGY.—From Hawaii + *-ensis* (L., denoting locality).

REMARKS.—This species bears a close resemblance to *L.* (*L.*) *bermudensis* from the western Atlantic. Males are readily distinguished from that species by the different shape of the endopod of the first pleopod and by the much shorter and less spinose appendix masculina on the second pleopod. Females differ from those of *L.* (*L.*) *ber-*

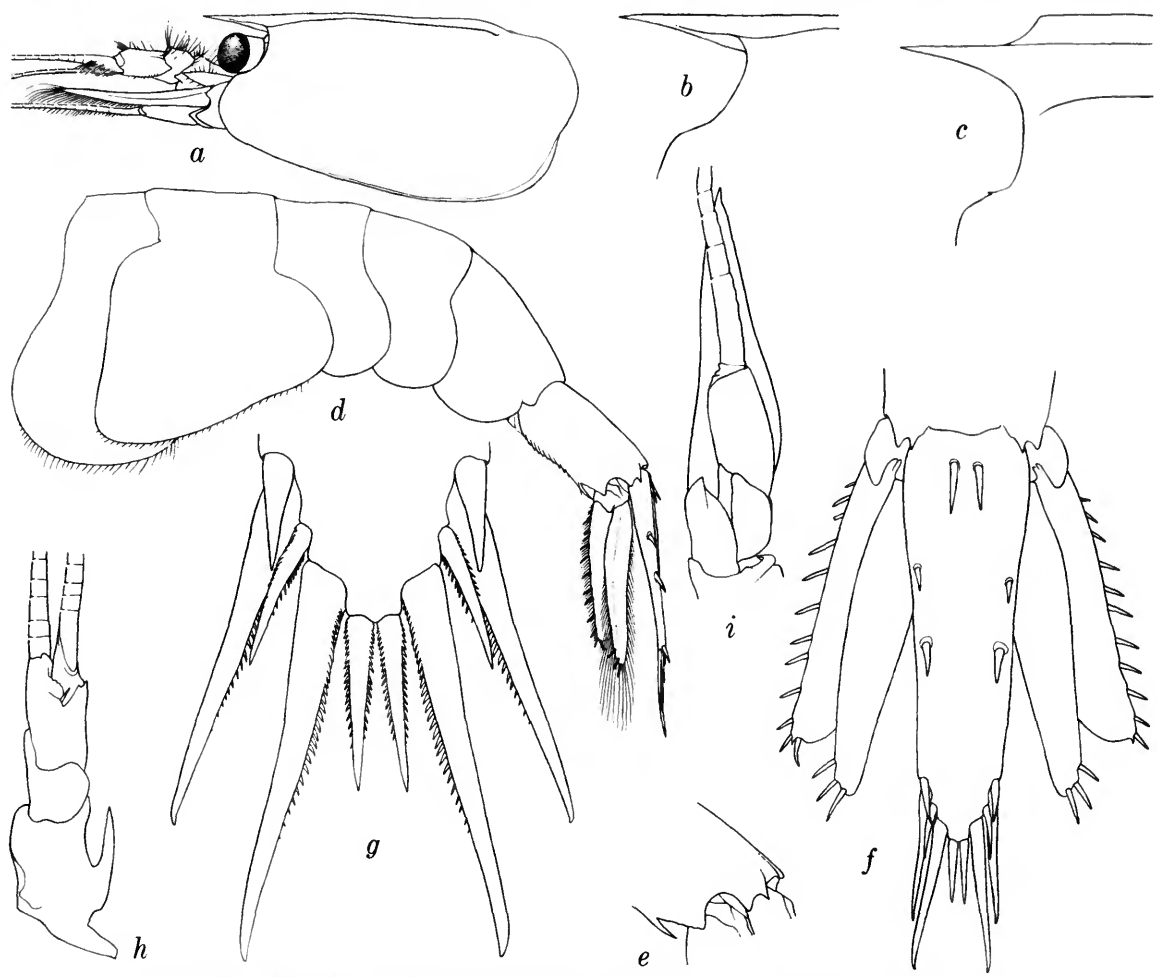

FIGURE 14.—*Leptochela* (*Leptochela*) *irrobusta*, holotype, ovigerous female: *a*, carapace and anterior appendages; *b*, rostrum and orbit, lateral aspect; *c*, same, dorsolateral aspect; *d*, abdomen; *e*, posterior end of 6th abdominal somite; *f*, telson and uropods; *g*, posterior margin of telson; *h*, right antennule, dorsal aspect; *i*, right antenna, ventral aspect. (Magnifications: *a*, *d*, × 12; *b*, *c*, *e*, *f*, *h*, *i*, × 25; *g*, × 62.

mudensis only in the more slender rostrum (in dorsal aspect) and the extremely minute serrations on the dorsolateral margin of the orbit.

Leptochela (*L.*) *hawaiiensis* superficially resembles *L.* (*L.*) *irrobusta,* which is common throughout the Indo-Pacific region westward from the Marshall and Samoa islands, but the latter species is differentiated by the extra pair of dorsolateral spines on the telson, as well as by the mesially directed tooth on the ventral portion of the orbital margin.

5. *Leptochela* (*Leptochela*) *irrobusta,* new species

FIGURES 14–18

Leptochela robusta.—Balss, 1915:17.—De Man, 1916:148 [part]; 1920:19 [part], pl. 4: fig. 7*x*.—Balss, 1921:7.—Kemp, 1925:252.—Estampador, 1937:491.—Holthuis, 1953:52.—Chace, 1955:5. [Not *L. robusta* Stimpson, 1860.]

?*Leptochela robusta.*—De Man, 1902:902.—Borradaile, 1917: 398.—Calman, 1939:188.—Armstrong, 1941:1.—George and Paulinose, 1973:196, figs. 1–5.

DIAGNOSIS.—Rostrum with dorsal margin usually straight or concave. Carapace with 3 longitudinal dorsal ridges in breeding females only. Orbital margin entire, rarely minutely serrate, with mesially directed tooth on ventral portion; suborbital angle unarmed. Fifth abdominal somite entire, without dorsal elevations or posterior tooth. Telson with 2 pairs of dorsolateral spines in addition to anterior mesial pair; posterior margin without pair of minute mesial spines in addition to usual 5 pairs of prominent spines in adults. Antennal scale nearly ⅔ as long as carapace. First pereopod with 12 to 40 spines on opposable margin of movable finger. Second pereopod with 16 to 45 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of 1st pleopod of male rounded distolaterally, not flared. Appendix masculina, not including spines, falling slightly short of or barely overreaching appendix interna. Maximum carapace length 5.1 mm.

DESCRIPTION.—Rostrum (Figure 14*a,b*) variable, dorsal margin usually straight or concave, rarely slightly sinuous or convex, frequently overreaching eyes, rarely extending to level of distal margin of basal segment of antennular peduncle. Carapace with or without obscure median dorsal carina on anterior 1/10 to ⅓ of length in males and nonbreeding females, tricarinate in breeding females, but lateral carinae often rounded in posterior half of length. Orbital margin (Figure 17*a*) usually entire, rarely microscopically serrate, especially in juveniles (Figure 16*a*); suborbital angle rounded, but ventral margin of orbit armed with mesially directed tooth visible only in dorsolateral view (Figure 14*c*).

Abdomen (Figure 14*d*) regularly rounded dorsally on 4 anterior somites. Fifth somite rounded or obscurely carinate, rarely distinctly so; dorsal margin entire, without elevations of any kind; posterior margin unarmed. Pleura of 5 anterior somites rounded in adults, those of 3rd, 4th, and 5th somites bearing small tooth in juveniles (Figure 16*b*). Sixth somite about 1.9 times as long as high, with usual transverse swelling and carina near anterior end of dorsal surface, curved slender spine posteriorly on ventrolateral surface, and distinct acute tooth on posterodorsal margin of posterolateral lobe (Figure 14*e*). Telson (Figure 14*f*), not including posterior spines, about 1½ times as long as 6th somite, about 3⅓ times as long as wide, normally armed with 2 pairs of dorsolateral spines varying slightly in size and position, in addition to anterior dorsomesial pair; posterior margin (Figure 14*g*) without minute pair of mesial spines between bases of mesial pair of usual 5 pairs of prominent spines, except occasionally in juveniles (Figure 16*c,d*).

Eye (Figure 17*a*) with papilla on mesial surface of stalk proximal to cornea, cornea slightly wider than stalk, increasing in relative diameter with size.

Antennular peduncle (Figure 14*h*) with stylocerite reaching nearly as far as distolateral margin of basal segment; 2nd segment subequal in length to distal segment in mesial aspect, less than ½ as long in dorsal aspect. Dorsolateral flagellum at least 3 times as long as carapace; ventromesial flagellum about 1⅓ times as long as carapace.

Antennal scale (Figure 14*i*) slightly more than 0.6 as long as carapace, 3.5 to 4.6 times as long as wide, lateral margin sinuous, distal tooth obscurely separated from mesial margin of blade. Distal segments of antennal peduncle about ⅔ as wide as scale, not reaching midlength of scale. Flagellum at least 3 times as long as carapace.

Mouthparts as illustrated (Figure 15*a–f*). Third maxilliped (Figure 15*f*) very rarely overreaching

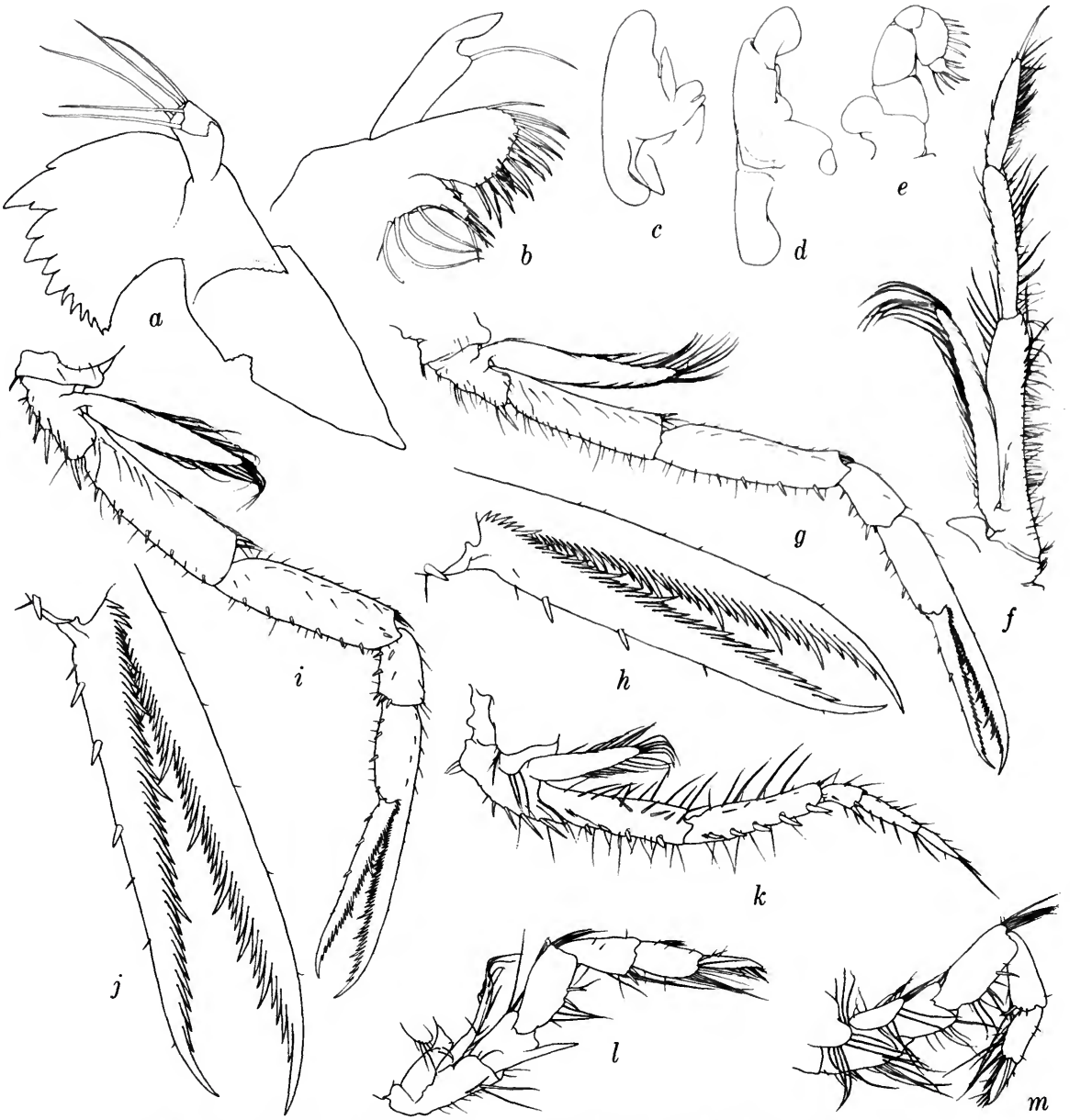

FIGURE 15.—*Leptochela* (*Leptochela*) *irrobusta*, holotype, ovigerous female: *a*, right mandible; *b*, right 1st maxilla; *c*, right 2nd maxilla; *d*, right 1st maxilliped; *e*, right 2nd maxilliped; *f*, right 3rd maxilliped; *g*, right 1st pereopod; *h*, same, fingers; *i*, right 2nd pereopod; *j*, same, fingers; *k*, right 3rd pereopod; *l*, right 4th pereopod; *m*, right 5th pereopod. (Magnifications: *c–g*, *i*, *k–m*, × 25; *a*, *b*, *h*, *j*, × 62.)

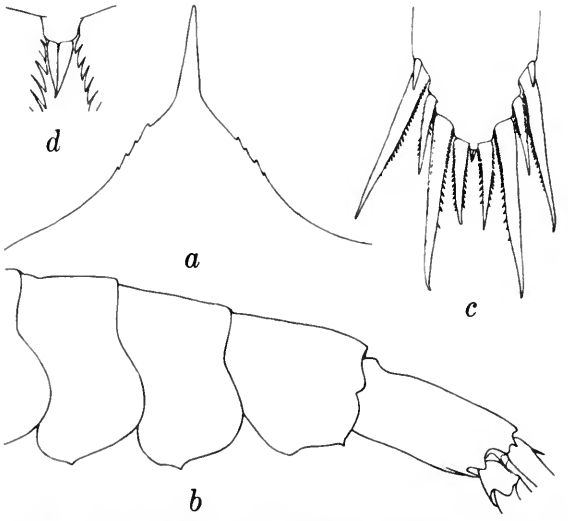

FIGURE 16.—*Leptochela* (*Leptochela*) *irrobusta*, paratype, juvenile from Bikini lagoon, carapace length 1.7 mm: *a*, rostrum and dorsal orbital margin; *b*, abdomen; *c*, posterior margin of telson; *d*, same, mesial spines. (Magnifications: *b*, × 25; *a*, *c*, × 62; *d*, × 260.)

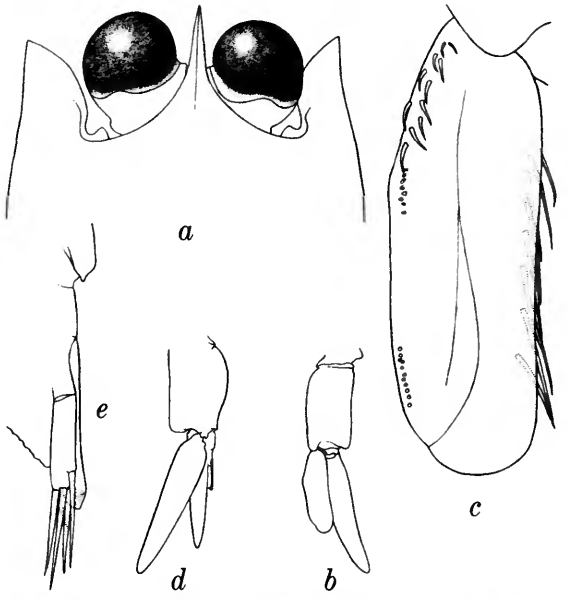

FIGURE 17.—*Leptochela* (*Leptochela*) *irrobusta*, paratype, male from Bikini lagoon, carapace length 3.6 mm: *a*, anterior part of carapace and eyes, dorsal aspect; *b*, right 1st pleopod; *c*, same, endopod; *d*, right 2nd pleopod; *e*, same, appendix masculina and appendix interna. (Magnifications: *b*, *d*, × 12; *a*, × 25; *c*, *e*, × 62.)

antennal scale, distal segment $\frac{7}{10}$ to $\frac{2}{5}$ as long as penultimate segment.

First pereopod (Figure 15*g*) overreaching antennal scale, occasionally by as much as length of fingers; fingers 1.3 to 2.0 times as long as palm; dactyl (Figure 15*h*) armed with 12 to 40 spines on opposable margin. Second pereopod (Figure 15*i*) rarely overreaching antennal scale by more than length of fingers; fingers 1.5 to 2.2 times as long as palm; dactyl (Figure 15*j*) armed with 16 to 45 spines on opposable margin. Third pereopod (Figure 15*k*) overreaching extreme anterior margin of carapace by about length of dactyl; exopod falling far short of distal end of ischium; ischium armed with row of about 4 stout spines near flexor margin; merus with about 5 longer stout spines near flexor margin; dactyl variable in length and shape, usually shorter than propodus. Fourth pereopod (Figure 15*l*) reaching to about distal $\frac{1}{5}$ of ischium of second pereopod when both extended anteriorly; dactyl usually longer, occasionally slightly shorter than propodus. Fifth pereopod (Figure 15*m*) similar to and nearly as long as 4th, reaching at least midlength of ischium of 2nd pereopod when both extended anteriorly; dactyl usually slightly shorter than propodus.

Endopod of first pleopod of male (Figure 17*b*, *c*) subelliptical, fully 3 times as long as wide. Appendix masculina (Figures 17*d*,*e*, 18*a*,*b*) bearing 3 to 7 long spines, usually in distal half, falling slightly short of or extending very little beyond end of appendix interna, not including spines. Lateral branch of uropod (Figure 14*f*) armed with 8 to 16 movable spines, in addition to setae.

SIZE.—Carapace lengths of males, 1.8–5.1 mm; of nonbreeding females, 2.0–5.1 mm; of nonovigerous breeding females, 3.2–4.3 mm; of ovigerous females, 2.7–4.6 mm. The smallest male has a rudimentary appendix masculina, but appendices masculinae may be less than fully developed in some males with a carapace length up to 3.0 mm.

MATERIAL.—PERSIAN GULF. About 200 m off southwest end of Juraid Island; 27°10′N, 49°51′E; 9 m; massive coral formations interspersed with patches of coral sand; 5 October 1956; 7:45 A.M.; Petersen sample; C. E. Dawson Sta. 7: 1 ♂ (2.9).

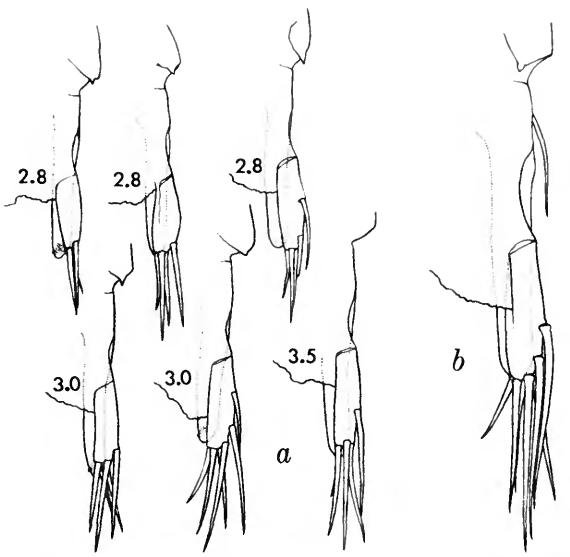

FIGURE 18.—*Leptochela* (*Leptochela*) *irrobusta*: *a*, appendices masculinae of male paratypes selected at random from Bikini lagoon, with carapace lengths (mm) as indicated; *b*, appendix masculina of male paratype, carapace length 5.0 mm, from *Albatross* Sta. 5134. (Magnifications: *a*, *b*, × 62.)

VIETNAM. Bay of Nha Trang; 1 January to 10 April 1960; Ariel Gallardo Sta. 220a: 1 ♂ (4.3). Same; Sta. 317: 1 ♀ (3.6).

PHILIPPINE ISLANDS. Sablayan Anchorage, Mindoro; electric light; 13 December 1908; *Albatross:* 1 ♀ (3.1). Batan Island, Lagonoy Gulf; electric light; 5 June 1909; *Albatross:* 1 ovig. ♀ (4.0). Port Cataingan, Masbate; electric light; 19 April 1908; *Albatross:* 1 ♂ (2.8). Nogas Point, Panay; electric light; 3 February 1908; *Albatross:* 10 ♂ (3.1–3.7) 9 ♀ (2.8–3.8) 4 juv. (1.7–2.3). Mahinog Anchorage, Camiguin Island; electric light; 3 August 1909; *Albatross:* 2 ♂ (2.5, 2.6) 9 ♀ (3.0–3.9). Sulu Sea off Panabutan Point, Mindanao; 49 m; green mud, coral sand; 6 February 1908; 9:27 A.M.; 9-foot Tanner beam trawl, mud bag; *Albatross* Sta. 5131: 1 ♀ (5.0). Same; 70 m; green mud, sand; 6 February 1908; 10:40 A.M.; 9-foot Tanner beam trawl, mud bag; *Albatross* Sta. 5133: 4 ♂ (4.7–5.1) 10 ♀ (4.2–5.1) (7 ovig. (4.2–4.6)). Off Balukbaluk Island, near Basilan Island, Sulu Archipelago; 6°44′45″ N, 121°48′ E; 46 m; fine sand; 7 February 1908; 7:22 A.M.; 9-foot Tanner beam trawl, mud bag; *Albatross* Sta. 5134: 1 ♂ (5.0). Off Jolo Island, Sulu Archipelago; 6°06′N, 120°58′50″ E; 35 m; sand, coral; 14 February 1908; 10:55 A.M.; 12-foot Agassiz beam trawl two mud bags; *Albatross* Sta. 5138: 1 ovig. ♀ (4.4).

INDONESIA. Labuan Blanda Island, Selat Butung, Celebes; electric light; 13 December 1909; *Albatross:* 1 ♂ (3.6) 2 ♀ (3.6, 3.7).

MARSHALL ISLANDS. Eniwetok Atoll; lagoon; subtidal; 6 June 1946; M. W. Johnson: 1 ♀ (3.5). Eniwetok Atoll; lagoon off Eniwetok Island at *Bowditch* anchorage; surface light at night; 23 May 1946; L. P. Schultz: 2 ♂ (2.3) 3 ♀ (2.2–2.3) 4 juv. (1.8–2.0). Eniwetok Atoll; Southwest Passage, leeward side of reef 3.7 km south of Rigili Island; surface light at night; 24 May 1946; L. P. Schultz: 10 ♂ (2.1–3.1) 18 ♀ (2.0–3.3) 10 juv. (1.6–1.9). Bikini Atoll; northeast end of lagoon at *Bowditch* anchorage; surface light at night; 30 March 1946; L. P. Schultz and V. E. Brock: 42 ♂ (2.0–3.2) 83 ♀ (2.0–3.4) (8 ovig. (2.7–3.2)) 16 juv. (1.7–2.0). Same; 23 April 1946; L. P. Schultz and J. P. E. Morrison: 46 ♂ (2.0–3.1) 46 ♀ (2.1–3.7) 8 juv. (1.8–2.0) + 452 ♂, ♀, & juv. (1 ovig.). Same; 24 April 1946; L. P. Schultz: 47 ♂ (1.8–3.4) 46 ♀ (2.2–3.4) (5 ovig. (2.9–3.2)) 7 juv. (1.7–2.1) + 1,731 ♂, ♀, & juv. (13 ovig.), 1 ovig. ♀ (3.0) is holotype. Same; 25 April 1946; L. P. Schultz: 40 ♂ (2.0–3.4) 51 ♀ (2.0–3.5) 9 juv. (1.4–1.9) + 1,005 ♂, ♀, & juv. (4 ovig.). Bikini Atoll; lagoon, 7.4 km south of west end of Bikini Island; about 45 m; sand and *Halimeda;* 26 August 1947; J. P. E. Morrison: 1 ♂ (2.8). Rongelap Atoll; lagoon, 0.9 km off Yugui Island; 24 m; surface light at night; 30 July 1946; E. S. Herald: 20 ♂ (2.0–3.0) 36 ♀ (2.0–3.0) 74 juv. (1.4–2.0). Rongelap Atoll; lagoon, 0.9 km off Lomuilal Island; 24 m; surface light at night; 31 July 1946; E. S. Herald: 2 ♂ (2.3) 3 ♀ (2.1–2.9). Rongerik Atoll; lagoon, 183 m off Eniwetak Island; surface light at night; 28 June 1946; L. P. Schultz and E. S. Herald: 12 ♂ (2.4–3.4) 5 ♀ (2.5–3.1). Ujae Atoll; 60 m outside Ujae Passage; surface at stern of ship under lights; 1951–1952; F. S. MacNeil: 5 ♂ (2.7–3.0) 3 ♀ (2.0–3.1).

HABITAT.—It will be noted that ⅔ of the lots and all but 24 of the 3876 specimens listed above were taken at surface lights at night. That the species sometimes occurs on or near the bottom, however, is indicated by the 14 specimens trawled at *Albatross* station 5133 and, especially, by the single male taken in a Petersen grab in the Persian Gulf. The trawled specimens were found in depths of 35 to 70 meters on bottoms of mud or sand, sometimes with fragments of coral or calcareous algae.

TYPE-LOCALITY.—Lagoon of Bikini Atoll, Marshall Islands; surface at night.

DISPOSITION OF TYPES.—The ovigerous female holotype (USNM 94729) and the rest of the type-series are deposited in the National Museum of Natural History, Smithsonian Institution, under the catalog numbers of the United States National Museum (USNM).

DISTRIBUTION.—Red Sea and Persian Gulf, Laccadive, Maldive, Andaman, and Nicobar islands, Burma, Western Australia, Indonesia, and Philippine Islands eastward to the Marshall and Samoa islands, at the surface and to depths of 118 and

possibly 275 meters. (See *L.* (*L.*) *robusta.*)

ETYMOLOGY.—From *ir-* (L., = not) + *robusta.*

REMARKS.—Quite understandably, this abundant wide-ranging, and variable little species has been confused heretofore with *L.* (*L.*) *robusta.* Immature females of the latter species can seldom be distinguished from *L.* (*L.*) *irrobusta* with confidence. In general, *L.* (*L.*) *irrobusta* has the rostrum proportionately longer, the spine on the ventrolateral surface of the posterior part of the sixth abdominal somite curved rather than nearly straight, and the posterior pair of dorsolateral spines arising near the midlength of the telson rather than more posteriorly, but the species is so variable that these characters are not always reliable. The size of sexually mature individuals—carapace lengths of 2.7 to 4.6 mm in *L.* (*L.*) *irrobusta* and more than 6 mm in *L.* (*L.*) *robusta*—is important, but it is useful only for tricarinate females, because nonbreeding females may be larger than ovigerous ones. The only really definitive character lies in the length, form, and spination of the male appendix masculina (compare Figures 18 and 28*e–h*). That this character is meaningful is confirmed by comparing Figure 28*f* showing the form of the appendix masculina in a male *L.* (*L.*) *robusta* with a carapace length of 3.0 mm, with Figure 18*b*, which illustrates the appendix in a considerably larger male of *L.* (*L.*) *irrobusta.*

Most of the Red Sea specimens examined through the kind cooperation of L. B. Holthuis and mentioned in the Remarks section under *L. aculeocaudata* belong to *L. irrobusta,* but they are not otherwise treated as part of this report nor are they included in the type-series of this species.

6. *Leptochela* (*Leptochela*) *japonica* Hayashi and Miyake

FIGURES 19–21

Leptochela japonica Hayashi and Miyake, 1969:1, figs. 1, 2.—Fujino and Miyake, 1970:242.

DIAGNOSIS.—Rostrum with dorsal margin slightly sinuous. Carapace with 3 longitudinal dorsal ridges in both males and females. Orbital margin entire, not serrate, without mesially directed tooth on ventral portion; suborbital angle unarmed. Fifth abdominal somite with 3 distinct elevations in dorsal midline, posterior margin bluntly produced mesially. Telson with 1 pair of dorsolateral spines in addition to anterior mesial pair; posterior margin without pair of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale slightly more than ½ as long as carapace. First pereopod with about 48 spines on opposable margin of movable finger. Second pereopod with about 60 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of 1st pleopod of male not flared distolaterally. Appendix masculina, not including spines, slightly overreaching appendix interna. Maximum carapace length 6.2 mm.

DESCRIPTION OF MALE.—Rostrum (Figure 19*a*) with dorsal margin faintly sinuous, not overreaching eyes. Carapace with distinct median carina extending posteriorly slightly beyond midlength and with well-marked pair of dorsolateral carinae extending to about posterior 1.3 of carapace. Orbital margin entire, not serrate, ventral portion without mesially directed tooth; suborbital angle broadly rounded, unarmed.

Abdomen (Figure 19*b*) rounded dorsally on 3 anterior somites, distinctly carinate in midline on 4th and 5th, latter surmounted by 3 low but distinct elevations and projecting posteriorly as blunt tooth. Sixth somite about 1½ times as long as high, transverse swelling near anterior end of dorsal surface bearing high sharp carina trending slightly anteriorly; spine on ventrolateral surface slightly curved; posterolateral lobe (Figure 19*c*) without tooth on posterodorsal margin. Telson (Figure 19*d*) less than 1½ times as long as 6th somite, about 2½ times as long as wide, armed with 1 pair of dorsolateral spines arising at about midlength, in addition to anterior mesial pair; posterior margin without pair of minute spines between bases of mesial pair of usual 5 pairs of prominent spines.

Eye with papilla on mesial surface of stalk proximal to juncture with cornea, cornea unusually inflated, much wider and longer than stalk.

Antennular peduncle (Figure 19*e*) with stylocerite reaching about as far as distolateral margin of basal segment; 2nd segment about as long as distal segment in ventromesial aspect, much shorter in dorsal aspect.

Antennal scale (Figure 19*f*) nearly 0.6 as long

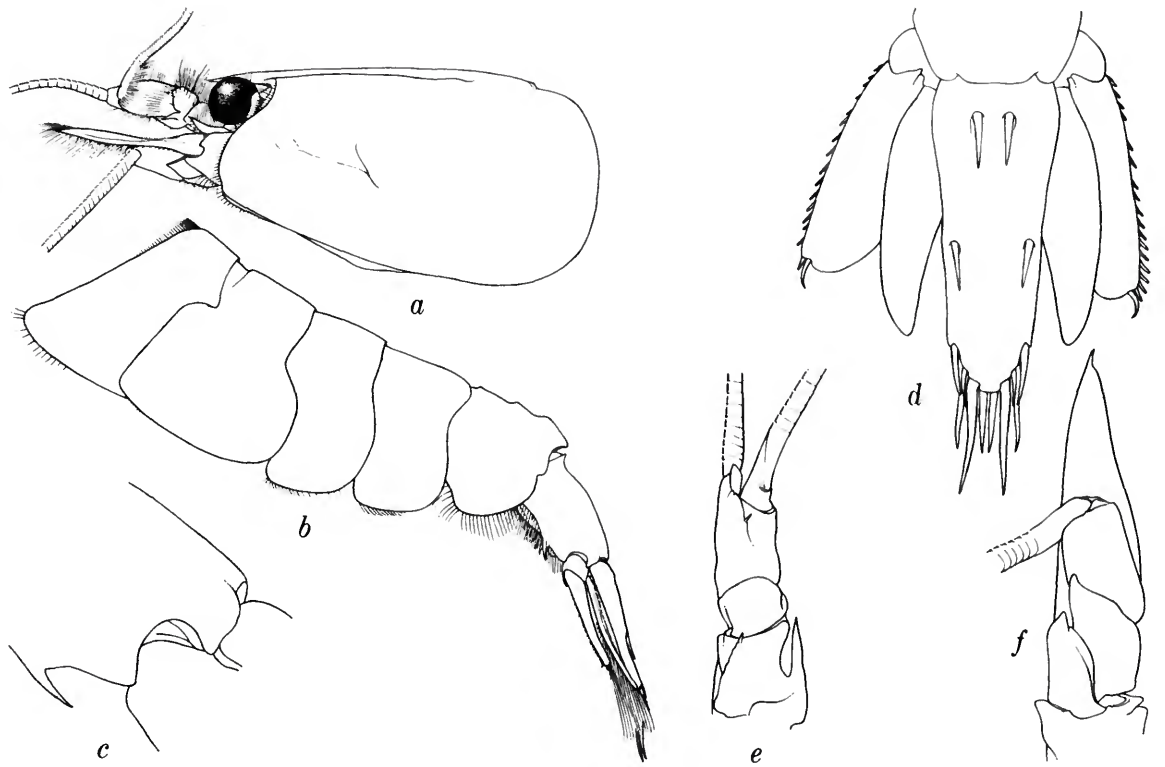

FIGURE 19.—*Leptochela (Leptochela) japonica*, male from Gulf of Thailand, carapace length 5.8 mm: *a*, carapace and anterior appendages; *b*, abdomen; *c*, posterior end of 6th abdominal somite; *d*, telson and uropods; *e*, right antennule, dorsal aspect; *f*, right antenna, ventral aspect. (Magnifications: *a*, *b*, × 6; *d–f*, × 12; *c*, × 25.)

as carapace, 3.4 times as long as wide, lateral margin convex distally, nearly straight on proximal ⅔ of length, blade forming slight shoulder at base of distal tooth. Distal segments of antennal peduncle about $^9/_{10}$ as wide as scale, reaching nearly to midlength of scale; ventral tooth on basal segment blunt, rather indistinct.

Mouthparts as illustrated (Figure 20*a–f*). Mandible (Figure 20*a*) with rather distinct angle in distal margin of incisor process. Third maxilliped (Figure 20*f*) not reaching as far as distal end of antennal scale, distal segment nearly ⅘ as long as penultimate segment.

First pereopod (Figure 20*g*) overreaching antennal scale by little more than length of fingers; fingers about as long as palm; dactyl (Figure 20*h*) armed with 48 spines on opposable margin. Second pereopod (Figure 20*i*) overreaching antennal scale by nearly length of fingers; fingers 1.3 times as long as palm; dactyl (Figure 20*j*) armed with 60 spines on opposable margin. Third pereopod (Figure 20*k*) overreaching extreme anterior margin of carapace by nearly ½ length of dactyl; exopod not nearly reaching distal end of ischium; ischium with row of about 6 slender spines near middle of lateral surface and 3 oblique rows of 3, 8, and 7 stouter spines near flexor margin; merus with row of 10 stout spines, increasing in length distally, near flexor margin; dactyl subequal in length of propodus. Fourth pereopod (Figure 20*l*) reaching at least to midlength of 2nd pereopod when both extended anteriorly; merus with rather discrete subrectangular lobe bearing 2 stout spines on flexor margin; dactyl shorter than propodus.

FIGURE 20.—*Leptochela* (*Leptochela*) *japonica*, male from Gulf of Thailand, carapace length 5.8 mm: *a*, right mandible; *b*, right 1st maxilla; *c*, right 2nd maxilla; *d*, right 1st maxilliped; *e*, right 2nd maxilliped; *f*, right 3rd maxilliped; *g*, right 1st pereopod; *h*, same fingers; *i*, left 2nd pereopod; *j*, same, fingers; *k*, right 3rd pereopod; *l*, right 4th pereopod; *m*, right 5th pereopod. (Magnifications: *f*, *g*, *i*, *k–m*, × 12; *a–e*, *h*, *j*, × 25.)

Fifth pereopod (Figure 20*m*) reaching to about distal ⅓ of ischium of 3rd pereopod when both extended anteriorly; similar to 4th, especially in form of merus, but distinctly shorter; dactyl much shorter than propodus.

Endopod of first pleopod (Figure 21*a,b*) long and comparatively narrow, nearly 3 times as long as wide, broadly and obscurely obtuse, but not flared, distolaterally. Appendix masculina (Figure 21*c,d*) bearing 7 long spines and slightly overreaching appendix interna, not including spines. Lateral branch of uropod (Figure 19*d*) armed with about 20 movable spines increasing in length distally.

SIZE.—Carapace lengths of males, 4.0 and 5.8 mm. Hayashi and Miyake (1969:5) noted that the four ovigerous females in the type-series have carapace lengths of 5.5–6.2 mm, and the single female without eggs has a carapace length of 4.2 mm.

MATERIAL.—GULF OF THAILAND. Shore reef region on east side of Goh Kram Island; 12°41′35″N, 100°48′28″E; 25 October 1957; George Vanderbilt Foundation Sta. 8: 1 ♂ (5.8).

QUEENSLAND, AUSTRALIA. Bustard Bay (24°05′S, 151°48′E); 19 September 1938; Haul 46/38 (old number, Net 200; K. Sheard: 1 ♂ freshly molted (4.0) (Australian Museum).

HABITAT.—The four ovigerous females in the type-series were dredged in 45 and 65–66 meters; the single female without eggs was taken in a surface plankton net at night.

TYPE-LOCALITY.—Tachibana-wan (Chijiwa Bay northwestern Kyushu, Japan; 65–66 meters.

DISTRIBUTION.—Korea Strait; northeast of Twiwan; Gulf of Thailand; and Queensland, Australia; 45–111 meters.

REMARKS.—Proof of the identity of the male from the Gulf of Thailand with *L.* (*L.*) *japonica* must be deferred until additional material becomes available. The Thailand specimen has the dorsal projections on the fifth abdominal somite less prominent, and there seem to be subtle and unexpected differences in some of the mouthparts, but the specimen agrees in most other particulars with the description of *L.* (*L.*) *japonica,* even to the spination on the third pereopod and the characteristic shape of the merus of the fourth and fifth pereopods. Certainly the most interesting feature of the specimen is the dorsally tricarinate carapace, a development that was previously believed to be restricted to breeding females in *Leptochela.*

In the freshly molted male from Queensland, the projections of the fifth abdominal somite are stronger, much as depicted by Hayashi and Miyake (1969: fig. 1*a*), and the carapace—as well as can be determined from the soft and misshapen integument—seems to be tricarinate to the same extent as in the male from Thailand.

There is little doubt that *L.* (*L.*) *japonica* is related to *L.* (*P.*) *carinata* from the western Atlantic. Both species have dorsal projections on the fifth abdominal somite, unusually numerous spines on the opposable margins of the fingers of the two anterior pairs of pereopods, and reduced fifth pereopods. *Leptochela* (*L.*) *japonica* differs rather strikingly from *L.* (*P.*) *carinata,* however, in lacking the hinged dorsal lappet on the sixth abdominal somite, in the form of the telson, and in the much shorter and broader antennal scale. The former species therefore seems to represent a link between the two subgenera proposed above.

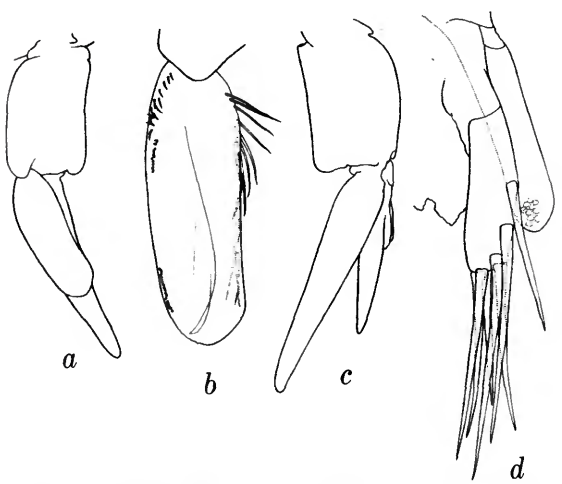

FIGURE 21.—*Leptochela* (*Leptochela*) *japonica,* male from Gulf of Thailand, carapace length 5.8 mm: *a,* right 1st pleopod; *b,* same, endopod; *c,* right 2nd pleopod; *d,* same, appendix masculina and appendix interna. (Magnifications: *a, c,* × 12; *b,* × 25; *d,* × 62.)

7. *Leptochela* (*Leptochela*) *papulata,* new species

FIGURES 22–24

DIAGNOSIS.—Rostrum with dorsal margin convex or slightly sinuous. Carapace with 3 longitudi-

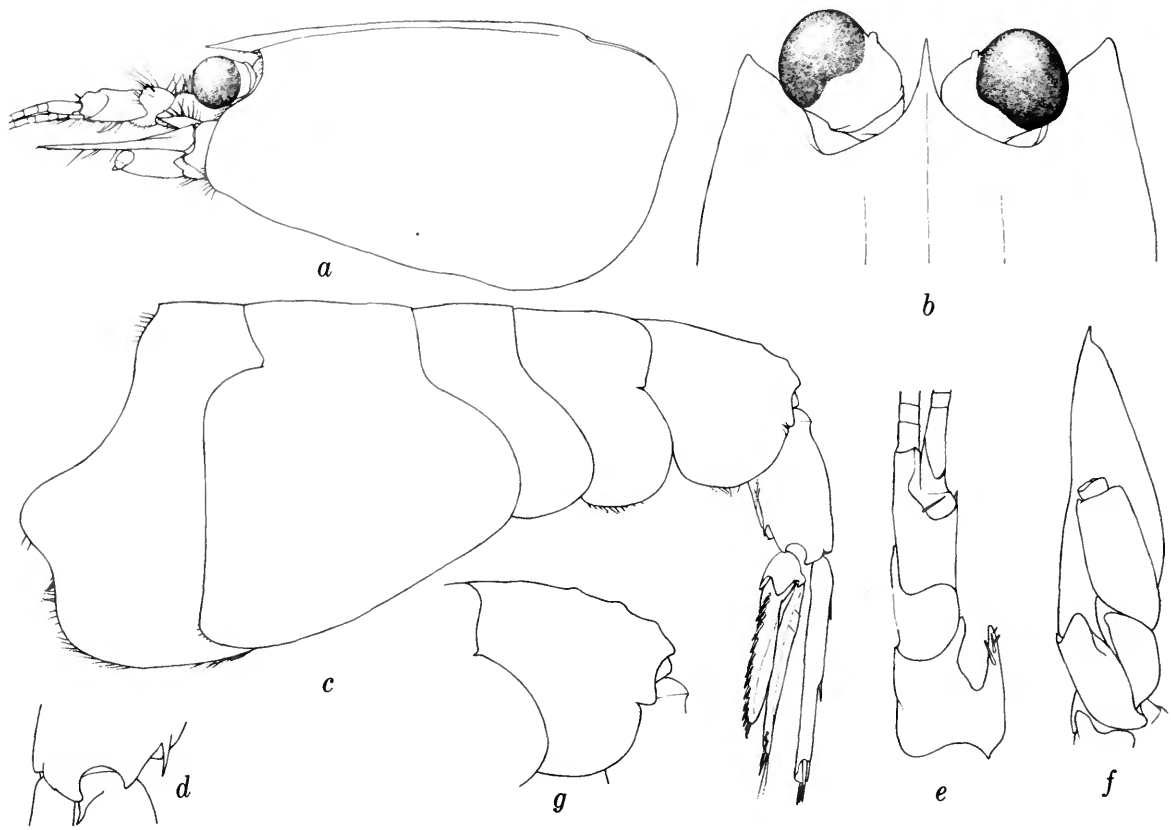

FIGURE 22.—*Leptochela* (*Leptochela*) *papulata*, holotype, ovigerous female: *a*, carapace and anterior appendages; *b*, anterior part of carapace and eyes, dorsal aspect; *c*, abdomen; *d*, posterior end of 6th abdominal somite; *e*, right antennule, dorsal aspect; *f*, right antenna, ventral aspect. Paratype, ovigerous female from *Grampus* Sta. 5099, carapace length 4.4 mm: *g*, 5th abdominal somite, lateral aspect. (Magnifications: *a*, *c*, *g*, × 12; *b*, *d*–*f*, × 25.)

nal dorsal ridges in breeding females only. Orbital margin entire, rarely minutely serrate, without mesially directed tooth on ventral portion; suborbital angle unarmed. Fifth abdominal somite with 1 to 3 more or less distinct pimplelike elevations in posterior half of dorsal midline, without posterior tooth. Telson with 1 pair of dorsolateral spines in addition to anterior mesial pair; posterior margin with pair of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale barely ½ as long as carapace. First pereopod with 16 to 28 spines on opposable margin of movable finger. Second preopod with 22 to 36 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of 1st pleopod of male flared distolaterally. Appendix masculina, not including spines, distinctly overreaching appendix interna. Maximum carapace length 4.4 mm.

DESCRIPTION.—Rostrum (Figure 22*a*) usually with dorsal margin regularly convex, rarely slightly concave in anterior half, usually falling short of distal surface of eye, rarely overreaching basal segment of antennular peduncle. Carapace with median dorsal carina on anterior ⅓ to ½ of length in males and nonbreeding females, sharply tricarinate over most of length in breeding females. Orbital margin (Figure 22*b*) entire, rarely minutely serrate, ventral portion without mesially

FIGURE 23.—*Leptochela* (*Leptochela*) *papulata*, paratype, carinate female from *Atlantis* Sta. A-266-36, carapace length 2.7 mm: *a*, telson and left uropod; *b*, posterior margin of telson; *c*, same, mesial spines; *d*, right mandible; *e*, right 1st maxilla; *f*, right 2nd maxilla; *g*, right 1st maxilliped; *h*, right 2nd maxilliped; *i*, right 3rd maxilliped; *j*, right 1st pereopod; *k*, same, fingers; *l*, right 2nd pereopod; *m*, same, fingers; *n*, right 3rd pereopod; *o*, right 4th pereopod; *p*, right 5th pereopod. (Magnifications: *a*, *f–j*, *l*, *n–p*, × 25; *b*, *d*, *e*, *k*, *m*, × 62; *c*, × 260.)

directed tooth; suborbital angle rounded, not dentate.

Abdomen (Figure 22*c*) regularly rounded dorsally on 4 anterior somites. Fifth somite (Figure 22*c,g*) bluntly carinate dorsally, carina usually surmounted in posterior half by 1 to 3 (usually 3) pimplelike elevations, rarely with barely visible vestiges thereof; posterior margin unarmed. Sixth somite about 1.6 times as long as high, with usual transverse swelling and carina near anterior end of dorsal surface, long slender spine on ventrolateral surface, and usually with minute blunt tooth (Figure 22*d*) on posterodorsal margin of posterolateral lobe (tooth sometime lacking, rarely prominent and acute). Telson (Figure 23*a*), not including posterior spines, about 1.8 times as long as 6th somite, about 3.4 times as long as wide, armed with 1 pair of dorsolateral spines at about midlength, in addition to anterior mesial pair; posterior margin (Figure 23*b*) bearing pair of minute spines (Figure 23*c*) between bases of mesial pair of usual 5 pairs of prominent spines.

Eye (Figure 22*b*) with papilla on mesial surface of stalk proximal to cornea, cornea slightly wider than stalk.

Antennular peduncle (Figure 22*e*) with statocertie reaching nearly as far as distolateral margin of basal segment; 2nd segment longer than distal segment in mesial aspect but distinctly shorter in dorsal aspect.

Antennal scale (Figure 22*f*) barely 0.5 as long as carapace, 2.8 to 3.5 times as long as wide, lateral margin sinuous, blade forming rather distinct shoulder at base of distal tooth. Distal segments of antennal peduncle about ⅔ as wide as scale and nearly reaching midlength of scale.

Mouthparts as illustrated (Figure 23*d–i*). Third maxilliped (Figure 23*i*) rarely overreaching antennal scale, distal segment about ⅘ as long as penultimate segment.

First pereopod (Figure 23*j*) usually overreaching antennal scale by little more than length of fingers; fingers 1.2 to 1.5 times as long as palm; dactyl (Figure 23*k*) armed with 16 to 28 spines on opposable margin. Second pereopod (Figure 23*l*) sometimes overreaching antennal scale by more than length of fingers; fingers 1.6 to 2.0 times as long as palm; dactyl (Figure 23*m*) armed with 22 to 36 spines on opposable margin. Third pereopod (Figure 23*n*) overreaching extreme anterior margin of carapace by about length of dactyl; exopod falling far short of distal end of ischium; ischium armed with row of about 9 slender sharp spines near extensor margin and 3 subequally spaced stout spines on lateral surface; merus with 4 longer blunt spines on lateral surface; dactyl slightly shorter than propodus. Fourth pereopod (Figure 23*o*) overreaching ischium of 2nd pereopod by about length of dactyl when both extended anteriorly; dactyl shorter than propodus. Fifth pereopod (Figure 23*p*) similar to and only slightly shorter than 4th, reaching to about distal ⅓ of ischium of 2nd pereopod when both extended anteriorly; dactyl nearly as long as propodus.

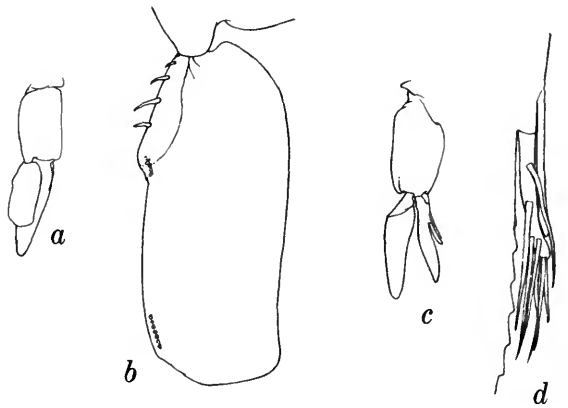

FIGURE 24.—*Leptochela* (*Leptochela*) *papulata*, paratype, male from *Beveridge* Sta. BST. 271, V, carapace length 2.6 mm: *a*, right 1st pleopod; *b*, same, endopod; *c*, right 2nd pleopod; *d*, same, appendix masculina and appendix interna. (Magnifications: *a*, *c*, × 12; *b*, *d*, × 62.)

Endopod of 1st pleopod of male (Figure 24*a,b*) with lateral margin flared distally. Appendix masculina (Figure 24*c,d*) bearing 7 long spines, distinctly overreaching appendix interna, without including spines. Lateral branch of uropod (Figure 23*a*) armed with 10 to 17 movable spines, in addition to setae.

SIZE.—Carapace lengths of males, 2.1–3.9 mm; of nonbreeding females, 2.2–3.6 mm; of nonovigerous breeding females, 2.7, 3.9 mm; of ovigerous females, 3.2–4.4 mm; of juveniles, 1.6–2.0 mm. The smallest male has a barely discernible appendix masculina; the smallest male with a fully developed appendix masculina has a carapace length of 2.6 mm.

MATERIAL.—NORTH CAROLINA. East of Cape Lookout; 34°35′30″N, 75°45′30″W; 59 m; white sand with black specks; 18 October 1885; large beam trawl; *Albatross* Sta. 2605: 1 ovig. ♀ (3.8) holotype. Southeast of Cape Lookout; 34°34.5′N, 76°25.5′W; 20 m; sand and broken shell; 9°C; 19 January 1966; dredge; *Beveridge* (J. H. Day Sta. BST. 271. V.): 1 ♂ (2.6) 1 ♀ (2.5). Same locality and date; 0.2m² Van Veen grab; *Beveridge* (J. H. Day Sta. BST 274. E.): 1 ♀ (2.2). 34°28.5′N, 76°13.1′W; 33 m; 15 February 1965; Van Veen grab; *Eastward* Sta. 489: 1 juv. (2.0). 34°28.1′N, 76°20.0′W; 27 m; 15 February 1965; small biological trawl; *Eastward* Sta. 497: 1 ♀ (2.7) 1 juv. (2.0). 34°24.8′N, 75°59.5′W; 40 m; coarse sand and mud; 20.6°C; 30 November 1965; dredge; *Eastward* Sta. 3464 (J. H. Day Sta. BST. 236. P.): 1 y ♂ (2.1). 34°20.0′N, 75°54.5′W; 202 m; hard packed; 8 January 1966; dredge; *Eastward* Sta. 3538 (J. H. Day Sta. BST. 289, M.): 1 juv. (1.6+). South of Cape Lookout; 34°04.5′N, 75°25.5′W; 20 m; coarse sand; 20°C; 24 November 1965; 0.2m² Van Veen grab; *Beveridge* (J. H. Day Sta. BST. 233. N.): 1 ovig. ♀ (3.5).

SOUTH CAROLINA. Southeast of Charleston; 32°12′N, 79°15′W; 46 m; terigenous sand, shell debris; 12 July 1961 (1730–1732); Van Veen grab; *Atlantis* Sta. A-266-36: 1 ♀ (2.7).

GEORGIA. Sapelo Whistle 335°–5½ km; 21 m; 28 February 1962; M. Gray: 1 ♀ (3.6). East of Doboy Sound Sea Buoy 13–46 km; 16–22 m; 4 December 1962; M. Gray: 1 ♀ (2.9).

GULF OF MEXICO. South of Cape San Blas, Florida; 29°15′30″N, 85°29′30″W; 49 m; gravel; 7 February 1885; large beam trawl; *Albatross* Sta. 2372: 1 ♀ (3.6). Anclote Light, Florida, E 7/8 N-39.8 km; 23 m; rock, coral, and sand; 17.2°C; 28 March 1901 (10:30 A.M.); dredge; *Fish Hawk* Sta. 7106: 1 ♂ (3.2). Southwest of Sarasota, Florida; 27°04′00″N, 83°21′15″W; 48 m; coarse gray sand and broken shell; 18 March 1885; large beam trawl; *Albatross* Sta. 2409: 1 ♂ (3.9). West of Captiva Island, Florida; 26°33′N, 83°10′W; 51 m; sandy; 19.1°C; 2 April 1901 (6.30 A.M.); 7-ft beam trawl; *Fish Hawk* Sta. 7123: 1 ovig. ♀ (3.9). West of Marco Florida; 26°04′00″N, 82°49′00″W; 39 m; sand and broken shell; 17 March 1889; hand dredge; *Grampus* Sta. 5099: 1 ovig. ♀ (4.4). 25°54′00″N, 83°20′00″W; 57 m; gray sand with black specks and broken shell; 15 March 1889; hand dredge; *Grampus* Sta. 5092; 2 ♀ (3.2, 3.9) (1 ovig. (3.2)). Northwest of Dry Tortugas; 25°34′00″N, 83°28′00″W; 71 m; gray coral and fine shell; 1 March 1889; hand dredge; *Grampus* Sta. 5076: 1 ♂ (3.8).

HABITAT.—In depths of 20 to 202 meters, usually less than 70 meters, commonly on bottoms of sand, frequently with shell fragments, occasionally on gravel, rock, and coral, at bottom temperatures ranging from 9° to 20.6°C.

There is no evidence from the material available that *L.* (*L.*) *papulata* approaches the surface at night, as do *L.* (*L.*) *bermudensis* and *L.* (*L.*) *serratorbita*, but additional surface or subsurface collections in the region inhabited by the former species may refute this assumption; the fact that, on four different occasions, specimens of *L.* (*L.*) *papulata* were found in grab samples indicates that the species must spend some time in actual contact with the bottom.

TYPE-LOCALITY.—East of Cape Lookout, North Carolina; 34°35′30″N, 75°45′30″W; 59 meters.

DISPOSITION OF TYPES.—The ovigerous female holotype (USNM 23375) and the rest of the type-series are deposited in the National Museum of Natural History, Smithsonian Institution, under the catalog numbers of the United States National Museum (USNM).

DISTRIBUTION.—Off North Carolina to Georgia and the eastern Gulf of Mexico, in depths of 20 to 202 meters.

ETYMOLOGY.—From *papula* (L., = pimple) + *atus* (L., = provided with), in reference to the one to three elevations usually present in the dorsal midline of the fifth abdominal somite.

REMARKS.—Apparently this species is closely related to *L.* (*L.*) *bermudensis*, as indicated by the form of the endopod of the first pleopod in males and the length of the appendix masculina, as well as by most other characters. It may be a slightly larger species, the smallest ovigerous female having a carapace length of 3.2 mm, whereas the largest specimens of *L.* (*L.*) *bermudensis* currently available have a carapace length of only 3.0 mm, and females of that species may be ovigerous at a carapace length of 2.4 mm. Most specimens of *L. papulata* may be distinguished by the one to three (usually three) elevations in the dorsal midline of the fifth abdominal somite; occasionally, even in mature individuals, these elevations are so obscure as to be barely discernible, but the dorsal margin of the fifth somite is always faintly sinuous in lateral view, rather than regularly convex as in *L.* (*L.*) *bermudensis*. Also, the posterolateral extension of the sixth abdominal somite is usually unarmed or bears an obscure blunt or subacute tooth, rather than the prominent acute tooth usually present in *L.* (*L.*) *bermudensis;* however, occasional specimens of *L.* (*L.*) *papulata* have a tooth nearly as prominent and sharp as in *L.* (*L.*) *bermudensis*. Finally, the anterior margin of the carapace is usually convex in *L.* (*L.*) *papulata*, whereas it is often concave in *L.* (*L.*) *bermudensis*. A few of the specimens of *L.* (*L.*) *papulata* examined have the dorsolateral margin

of the orbit minutely serrate, but these serrations are even more obscure than in *L.* (*L.*) *hawaiiensis* and much less prominent than in *L.* (*L.*) *serratorbita.*

8. *Leptochela* (*Leptochela*) *pugnax* De Man

FIGURES 25–27

Leptochela pugnax De Man, 1916:148; 1920:26, pl. 4: fig. 8.—Kemp, 1925:255.—Armstrong, 1941:3.—Kubo, 1955:101, figs. 4, 5.—Holthuis and Gottlieb, 1958:22.

?*Leptochela* sp. De Man, 1920:30.

Leptochela robusta.—Miyadi, 1940b:141; 1941:180. [Not *L. robusta* Stimpson, 1860.]

DIAGNOSIS.—Rostrum with dorsal margin concave. Carapace with 3 longitudinal dorsal ridges in breeding females only. Orbital margin entire, not serrate, without mesially directed tooth on ventral portion; suborbital angle distinctly dentate. Fifth abdominal somite entire, without dorsal elevations or posterior tooth. Telson with 1 pair of dorsolateral spines in addition to anterior mesial pair; posterior margin without pair of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale more than ½ but usually less than ⅔ as long as carapace. First pereopod with 16 to 21 spines on opposable margin of movable finger. Second pereopod with 17 to 26 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of first pleopod of male slightly but not conspicuously flared distolaterally. Appendix masculina, not including spines, not overreaching appendix interna. Maximum carapace length 3.4 mm.

DESCRIPTION.—Rostrum (Figure 25*a,b*) distinctly upturned, dorsal margin concave, rarely reaching as far as distal end of basal segment of antennular peduncle. Carapace with sometimes obscure median dorsal carina on anterior ¼ to ⅓ of length but without paired dorsolateral ridges in males and nonbreeding females, median carina on ¾ to $^{9}/_{10}$ of length and paired dorsolateral ridges on ½ to ⅘ of length in breeding females. Orbital margin (Figure 25*b*) entire, not serrate, ventral portion without mesially directed tooth; suborbital angle distinctly dentate.

Abdomen (Figure 25*c*) regularly rounded dorsally on 3 anterior somites, occasionally bluntly and inconspicuously carinate on 4th and 5th. Fifth somite without dorsal prominences and without posterodorsal tooth. Sixth somite about 1.8 times as long as high, anterodorsal transverse swelling not prominent, spine on ventrolateral surface curved and distinct but not very long, posterolateral lobe bearing distinct acute tooth on posterodorsal margin (Figure 25*d*). Telson (Figure 25*e*), not including posterior spines, about 1.3 times as long as 6th somite, slightly less than 3

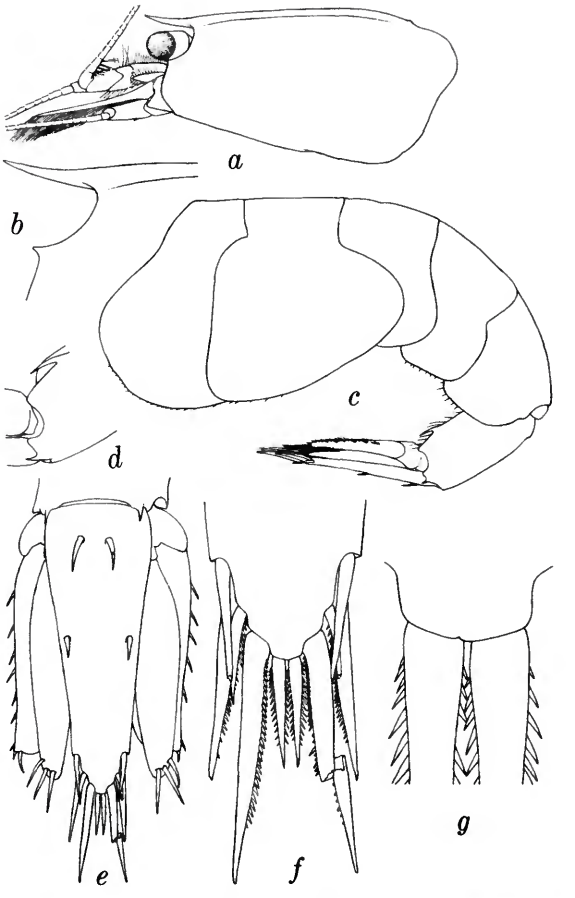

FIGURE 25.—*Leptochela* (*Leptochela*) *pugnax,* ovigerous female from Nicobar Islands, carapace length 2.5 mm: *a,* carapace and anterior appendages; *b,* rostrum and orbit, lateral aspect; *c,* abdomen; *d,* posterior end of 6th abdominal somite; *e,* telson and uropods; *f,* posterior margin of telson; *g,* same, mesial part. (Magnifications: *a, c,* × 12; *b, d, e,* × 25; *f,* × 62; *g,* × 260.)

FIGURE 26.—*Leptochela* (*Leptochela*) *pugnax*, male from Nicobar Islands, carapace length 2.8 mm: *a*, right antennule, dorsal aspect; *b*, right antenna, dorsal aspect; *c*, right mandible; *d*, right 1st maxilla; *e*, right 2nd maxilla; *f*, right 1st maxilliped; *g*, right 2nd maxilliped; *h*, right 3rd maxilliped; *i*, right 1st pereopod; *j*, same, fingers; *k*, right 2nd pereopod; *l*, same, fingers; *m*, right 3rd pereopod; *n*, right 4th pereopod; o, right 5th pereopod. (Magnifications: *a*, *b*, *h*, *i*, *k*, *m–o*, × 25; *c–g*, *j*, *l*, × 62.)

times as long as wide, armed with 1 pair of dorsolateral spines slightly anterior to midlength, in addition to anterior mesial pair; posterior margin (Figure 25*f,g*) without pair of minute spines between bases of mesial pair of usual 5 pairs of prominent spines.

Eye with rather prominent papilla on mesial surface of stalk proximal to cornea, cornea little wider than stalk.

Antennular peduncle (Figure 26*a*) with stylocerite reaching nearly as far as distolateral margin of basal segment; 2nd segment about as long as distal segment in mesial aspect, distinctly shorter in dorsal aspect.

Antennal scale (Figure 26*b*) 3.7 to 4.6 times as long as wide, lateral margin concave, blade only occasionally forming suggestion of subdistal shoulder, distal tooth usually continuous with mesial margin of blade. Distal segments of antennal peduncle nearly as wide as scale, reaching nearly to midlength of scale; basal segment without ventral tooth.

Mouthparts as illustrated (Figure 26*c–h*). Third maxilliped (Figure 26*h*) not reaching as far as distal end of antennal scale, distal segment at least ⅘ as long as penultimate segment.

First pereopod (Figure 26*i*) rarely overreaching antennal scale by as much as length of fingers; fingers 1.5 to 2.0 times as long as palm; dactyl (Figure 26*j*) armed with 16 to 21 spines on opposable margin. Second pereopod (Figure 26*k*) overreaching antennal scale by less than length of fingers; fingers 1.9 to 2.6 times as long as palm; dactyl (Figure 26*l*) armed with 17 to 26 spines on opposable margin. Third pereopod (Figure 26*m*) overreaching extreme anterior margin of carapace by lengths of dactyl, propodus, and carpus; exopod not nearly reaching distal end of ischium; ischium and merus each bearing 2 strong spines near flexor margins, carpus with 1; dactyl much shorter than propodus. Fourth pereopod (Figure 26*n*) reaching to about distal end of ischium of 2nd pereopod when both extended anteriorly; dactyl longer than propodus. Fifth pereopod (Figure 26*o*) similar to and more than ¾ as long as 4th, reaching to about middle ⅓ of ischium of 2nd pereopod when both extended anteriorly; dactyl longer than propodus.

Endopod of 1st pleopod of male (Figure 27*a,b*) concave in distal portion of lateral margin, causing slight flaring of disolateral angle. Appendix masculina (Figure 27*c,d*) bearing 6 long spines, not overreaching appendix interna, not including spines. Lateral branch of uropod (Figure 25*e*) armed with 8 to 11 spines, in addition to setae.

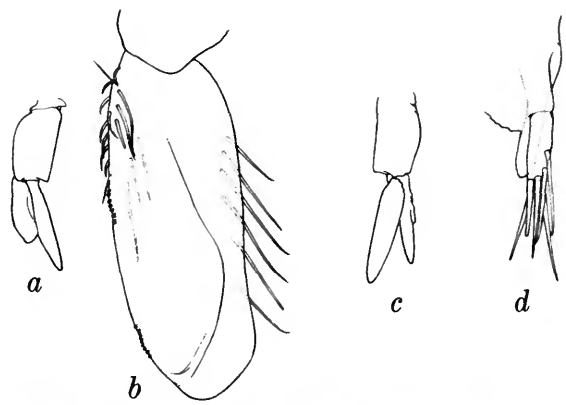

FIGURE 27.—*Leptochela* (*Leptochela*) *pugnax*, male from Nicobar Islands, carapace length 2.8 mm: *a*, right 1st pleopod; *b*, same, endopod; *c*, right 2nd pleopod; *d*, same, appendix masculina and appendix interna. (Magnifications: *a, c*, × 12; *b, d*, × 62.)

SIZE.—Carapace lengths of males, 2.5–3.0 mm; of nonbreeding females, 2.4–3.4 mm; of nonovigerous breeding females, 2.2–3.1 mm; of ovigerous females, 2.4–2.8 mm.

MATERIAL.—BAY OF BENGAL. Nicobar Islands; *Investigator;* received from Stanley W. Kemp: 11 ♂ (2.5–2.8) 13 ♀ (2.2–3.1) (3 ovig. (2.4–2.8)).

THAILAND. Anchorage in Mae Nam Chantaburi River at Tha Chalaep Harbor, Chantaburi Province; 24 December 1957; George Vanderbilt Foundation Sta. 134: 1 ♂ (3.0) 1 ♀ (2.8).

VIET NAM. Bay of Nha Trang; 1 January to 10 April 1960; Ariel Gallardo St. 77: 1 ♀ (3.4).

PHILIPPINE ISLANDS. Cagmanaba Bay, Luzon (13°02′N, 123°17′E); coral and sand; 11 March 1909; 8:00 A.M.; dynamite (8 shots in 1–9 m); *Albatross:* 1 ♂ (2.8). Mansalay, Mindoro (anchorage); electric light at surface over 16.5 m; 3 June 1908; 9:00 P.M.; *Albatross:* 2 ♂ (2.8, 2.9) 2 ♀ (2.8, 2.9).

HABITAT.—Little is known of the ecological requirements of *L. pugnax*. All of the documented specimens have been taken in inshore waters ranging in depth from 8 to 140 meters on both sand and mud bottoms, and they have been attracted to lights at the surface on a few occasions.

TYPE-LOCALITY.—Five Indonesian localities between Java and the Moluccas; 9–55 meters.

DISTRIBUTION.—*Leptochela* (*L.*) *pugnax* is known with reasonable certainty from the Maldive Islands eastward to eastern Indonesia and northward to the south coast of Honshu, Japan (see discussion of distribution of *L.* (*L.*) *robusta*), in depths of 8 to 55 meters. A few specimens from the Red Sea that I have been able to examine through the courtesy of L. B. Holthuis seem to differ slightly from the typical form. Whether they, and possibly those recorded as *L. pugnax* from the Eastern Mediterranean by Holthuis and Gottlieb (1958:22), represent a distinct taxon can be determined only by further study that is beyond the scope of this review.

REMARKS.—Apparently only two described species of *Leptochela, L.* (*L.*) *pugnax* and the American *L.* (*L.*) *serratorbita,* invariably have the ventral angle of the orbit armed with a distinct tooth. It seems probable, therefore, that the three young specimens recorded by De Man (1920:30) as *Leptochela* sp. from as many additional Indonesian localities are identifiable with *L.* (*L.*) *pugnax,* for all of them are described as having the ventral angle of the orbit dentate.

9. *Leptochela* (*Leptochela*) *robusta* Stimpson

FIGURE 28

Leptochela robusta Stimpson, 1860:43.—De Man, 1916:148 [part]; 1920:20 [part], pls. 3, 4 [except fig. 7*x*].

DIAGNOSIS.—Rostrum variable, dorsal margin usually straight, concave, or sinuous. Carapace wits 3 longitudinal dorsal ridges in breeding females only. Orbital margin entire, not serrate, with mesially directed tooth on ventral portion; suborbital angle unarmed. Fifth abdominal somite entire, without dorsal elevations or posterior tooth. Telson with 2 pairs of dorsolateral spines in addition to anterior mesial pair; posterior margin without pair of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale about ⅔ as long as carapace. First pereopod with 25 to 44 spines on opposable margin of movable finger. Second pereopod with 28 to 47 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of 1st pleopod of male not flared distolaterally. Appendix masculina, not including spines, distinctly overreaching appendix interna. Maximum carapace length 6.4 mm.

DESCRIPTION.—Rostrum variable, dorsal margin usually straight, concave, or sinuous, rarely overreaching eyes. Carapace without median dorsal carina in males and nonbreeding females, tricarinate in breeding females. Orbital margin entire, not minutely serrate; suborbital angle rounded, but ventral margin of orbit armed with mesially directed tooth visible only in dorsolateral view (Figure 28*a*).

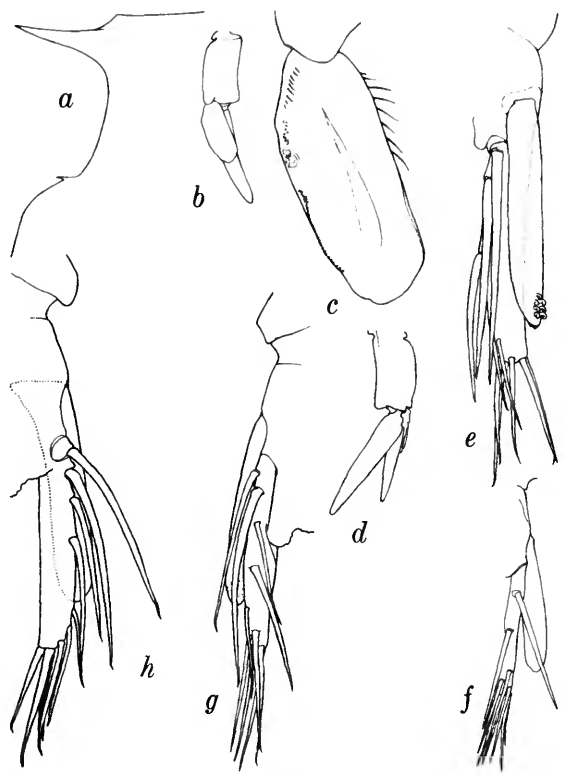

FIGURE 28.—*Leptochela* (*Leptochela*) *robusta,* male from *Albatross* Sta. 5596, carapace length 6.0 mm: *a,* orbital region, dorsolateral aspect; *b,* right 1st pleopod; *c,* same, endopod; *d,* right 2nd pleopod; *e,* same, appendix masculina and appendix interna. Male from same station, carapace length 3.0 mm: *f,* right appendix masculina and appendix interna. Male from *Albatross* Sta. 5159, carapace length 4.8 mm: *g,* left appendix masculina and appendix interna. Male from *Albatross* Sta. 5169, carapace length 5.1 mm: *h,* right appendix masculina and appendix interna. (Magnifications: *b, d,* × 6; *a,* × 12; *c,* × 25; *e–h,* × 62.)

Abdomen regularly rounded dorsally on 3 anterior somites and usually on 4th. Fifth somite rounded or obscurely carinate, rarely distinctly so; dorsal margin entire, without elevations of any kind; posterior margin unarmed. Sixth somite about 1.8 times as long as high, with usual tranverse swelling and carina near anterior end of dorsal surface, relatively short and obscure sharp spine on ventrolateral surface, and distinct acute tooth on posterodorsal margin of posterolateral lobe. Telson, not including posterior spines, less than 1½ times as long as 6th somite, about 3⅓ times as long as wide, armed with 2 pairs of dorsolateral spines, spaced almost equidistantly, in addition to anterior mesial pair; posterior margin without minute pair of spines between bases of mesial pair of usual 5 pairs of prominent spines.

Eye with papilla on mesial surface of stalk proximal to cornea, cornea distinctly wider than stalk.

Antennular peduncle with stylocerite reaching nearly as far as distolateral margin of basal segment; 2nd segment subequal in length to distal segment in mesial aspect, no more than ½ as long in dorsal aspect. Dorsolateral flagellum about 3⅓ times as long as carapace; ventromesial flagellum fully 1⅓ times as long as carapace.

Antennal scale 0.5 to 0.7 as long as carapace, 2.8 to 4.2 times as long as wide, lateral margin faintly sinuous, distal tooth obscurely separated from mesial margin of blade. Distal segments of antennal peduncle nearly ⅔ as wide as scale, reaching to about midlength of scale. Flagellum slightly more than 3 times as long as carapace.

Mouthparts typical of genus. Third maxilliped not nearly reaching distal end of antennal scale, distal segment about ¾ as long as penultimate segment.

First pereopod overreaching antennal scale by less than length of fingers; fingers 1.5 to 1.7 times as long as palm; dactyl armed with 25 to 44 spines on opposable margin. Second pereopod overreaching antennal scale by less than length of fingers; fingers 1.8 to 2.1 times as long as palm; dactyl armed with 28 to 47 spines on opposable margin. Third pereopod overreaching extreme anterior margin of carapace by about length of dactyl; exopod falling far short of distal end of ischium; ischium armed with row of 4 stout spines near flexor margin; merus with 6 or 7 longer stout spines near flexor margin; dactyl variable, usually longer than propodus. Fourth pereopod reaching nearly to distal end of ischium of 2nd pereopod when both extended anteriorly; dactyl usually longer, occasionally slightly shorter than propodus. Fifth pereopod similar to and about as long as 4th, reaching at least to midlength of ischium of 2nd pereopod when both extended anteriorly; dactyl slightly shorter than propodus.

Endopod of 1st pleopod of male (Figure 28*b,c*) subelliptical, little more than 2½ times as long as wide. Appendix masculina (Figure 28*d–h*) bearing 8 to 11 long spines, longest arising from proximal half of length, distinctly overreaching appendix interna, not including spines. Lateral branch of uropod armed with 9 to 13 movable spines, in addition to setae.

SIZE.—Carapace lengths of males, 3.0–6.0 mm; of nonbreeding females, 3.7–6.2 mm. De Man's (1920) description of the *Siboga* material indicates that ovigerous females have a carapace length of about 6.4 mm.

MATERIAL.—PHILIPPINE ISLANDS. Cebu; stomach of cardinal fish, *Archamia lineolata;* 26 June 1970; Y Haneda and F. Tsuji: 1 ♂ (4.4) 1 ♀ (4.5). Off Zamboanga, Mindanao; 6°54′00″N, 122°04′30″E; surface over depth of 17 m; 10 October 1909; 6:00 P.M.; 10-foot plankton net (ship at anchor); *Albatross* Sta. 5596: 2 ♂ (3.0, 6.0) 4 ♀ (3.7–6.2). Off Tinagta Island, Tawitawi Group, Sulu Archipelago; 5°11′50″N, 119°54′E; 18 m; coral sand; 21 February 1908; 10:08 A.M.; 9-foot Johnston oyster dredge; *Albatross* Sta. 5159: 1 ♂ (4.8). Off Sibutu Island. Sulu Archipelago; 4°32′15″N, 119°22′45″E; 18 m; coral sand; 27 February 1908; 8:36 A.M.; 9-foot Johnston oyster dredge; *Albatross* Sta. 5169: 1 ♂ (5.1).

HABITAT.—Six of the 10 specimens examined were taken at the surface over a depth of 17 meters. Two were found in the stomach of a cardinal fish, and the remaining two were taken on coral sand in 18 meters with a dredge modified from a beam trawl by bolting a rake bar to the heel. The lot of 61 *Siboga* specimens (De Man, 1920) that almost certainly belong to this species were taken on a bottom of fine and coarse sand with dead shells in 141 meters.

TYPE-LOCALITY.—"Mari Sinensi, prof. 20 org." It seems reasonably safe to assume that Stimpson's "Mari Sinensi" refers to what is currently called the South China Sea, because of references in parts of his "Prodromus descriptionis" to "In mari Sinensi Boreali, lat. bor. 23°." On the same page with his preliminary description of *L.* (*L.*) *ro-*

busta, however, Stimpson records specimens of *Sicyonia ocellata* "In mari Sinensi quoque, lat. bor. 24°," a locality in Formosa Strait which connects the South China Sea and the East China Sea, so a shadow of doubt must remain.

DISTRIBUTION.—Known with reasonable certainty only from the "China Sea"; off Cebu and the Sulu Archipelago in the Philippine Islands; and north of Pulau Waigeo, Indonesia; at the surface and to a depth of 141 meters.

Whether either *L.* (*L.*) *robusta* or *L.* (*L.*) *irrobusta* live in Japanese waters is uncertain at the present time. The following passage is extracted from remarks kindly translated by Keiji Baba from Kubo (1955:98):

> Four species of this genus occur in Japan, including the two reported here for the first time, but one of them, *L. robusta,* is unavailable to me. *Leptochela robusta* was first reported by Stimpson (1860) from the East China Sea and it has been recorded subsequently from various localities in the Pacific and Indian oceans. From Japanese waters, it was collected from Toyama-wan by Kikuchi (1932) and from Tanabe-wan (7–27 m), Matoya-wan (7 m), Gokasho-wan (13 m), Ago-wan (10–21 m), and Nanao-wan by Miyadi (1940, 1941). All of Miyadi's specimens were identified by me at Prof. Miyadi's request, but recently a question arose about that identification, and I again examined those from Tanabe-wan and Ago-wan. This examination verified that those reported as *L. robusta* are *L. pugnax.* Those from Matoya-wan, Gokasho-wan, and Nanao-wan have not been re-examined as yet. The Toyama-wan record by Kikuchi was merely extracted from a list, so it cannot be accepted as a reliable record of *L. robusta.*

REMARKS.—Because of the brevity of Stimpson's preliminary description, his failure to deposit any material of the species in the British Museum, and the subsequent loss of the invertebrates collected by the North Pacific Exploring Expedition in the Chicago fire of 1871, the true identity of *L.* (*L.*) *robusta* may never be known. We are inclined to believe, however, that it is identical with the larger of the two forms so fully described and figured by De Man (1920). Stimpson indicated that the species is one inch long, he stressed its robust form, and he compared it with *L.* (*L.*) *gracilis,* another of the larger species of the genus. Such statements would hardly be applicable to *L.* (*L.*) *aculeocaudata, L.* (*L.*) *irrobusta,* or *L.* (*L.*) *pugnax,* the only other species known from the region to which Stimpson's description might otherwise apply.

There seemed to be no need to duplicate De Man's excellent figures of this species. For a comparison of *L.* (*L.*) *robusta* and *L.* (*L.*) *irrobusta,* see "Remarks" Inder the latter species.

10. *Leptochela* (*Leptochela*) *serratorbita* Bate

FIGURES 29–31

Leptochela serratorbita Bate, 1888:859, pl. 139: fig. 1.—Young, 1900:497.—Rathbun, 1901:127.—Schmitt, 1935:134, fig. 7.—Lunz, 1939:335.—Springer and Bullis, 1956:10.—Williams, 1965:41, figs. 33, 34.—Chace, 1972:16.

Leptochela serratorbita?.—Chace, 1937:111.

DIAGNOSIS.—Rostrum with dorsal margin straight, concave, or sinuous, rarely convex. Carapace without longitudinal dorsal ridges in either males or females. Orbital margin minutely spinulose dorsolaterally, with mesially directed rectangular or obtuse tooth on ventral portion; suborbital angle dentate. Fifth abdominal somite entire, without dorsal elevations or posterior tooth. Telson with 2 pairs of dorsolateral spines in addition to anterior mesial pair; posterior margin with pair (frequently fused, rarely absent) of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale more than ½ but less than ⅔ as long as carapace. First pereopod with 9 to 29 spines on opposable margin of movable finger. Second pereopod with 13 to 37 spines on opposable margin of movable finger. Third pereopod with exopod not nearly reaching distal end of ischium. Endopod of 1st pleopod of male rather narrowly rounded distally. Appendix masculina, not including spines, occasionally reaching to or slightly beyond distal end of appendix interna. Maximum carapace length 4.1 mm.

DESCRIPTION.—Rostrum (Figure 29*a,b*) with dorsal margin variable, straight, concave, sinuous, or rarely convex, falling slightly short of or reaching slightly beyond level of distal margin of basal segment of antennular peduncle. Carapace without median or dorsolateral carinae or ridges in either males or females. Orbital margin (Figure 29*b,c*) minutely spinulose dorsolaterally, with mesially directed rectangular or obtuse tooth on ventral portion; suborbital angle dentate.

Abdomen (Figure 29*d*) rounded dorsally on 3 anterior somites, usually bluntly carinate on at least posterior part of 4th and all of 5th. Fifth

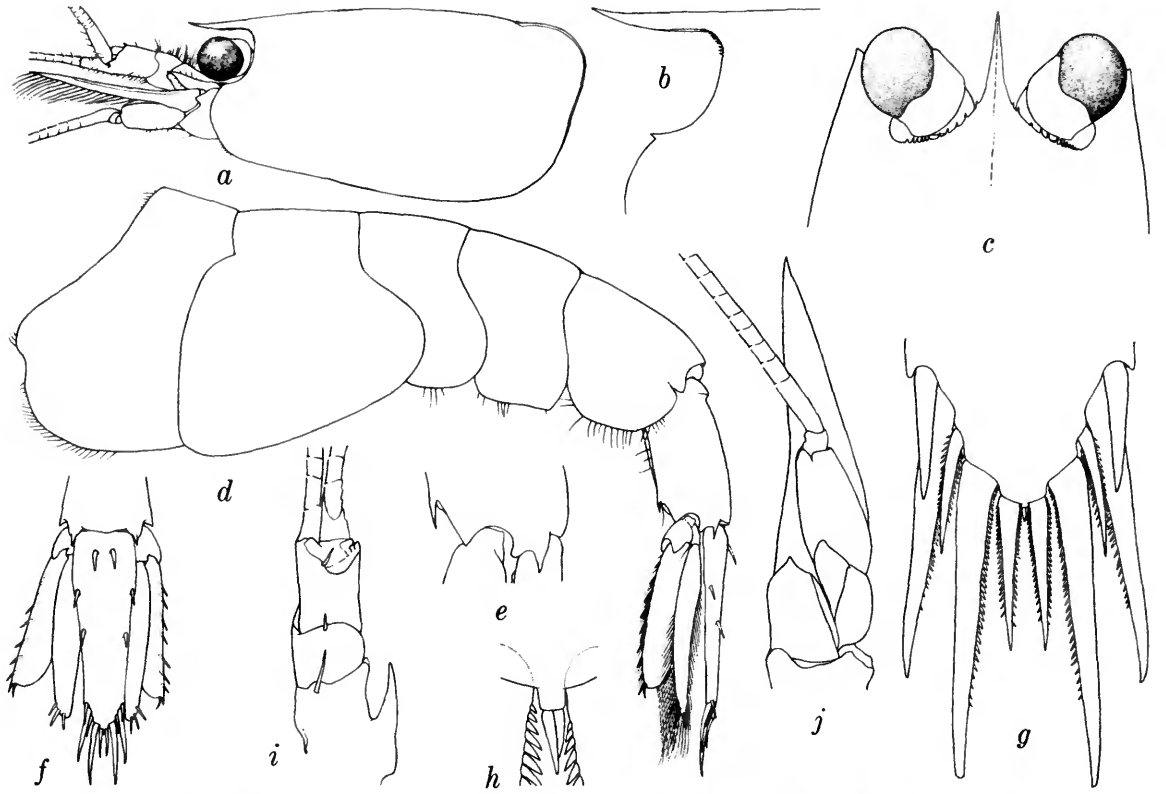

FIGURE 29.—*Leptochela* (*Leptochela*) *serratorbita*, ovigerous female from Key West, Florida, carapace length 3.0 mm: *a*, carapace and anterior appendages; *b*, orbital region, lateral aspect; *c*, anterior part of carapace and eyes, dorsal aspect; *d*, abdomen; *e*, posterior end of 6th abdominal somite; *f*, telson and uropods; *g*, posterior margin of telson; *h*, same, mesial spines; *i*, right antennule, dorsal aspect; *j*, right antenna, ventral aspect. (Magnifications: *a*, *d*, *f*, × 12; *b*, *c*, *e*, *i*, *j*, × 25; *g*, × 62; *h*, × 260.)

somite entire, without dorsal prominences or posterodorsal tooth. Sixth somite nearly twice as long as high, with usual transverse swelling near anterior end of dorsal surface, relatively short slender spine on ventrolateral surface, and rather strong acute tooth on posterodorsal margin of posterolateral lobe (Figure 29*e*). Telson (Figure 29*f*) nearly 1½ times as long as 6th somite, fully 3 times as long as wide, armed with 2 pairs of dorsolateral spines, posterior pair near midlength, in addition to anterior mesial pair; posterior margin (Figure 29*g*) bearing pair (frequently fused, rarely absent) of minute spines (Figure 29*h*) between bases of mesial pair of usual 5 pairs of prominent spines.

Eye (Figure 29*c*) with papilla (visible only in oblique view) on dorsomesial surface of stalk at juncture with cornea, cornea slightly wider than stalk.

Antennular peduncle (Figure 29*i*) with stylocerite reaching about as far as distolateral margin of basal segment; 2nd segment about as long as distal segment in ventromesial aspect, much shorter in dorsal aspect.

Antennal scale (Figure 29*j*) 0.5 to 0.6 as long as carapace, 2.9 to 4.4 times as long as wide, lateral margin noticeably concave at about midlength, distal tooth usually continuous with mesial margin of blade, latter rarely with suggestion of subdistal shoulder. Distal segments of antennal

FIGURE 30.—*Leptochela* (*Leptochela*) *serratorbita*, ovigerous female from Key West, Florida, carapace length 3.0 mm: *a*, right mandible; *b*, right 1st maxilla; *c*, right 2nd maxilla; *d*, right 1st maxilliped; *e*, right 2nd maxilliped; *f*, right 3rd maxilliped; *g*, right 1st pereopod; *h*, same, fingers; *i*, right 2nd pereopod; *j*, same, fingers; *k*, right 3rd pereopod; *l*, right 4th pereopod; *m*, right 5th pereopod. (Magnifications: *c–g*, *i*, *k–m*, × 25; *a*, *b*, *h*, *j*, × 62.)

peduncle about ¾ as wide as scale, not nearly reaching midlength of scale; ventral tooth on basal segment neither prominent nor very sharp.

Mouthparts as illustrated (Figure 30*a–f*). Mandible (Figure 30*a*) with distal margin faintly concave. Third maxilliped (Figure 30*f*) rarely reaching as far as distal end of antennal scale, distal segment more than ⅘ as long as penultimate segment.

First pereopod (Figure 30*g*) usually overreaching antennal scale by less than length of fingers; fingers 1.4 to 2.1 times as long as palm; dactyl (Figure 30*h*) armed with 9 to 29 spines on opposable margin. Second pereopod (Figure 30*i*) overreaching antennal scale by less than length of fingers; fingers 1.5 to 2.4 times as long as palm; dactyl (Figure 30*j*) armed with 13 to 37 spines on opposable margin. Third pereopod (Figure 30*k*) overreaching anterior margin of carapace by combined lengths of dactyl and propodus; exopod not nearly reaching distal end of ischium; ischium bearing row of 3 long spines near flexor margin and subdistal spine on extensor margin; merus armed with 5 or more similar spines near flexor margin; dactyl distinctly shorter than propodus. Fourth pereopod (Figure 30*l*) reaching nearly to midlength of ischium of 2nd pereopod when both extended anteriorly; dactyl usually longer than propodus. Fifth pereopod (Figure 30*m*) similar to and little shorter than 4th, reaching to about midlength of ischium of 3rd pereopod when both extended anteriorly; dactyl usually longer than propodus.

Endopod of 1st pleopod of male (Figures 31*a, b*) rather narrowly rounded distally, lateral margin convex, not flared distally. Appendix masculina (Figure 31*c,d*) bearing 6 long spines and occasionally reaching to end of or slightly beyond appendix interna, not including spines. Lateral branch of uropod (Figure 29*f*) armed with 7 to 13 spines.

SIZE.—Carapace length of males, 1.5–3.7 mm; of females without eggs, 1.6–4.1 mm; of ovigerous females, 2.7–3.9 mm.

MATERIAL.—NORTH CAROLINA. Beaufort; 6 November 1929; J. S. Gutsell: 1 ♀ (4.1).

GULF OF MEXICO: Cayos Arcas, Bahía de Campeche; 18 m; 11 December 1952; from bonefish stomach; *Oregon:* 1 ♂ (2.8).

FLORIDA KEYS. Key West; 1884; electric light at surface; *Albatross* (W. Nye): 81 ♂ (2.5–3.4) 43 ♀ (2.0–3.6) (4 ovig. (2.9–3.0)).

PUERTO RICO. Playa de Fajardo; 23 February 1933; 8-foot circular net under cargo light; Johnson-Smithsonian Deep-sea Expedition: 115 ♂ (2.0–3.7) 35 ♀ (1.7–3.6) (1 ovig. (3.4)) 1?. Cayo Icacos; 24 February 1933; 8-foot circular net with cargo light and submarine light; Johnson-Smithsonian Deep-sea Expedition: 3 ♂ (1.8–2.6) 5 ♀ (2.2–3.0). Off Isla de Vieques; Culebritas lighthouse NE 1/2 N 18.5 km; 27 m; coral; 8 February 1899; tangle; *Fish Hawk* Sta. 6091: 1 ovig. ♀ (2.7). Off Isla de Culebra; Culebritas lighthouse NE 9.7 km; 27 m; coral; 8 February 1899; tangle; *Fish Hawk* Sta. 6093: 4 ♂ (2.5–3.0). Canal de Luis Peña, Isla de Culebra; 25 February 1938; 8-foot circular net under cargo light; Johnson-Smithsonian Deep-sea Expedition: 25 ♂ (2.1–3.3) 2 ♀ (2.6, 2.8). Same; 3-foot net towed from port launch: 4 ♂ (2.3–2.5).

VIRGIN ISLANDS. Brewers Bay, Saint Thomas; 1 March 1933; 8-foot circular net under cargo light; Johnson-Smithsonian Deep-sea Expedition: 15 ♂ (1.5–2.4) 53 ♀ (1.6–2.8). Saint Thomas; 17–24 January 1884; *Albatross:* 8 ♂ (1.9–3.0) 2 ♀ (2.6) 1? (2.3). Sopers Hole, Tortola; 5–11 m; shells and compact sand; 1 April 1958; dredge; Smithsonian-Bredin Caribbean Expeditions Sta. 25–58; 2 ♂ (2.6, 2.7). Off Vixen Point, Prickly Pear Island, Virgin Gorda; 6 April 1958; 9:00 P.M.; light at bottom at anchorage in 20 m; Smithsonian-Bredin Caribbean Expeditions Sta. 36b-58: 1 juv. (0.8).

LEEWARD ISLANDS. Off Oyster Pond Landing, west side of Barbuda; 5 April 1956; 7:00–8:30 P.M.; light over side at anchorage in 5½ m; Smithsonian-Bredin Caribbean Expeditions Sta. 84–56: 222 ♂ (2.3–3.6) 200 ♀ (2.6–4.0) (8 ovig. (3.0–3.9)). South of Bird Island, Nonsuch Bay, Antigua Island; 23 April 1958; light over side at anchorage in 7 m; Smithsonian-Bredin Caribbean Expeditions Sta. 93–58: 1 ♂ (3.4).

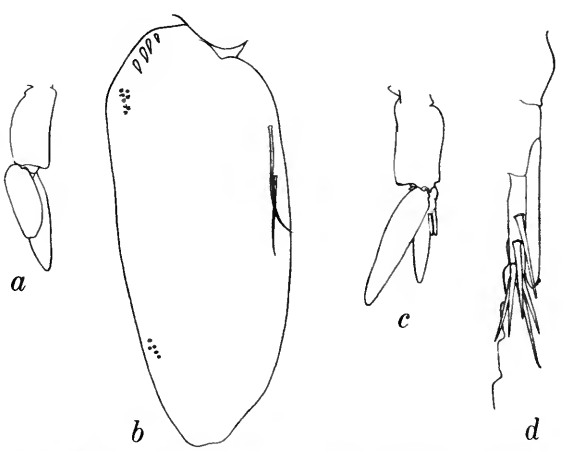

FIGURE 31.—*Leptochela* (*Leptochela*) *serratorbita,* male from Key West, Florida, carapace length 3.1 mm: *a,* right 1st pleopod; *b,* same, endopod; *c,* right 2nd pleopod; *d,* same, appendix masculina and appendix interna. (Magnifications: *a, c,* × 12; *b, d,* × 62.)

HABITAT.—In or over depths of 5½ to 27 meters. It may be noted that 8 of the 15 lots and all but 25 of the 826 specimens studied were taken under a light at the surface at night. See discussion of the habitat of *L.* (*L.*) *bermudensis* and remarks under *L.* (*P.*) *carinata*.

TYPE-LOCALITY.—Saint Thomas, Virgin Islands.

DISTRIBUTION.—North Carolina and western Gulf of Mexico to the Leeward Islands, in and over depths of 5½ to 27 meters.

Reexamination of the material collected at the surface beneath a light and dredged in 15–29 meters on a sandy bottom at San Lucas, Baja California, tentatively assigned to *L.* (*L.*) *serratorbita* by Chace (1937) has revealed no obvious differences from western Atlantic populations, but a more thorough comparison would be desirable when additional adult specimens become available from the eastern Pacific.

REMARKS.—The available evidence would seem to indicate that *L.* (*L.*) *serratorbita* has a more restricted range in the western Atlantic, both geographically and bathymetrically, than *L.* (*L.*) *bermudensis*, but that it is by far the commonest species of *Leptochela* within the limits of its range.

11. *Leptochela* (*Leptochela*) *sydniensis* Dakin and Colefax

FIGURES 32–34

Leptochela aculeocaudata.—Kemp, 1915:311 [part], figs. 34, 35, pl. 13: fig. 14; 1925:254.—Menon, 1937:6, pls. 1, 2: figs. 15–45.—Kubo, 1955:103, fig. 6.—Pillai, 1955:48, fig. 1.—Fujino and Miyake, 1970:239. [Not *L. aculeocaudata* Paulson, 1875.]

?*Leptochela hainanensis* Yu, 1936:87, figs. 1–3.

Leptochela sydniensis Dakin and Colefax, 1940:153, figs. 245, 246.

DIAGNOSIS.—Rostrum with dorsal margin nearly straight or sinuous. Carapace with 3 longitudinal dorsal ridges in breeding females only. Orbital margin entire, not serrate, without mesially directed tooth on ventral portion; suborbital angle unarmed. Fifth abdominal somite entire, without dorsal elevations or posterior tooth. Telson with 1 pair of dorsolateral spines in addition to anterior mesial pair; posterior margin normally without pair of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale about ½ as long as carapace. First pereopod with 20 to 44 spines on opposable margin of movable finger. Second pereopod with 21 to 46 spines on opposable margin of movable finger. Third pereopod with exopod nearly reaching distal end of ischium. Endopod of 1st pleopod of male obliquely rounded distally, lateral margin slightly concave but not flared distally. Appendix masculina, not including spines, usually not overreaching appendix interna. Maximum carapace length 4.7 mm.

DESCRIPTION.—Rostrum (Figure 32*a*) with dorsal margin nearly straight or sinuous, sometimes overreaching eyes but seldom reaching level of distal margin of basal segment of antennular peduncle. Carapace with median dorsal carina on anterior ⅓ or less of length in males and nonbreeding females, extending to midlength or beyond and with parallel but usually indistinct dorsolateral ridges in breeding females; ridges low, not concealing dorsal midline from lateral view; anterior lobe of carapace not concealing basal segment of antennal peduncle from lateral view. Orbital margin (Figure 32*b*) entire, not spinulose, without distinct mesially directed tooth on ventral portion; suborbital angle rounded, unarmed.

Abdomen (Figure 32*c*) rounded dorsally on 3 anterior somites, often partially carinate on 4th, usually distinctly carinate on 5th. Fifth somite entire, without dorsal prominences or posterodorsal tooth. Sixth somite nearly twice as long as high, with transverse carinate swelling at anterior end; usual slightly curved spine on ventrolateral surface and distinct acute tooth on posterodorsal margin of posterolateral lobe (Figure 32*d*). Telson (Figure 32*e*) nearly 1½ times as long as 6th somite, about 3½ times as long as wide, armed with 1 pair of dorsolateral spines at about midlength, in addition to anterior mesial pair; posterior margin (Figure 32*f*) normally without pair of minute spines between bases of mesial pair of usual 5 pairs of prominent spines.

Eye (Figure 32*b*) with rather prominent papilla (best seen in dorsolateral view) on dorsomesial surface of stalk at jucture with cornea, cornea inflated, wider than stalk.

Antennular peduncle (Figure 32*g*) with stylocerite reaching nearly as far as distolateral margin of basal segments; 2nd segment nearly as long as distal segment in both mesial and dorsal aspects.

FIGURE 32.—*Leptochela (Leptochela) sydniensis,* ovigerous female from Port Arthur, Tasmania, carapace length 4.4 mm: *a,* carapace and anterior appendages; *b,* anterior part of carapace and eyes, dorsal aspect; *c,* abdomen; *d,* posterior end of 6th abdominal somite; *e,* telson and uropods; *f,* posterior margin of telson; *g,* left antennule, dorsal aspect; *h,* left antenna, ventral aspect. (Magnifications: *a, c, e,* × 12; *b, d, g, h,* × 25; *f,* × 62.)

FIGURE 33.—*Leptochela* (*Leptochela*) *sydniensis*, ovigerous female from Port Arthur, Tasmania, carapace length 4.4 mm: *a*, right mandible; *b*, right 1st maxilla; *c*, right 2nd maxilla; *d*, right 1st maxilliped; *e*, left 2nd maxilliped; *f*, right 3rd maxilliped; *g*, left 1st pereopod; *h*, same, fingers; *i*, left 2nd pereopod; *j*, same, fingers; *k*, left 3rd pereopod; *l*, right 4th pereopod; *m*, right 5th pereopod. (Magnifications: *f*, *g*, *i*, *k–m*, × 12; *c–e*, × 25; *a*, *b*, *h*, *j*, × 62.)

Antennal scale (Figure 32*h*) about ½ as long as carapace, 3.1 to 3.9 times as long as wide, lateral margin distinctly concave near midlength, junction of mesial margin of blade with distal tooth marked only by faint sinuosity, without distinct shoulder. Distal segments of antennal peduncle nearly ⅔ as wide as scale, extending to about midlength of scale; basal segment bluntly produced distoventrally, without acute tooth.

Mouthparts as illustrated (Figure 33*a–f*). Third maxilliped (Figure 33*f*) rarely reaching level of tip of antennal scale, distal segment about ¾ as long as penultimate segment.

First pereopod (Figure 33*g*) occasionally overreaching antennal scale by as much as length of fingers; fingers 1.3 to 1.9 times as long as palm; dactyl (Figure 33*h*) armed with 20 to 44 spines on opposable margin. Second pereopod (Figure 33*i*) occasionally overreaching antennal scale by more than length of fingers; fingers 1.4 to 2.3 times as long as palm; dactyl (Figure 33*j*) armed with 21 to 46 spines on opposable margin. Third pereopod (Figure 33*k*) overreaching extreme anterior margin of carapace by about length of dactyl; exopod not nearly reaching distal end of ischium; ischium armed with 3 spines on flexor margin; merus with 4 spines; carpus with 1 spine; dactyl distinctly shorter than propodus. Fourth pereopod (Figure 33*l*) reaching distal end of ischium of 2nd pereopod when both extended anteriorly; dactyl usually distinctly longer than propodus. Fifth pereopod (Figure 33*m*) similar and subequal in length of 4th, barely overreaching midlength of ischium of 2nd pereopod when both extended anteriorly; dactyl about as long as propodus.

Endopod of 1st pleopod of male (Figure 34*a,b*) obliquely rounded distally, lateral margin slightly concave but not flared distally. Appendix masculina (Figure 34*c,d*) bearing 5 to 7 long spines, usually not overreaching appendix interna, not including spines. Lateral branch of uropod (Figure 32*e*) armed with 10 to 15 movable spines.

SIZE.—Carapace lengths of males, 2.3–4.4 mm; of females without eggs, 2.3–4.7 mm; of ovigerous females, 3.3–4.4 mm. The smallest male, from the East China Sea, has the appendix masculina no more than ½ as long as the appendix interna.

MATERIAL.—EAST CHINA SEA. Northeast of Taiwan; 26°05′N, 122°55′E; 110–111 m; *Kaiyo-Maru* Sta. 9: 3♂ (2.3–3.4) 7♀ (3.2–4.1) (2 ovig. (3.5, 4.1)) (Zoological Laboratory of Kyushu University).

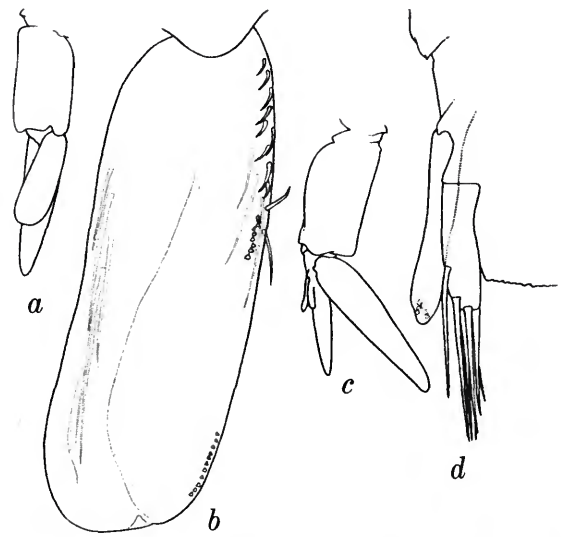

FIGURE 34.—*Leptochela* (*Leptochela*) *sydniensis*, male from north of Cape Howe, Victoria, Australia, carapace length 4.4 mm: *a*, left 1st pleopod; *b*, same, endopod; *c*, left 2nd pleopod; *d*, same, appendix masculina and appendix interna. (Magnifications: *a*, *c*, × 12; *b*, *d*, × 62.)

NEW SOUTH WALES. North Head, Sydney; 66 m; 27 February 1973; dredge; Australian Museum Shelf Benthic Survey Sta. 35: 3♀ (3.5–4.3) (1 ovig. (?)) (Australian Museum). 1.6 km E of Malabar outlet, Sydney; 33°58′15″S, 150°17′E; 66 m; 26 June 1973; dredge; AMSBS Sta. 3: 10♂ (3.1–3.7) 25♀ (3.4–4.3) (8 ovig. (3.3–3.6)) (Aus. Mus.). E of Malabar, Sydney; 83 m; 29 May 1974; AMSBS Sta. 40: 3♀ (3.7–4.0) (Aus. Mus.). 2 km E of Long Bay; 33°58′50″S, 150°17′E; 66 m; 30 January 1974; dredge; AMSBS Sta. 4: 20♂ (2.8–4.2) 8♀ (3.6–4.4) (1 ovig. (?)) (Aus. Mus.). 2.3 km E of Malabar, Sydney; 33°59′27″S, 15°16′48″E; 66 m; 29 January 1974; dredge; AMSBS Sta. 5: 5♂ (3.8–4.0) 3♀ (3.8–4.2) (Aus. Mus.).

VICTORIA. N of Cape Howe; 37°26′S, 150°15′E; 149 m; 19 June 1962; CSIRO Fisheries Sta. G2/59/62: 1♂ (4.4) (Aus. Mus.). N of Cape Howe; 37°26.5′S, 150°17′E; 300 m; 19 June 1962; CSIRO Fisheries Sta. G2/60/62: 1♂ (3.4) 1♀ (4.7) (Aus. Mus.). W of Cape Everard; 37°55′S, 149°00′E; 77 m; 20 June 1962; CSIRO Fisheries Sta. G2/61/62: 2♀ (2.2+, 4.2) (Aus. Mus.).

SOUTH AUSTRALIA. S of Investigator Group; 34°S, 134°32′E; 152 m; 12 July 1962; CSIRO Fisheries Sta. G2/128/62: 1♂ (4.4) 2♀ (3.2, 3.6) (1 ovig. (3.6)) (Aus. Mus.).

WESTERN AUSTRALIA. Great Australian Bight; 35°43′S, 125°04′E; 80 m; 7 July 1962; CSIRO Fisheries Sta. G2/104/62: 1♂ (3.4) (Aus. Mus.).

TASMANIA. In Port Arthur; C. T. Harrison: 1 ovig. ♀ (4.4) (Aus. Mus.).

HABITAT.—Kemp (1915) recorded specimens from weeds in shallow water on the extreme south coast of India, but most of the other records here attributed to this species pertain to depths greater than two meters. Fujino and Miyake (1970) listed material from the East China and Yellow seas from depths of 28 to 110 meters, as well as from the surface. The Australian specimens recorded above were taken in depths of 66 to 300 meters. Inasmuch as the larger lots from off New South Wales were taken with a dredge in 66 meters, it seems likely that the species lives on or near the bottom at least part of the time. The surface records from the East China or Yellow seas, on the other hand, suggest that it is also pelagic at times.

TYPE-LOCALITY.—Off Sydney, New South Wales, Australia. No type-material of this species could be found in the Australian Museum or in the University of Sydney.

DISTRIBUTION.—If my conclusions are correct (see "Remarks"), *L. sydniensis* is known from the Arabian Sea, the Bay of Bengal, the South China and Yellow seas, and Japanese waters, as well as off the southeastern and southern coasts of Australia.

REMARKS.—The opportunity to examine specimens of *L. aculeocaudata* from the Red Sea has convinced me that the concept of that species adopted by Kemp (1915, 1925) and subsequent authors is probably incorrect. Kemp (1925:250) was the first to discover that the presence or absence of paired dorsolateral longitudinal ridges on the carapace was not a simple sexual character but that these ridges are developed only in breeding females of certain species of the genus. He concluded his remarks on the subject as follows: "Dimorphic forms of the female have been found in *L. robusta, L. aculeocaudata* and *L. pugnax,* and it is not unlikely that the phenomenon occurs throughout the genus." We now know that the so-called tricarinate carapace is restricted to breeding females in most, but not all, of the species; it is found in all specimens of both sexes of *L.* (*L.*) *aculeocaudata* and *L.* (*L.*) *japonica* and in no specimens of either sex of *L.* (*L.*) *gracilis* and *L.* (*L.*) *serratorbita*. What, then, is the identity of the species that Kemp assigned to *L. aculeocaudata*?

I at first believed that *L. hainanensis* Yu, 1936, was the earliest available name for this form. Yu's species seems to agree with the one described by Kemp in most characters, as pointed out by Armstrong (1941) and Fujino and Miyake (1970), and its type-locality lies between the populations in the Indian Ocean recorded by Kemp and those in the western North Pacific recorded by Kubo (1955) and Fujion and Miyake. Reexamination of material from Hainan may reveal that this is the correct solution, but I am sufficiently disturbed by the figure of the antennal scale given by Yu (1936, fig. 1) and by his statement that "the outer margin is nearly straight, not concave behind the middle" to resist adopting the name *L. hainanensis* for this species at this time. According to Yu's figure, the antennal scale not only lacks the well-marked concavity in the lateral margin, but the blade seems to form a rather distinct shoulder at the base of the distal spine.

In describing *L. sydniensis,* Dakin and Colefax (1940:156) noted that the species was allied to *L. robusta, L. aculeocaudata,* and *L. pugnax,* according to the key published by Kemp (1925: 250). They proceeded to note the differences between the Australian species and *L. robusta* and *L. pugnax,* but they failed to distinguish it from Kemp's interpretation of *L. aculeocaudata.* The suspicion that there might be no differences has been supported by the opportunity afforded through the kind cooperation of Dr. Fujino to examine part of the lot from the southernmost station in the East China Sea recorded by Fujino and Miyake as *L. aculeocaudata.* No obviously significant differences could be found between these specimens and those from Australia. In the three females with a tricarinate carapace from the East China Sea, the dorsolateral ridges are stronger and sharper than in those from Australia, but the importance of this apparent distinction could not be evaluated from the material available to me.

It is very possible that this interpretation does not represent the final taxonomic word on this rather complex problem, but I hope that I may have contributed to some extent toward such a solution.

Proboloura, new subgenus

DEFINITION.—Sixth abdominal somite bearing

movable lappet or flap attached anteriorly to transverse carinate swelling on dorsal surface. Telson with anterior pair of dorsolateral spines nearly in line with anterior dorsal pair. Antennal scale usually at least ¾ as long as carapace. Third pereopod with exopod reaching nearly or quite as far as distal end of ischium. Fifth pair of pereopods reduced, about ⅔ as long as 4th pair.

TYPE-SPECIES.—*Leptochela carinata* Ortmann.

ETYMOLOGY.—From *probolos* (G., = projecting object or prominence) + *oura* (G., = tail), in reference to lappet on 6th abdominal somite. Gender: Feminine.

REMARKS.—*Leptochela carinata* is so different from the other members of the genus, especially in the presence of a dorsal lappet on the sixth abdominal somite and the disposition of the dorsolateral spines on the telson, that supraspecific distinction seems desirable. That full generic status is hardly justified at this time is indicated by the much greater similarity between *L. carinata* and the other species of the genus than between any species of *Leptochela* and the species of other pasiphaeid genera. Also, the gap between *L. carinata* and its congeners is partially filled by *L. japonica* Hayashi and Miyake, in which the fifth abdominal somite is similarly crested and the fifth pereopods are somewhat reduced.

12. *Leptochela* (*Proboloura*) *carinata* Ortmann

FIGURES 35–37

Leptochela carinata Ortmann, 1893:41 [part], pl. 4: fig. 1.—Rathbun, 1901:127.—Schmitt, 1935:134.—Hayashi and Miyake, 1969:6, fig. 3.—Chace, 1972:16.

DIAGNOSIS.—Rostrum with dorsal margin usually convex, occasionally straight or even concave.

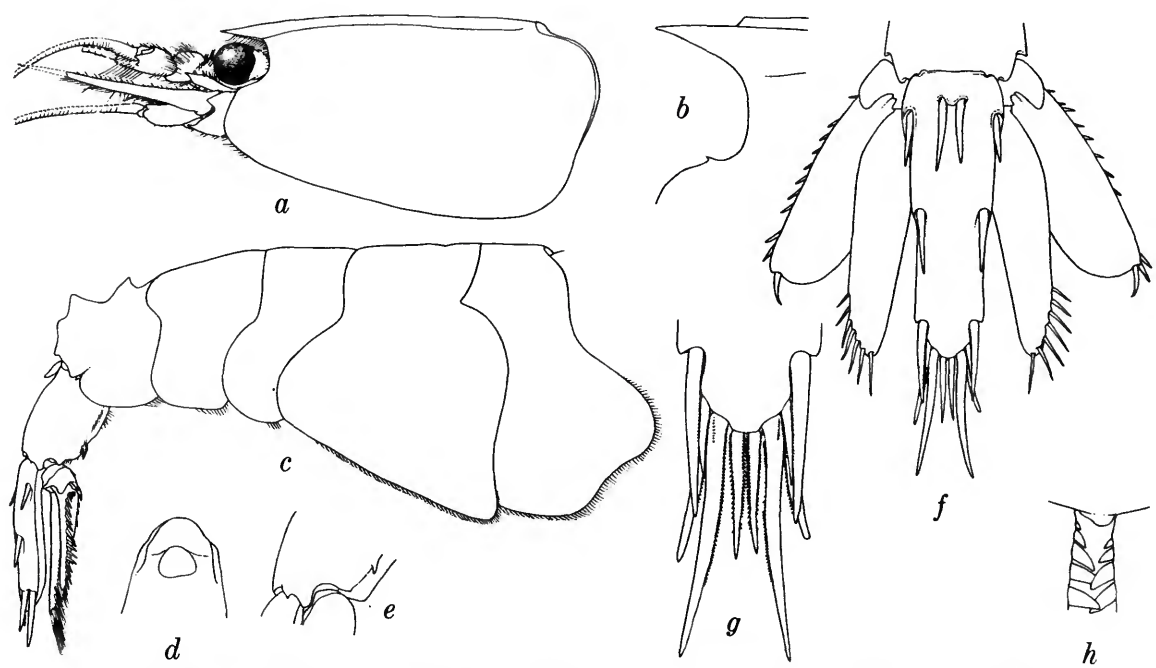

FIGURE 35.—*Leptochela* (*Proboloura*) *carinata*, ovigerous female from *Grampus* Sta. 5084, carapace length 6.7 mm: *a*, carapace and anterior appendages; *b*, rostrum and orbit, dorsolateral aspect; *c*, abdomen; *d*, anterior end of 6th abdominal somite, dorsal aspect showing lappet; *e*, posterior end of 6th abdominal somite. Male from Rum Cay, Bahamas, carapace length 5.7 mm: *f*, telson and uropods; *g*, posterior margin of telson; *h*, same, mesial part. (Magnifications: *a*, *c* ,× 6; *b*, *d–f*, × 12; *g*, × 25; *h*, × 260.)

Carapace with 3 longitudinal dorsal ridges in breeding females only. Orbital margin entire, not serrate, with mesially directed tooth on ventral margin; suborbital angle unarmed. Fifth abdominal somite with dorsal carina elevated into 4 teeth, anterior 2 very prominent, posteriormost forming blunt projection on posterior margin. Telson with 2 pairs of dorsolateral spines in addition to anterior mesial pair; posterior margin without pair of minute mesial spines in addition to usual 5 pairs of prominent spines. Antennal scale usually more than ¾ as long as carapace. First pereopod with 41 to 58 spines on opposable margin of movable finger. Third pereopod with exopod reaching nearly or quite as far as distal end of ischium. Endopod of 1st pleopod of male rounded distally, not produced distolaterally. Appendix masculina, not including spines, not overreaching appendix interna. Maximum carapace length 7.7 mm.

DESCRIPTION.—Rostrum (Figure 35*a*) with dorsal margin usually somewhat convex, occasionally straight or even concave, short, not overreaching basal segment of antennular peduncle. Carapace with median dorsal carina on anterior ⅓ to ½ of length but without paired dorsolateral carinae in males and nonbreeding females, dorsally tricarinate over most of length in breeding females. Orbital margin (Figure 35*b*) entire, not spinulose, but with mesially directed tooth on ventral portion; suborbital angle rounded.

Adbomen (Figure 35*c*) regularly rounded dorsally on 3 anterior somites and at least all but posterior ⅓ of 4th. Fifth somite sharply carinate, carina produced into 2 prominent acute anterior teeth and 2 low blunt teeth, posteriormost on posterior margin of somite. Sixth somite about 1½ times as long as high, with movable lappet subtriangular (broadening distally) (Figure 35*d*), comparatively short spine (Figure 35*e*) on ventrolateral margin, and acute, sometimes rather obscure tooth on posterodorsal margin of posterolateral lobe. Telson (Figure 35*f*), not including posterior spines, about 1.6 times as long as 6th somite, less than 3 times as long as wide, margins noticeably sinuous, armed with 3 pairs of long spines, 1 pair anteromesial, 2 pairs dorsolateral, anterior pair of latter nearly in line with anteromesial pair, posterior pair arising at about midlength of telson; posterior margin (Figure 35*g*) with indistinct lobe (Figure 35*h*) but without pair of minute spines between bases of mesial pair of usual 5 pairs of prominent spines.

Eye with papilla on mesial surface of stalk proximal to cornea, cornea distinctly wider than stalk.

Antennular peduncle (Figure 36*a*) with stylocerite considerably overreaching basal segment; 2nd segment subequal to distal segment in mesial aspect but distinctly shorter in dorsal aspect.

Antennal scale (Figure 36*b*) 0.7 to 0.9 times as long as carapace, 4.0 to 5.0 times as long as wide, both lateral and mesial margins nearly straight, latter continuous with distal spine without any indication of subdistal shoulder. Distal segments of antennal peduncle little more than ½ as wide as scale, reaching to about middle ⅓ of scale; basal segment with prominent ventral spine.

Mouthparts as illustrated (Figures 36*c–h*). Third maxilliped (Figure 36*h*) overreaching antennal scale, distal segment about ⅔ as long as penultimate segment.

First pereopod (Figure 36*i*) overreaching antennal scale by slightly more or, usually, less than length of fingers; fingers 1.0 to 1.2 times as long as palm; dactyl (Figure 36*j*) armed with 41 to 58 spines on opposable margin. Second pereopod (Figure 36*k*) rarely overreaching antennal scale by more than length of fingers; fingers 1.1 to 1.3 times as long as palm; dactyl (Figure 36*l*) armed with 43 to 66 spines on opposable margin. Third pereopod (Figure 36*m*) overreaching extreme anterior margin of carapace by length of dactyl and about ½ of propodus; exopod reaching nearly or quite as far as distal end of ischium; ischium armed with row of about 4 spines near extensor margin and about 6 on flexor margin; merus with 5 spines near extensor margin and 9 to 11 on flexor margin; dactyl shorter than propodus. Fourth pereopod (Figure 36*n*) reaching to middle ⅓ of ischium of 2nd pereopod when both are extended anteriorly; ischium armed with several stout spines on semicircular anterior lobe; similar spines on flexor margins of merus, carpus, and propodus; dactyl shorter than propodus. Fifth pereopod (Figure 36*o*) reduced, not more than ⅔ as long as 4th pereopod, reaching barely to distal end of basis of 2nd pereopod when both are extended anteriorly, ischium and merus especially short; ischium armed distally with several stout spines; similar spines on flexor margins of merus,

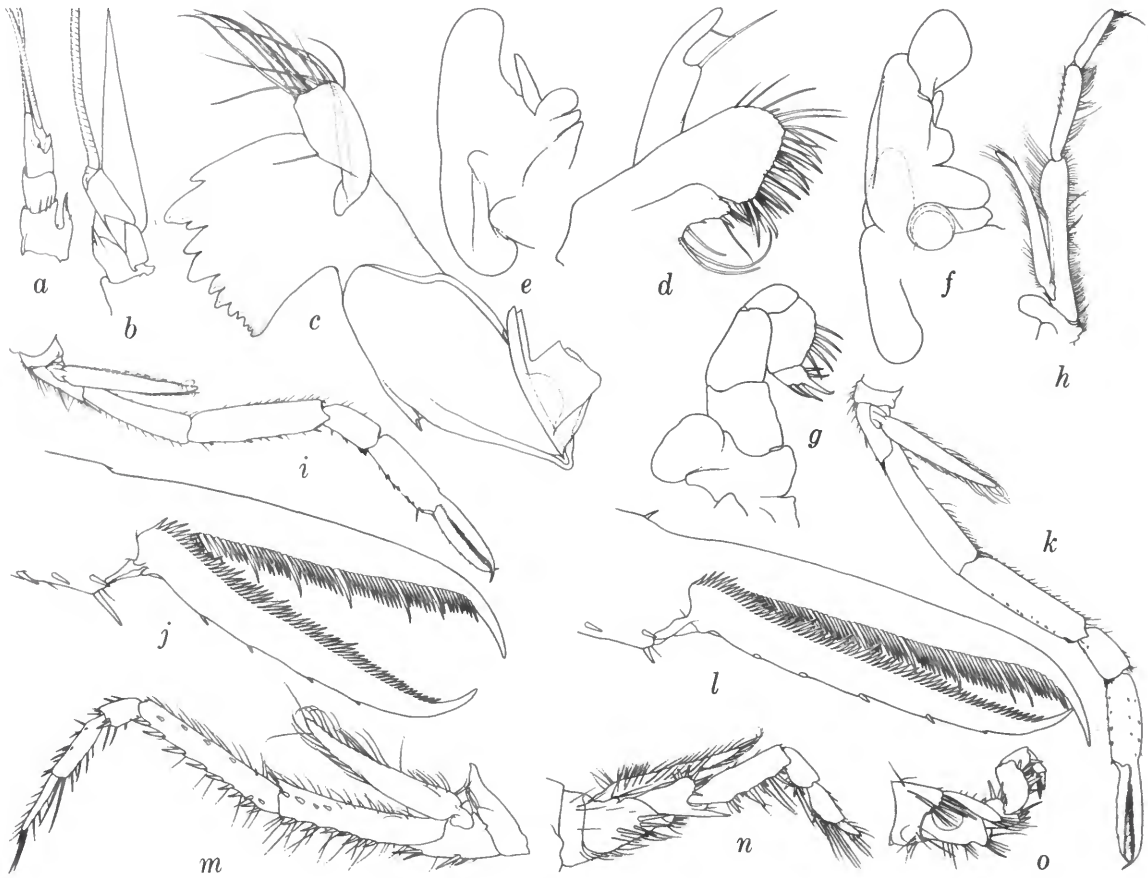

FIGURE 36.—*Leptochela* (*Proboloura*) *carinata*, female from *Grampus* Sta. 5084, carapace length 7.7 mm: *a*, right antennule, dorsal aspect; *b*, right antenna, ventral aspect; *c*, right mandible; *d*, right 1st maxilla; *e*, right 2nd maxilla; *f*, right 1st maxilliped; *g*, right 2nd maxilliped; *h*, right 3rd maxilliped; *i*, right 1st pereopod; *j*, same, fingers; *k*, right 2nd pereopod; *l*, same, fingers. Male from Rum Cay, Bahamas, carapace length 5.7 mm: *m*, left 3rd pereopod; *n*, right 4th pereopod; *o*, right 5th pereopod. (Magnifications: *a*, *b*, *h*, *i*, *k*, × 6; *e–g*, *m–o*, × 12; *c*, *d*, *j*, *l*.)

carpus, and propodus; dactyl very small, considerably shorter than propodus.

Endopod of 1st pleopod of male (Figure 37*a*,*b*) truncately rounded distally, lateral margin not flared distally. Appendix masculina (Figure 37*c*,*d*) bearing 7 long spines, not overreaching appendix interna, not including spines. Lateral branch of uropod (Figure 35*f*) armed with 14 to 22 spines.

SIZE.—Carapace lengths of males, 3.0–5.7 mm; of nonbreeding females, 2.4–7.7 mm; of ovigerous females, 4.3 and 6.7 mm.

MATERIAL.—GEORGES BANK. 41°22′N, 68°18′W, 35 m; 9 December 1955; 1-meter conical stramin net mounted on steel sled hauled along bottom; *Albatross III* Cruise 70, Collection 17 (R. L. Wigley): 1 ♂ (3.0) Northeast Fisheries Center, Woods Hole, Massachusetts).

GULF OF MEXICO. Between Cape San Blas and Tampa Bay, Florida; 28°47′N, 83°42′W; 24 m; 1 February 1970; dredge; L. G. Abele: 1 ♂ (5.7). Same; 28°31′N, 84°16′W; 26 m; corraline rubble; 9 April 1970; Peterson grab; L. G. Abele: 1 ♀ (5.2). Anclote Light, Florida, E 7/8 N, 39.8 km; 23 m; rock, coral, and sand; 17.2°C; 28 March 1901 (10:30 A.M.); dredge; *Fish Hawk* Sta. 7106: 2 ♀ (4.4, 6.2). Between Marco and Dry Tortugas, Florida; 25°44′32″N, 82°37′15″W;

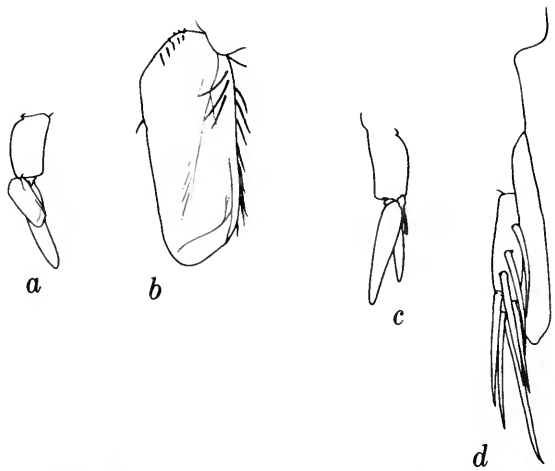

FIGURE 37.—*Leptochela (Proboloura) carinata*, male from northeastern Gulf of Mexico, carapace length 5.7 mm: *a*, right 1st pleopod; *b*, same, endopod; *c*, right 2nd pleopod; *d*, same, appendix masculina and appendix interna. (Magnifications: *a*, *c*, × 6; *b*, × 25; *d*, × 62.)

35 m; sand and coralline algae; 10 March 1889; hand dredge; *Grampus* Sta. 5084: 2♀ (6.7, 7.7) (1 ovig. (6.7)).

BAHAMAS. Rum Cay; surface; 1886; *Albatross:* 2♂ (5.2, 5.7) 2♀ (5.3, 5.5).

PUERTO RICO. Off Isla de Vieques; San Juan lighthouse NW 1/8 N 27.3 km; 20 m; coral, sand, and shells; 8 February 1899; tangle; *Fish Hawk* Sta. 6084: 1♂ (3.2). Same; Point Mula lighthouse SSW 3/8 W 10.6 km; 26 m; coral and sand; 8 February 1899; 7-foot beam trawl; *Fish Hawk* Sta. 6085: 1♂ (4.0). Same; Point Mula lighthouse E 1/2 N 20.8 km; 11 m; coral; 8 February 1899; tangle; *Fish Hawk* Sta. 6096: 1 ovig. ♀ (4.3). Off Isla de Culebra; Culebritas lighthouse NE 9.7 km; 27 m; coral; 8 February 1899; tangle; *Fish Hawk* Sta. 6093: 1♂ (4.3). Same; Canal de Luis Peña; 25 February 1933; 8-foot circular net under cargo light; Johnson-Smithsonian Deep-sea Expedition: 1♀ (2.4).

HABITAT.—In depths of 11 to 35 meters on bottoms of coral and sand, as well as coralline algae, rocks, and shells. Although 11 of the 16 specimens examined were apparently taken on or near the bottom with dredges, a beam trawl, a plankton net, a Peterson grab, and tangles, the lot of four specimens from the Bahamas was collected at the surface, as was the single specimen taken by the Johnson-Smithsonian Expedition in Canal de Luis Peña, Isla de Culebra. Also included among the material collected under a light at the latter station were three *L.* (*L.*) *bermudensis* and 27 *L.* (*L.*) *serratorbita,* so it is possible that *L.* (*P.*) *carinata,* which was taken at three bottom stations in that general area, is not especially photopositive.

TYPE-LOCALITY.—Off Baía de Marajó ("Küstenbank vor der Tocantins-Mündung"), Estado do Pará, Brazil, 50–100 meters.

DISTRIBUTION.—Georges Bank; Gulf of Mexico; Bahamas to Estado do Pará, Brazil, in depths of 11 to more than 50 meters.

REMARKS.—See "Remarks" under *L.* (*L.*) *bermudensis.*

Although *L.* (*P.*) *carinata* has the most extensive known distribution of any of the four Atlantic species of the genus, it is less well represented in the collections available to me than any of the other three species. On the other hand, it is the only one of the four species that was taken one or more times with each of the other species: once with *L.* (*L.*) *papulata,* once with *L.* (*L.*) *serratorbita,* and once with both *L.* (*L.*) *bermudensis* and *L.* (*L.*) *serratorbita.* The relative paucity of *L.* (*P.*) *carinata* in collections may reflect the possibility, mentioned above in the habitat discussion, that the species is less attracted to light than are either *L.* (*L.*) *bermudensis* or *L.* (*L.*) *serratorbita.* An alternative explanation may be that *L.* (*P.*) *carinata* does not swarm as do the two latter species.

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