

## THE FREE-SWIMMING COPEPODS OF THE WOODS HOLE REGION.

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An attempt to gain some knowledge of the pelagic copepod fauna of New England requires little justification, for even the most superficial student of marine zoology can not fail to be impressed by the vast number and variety of these little crustaceans and their mysterious appearance and disappearance at the surface of the sea. The closer observer will be attracted by the beautiful modifications of their structure, the interesting homologies of their parts—always a fascinating study in any group of arthropods—their peculiar sexual dimorphism, and their remarkable geographical and bathymetrical distribution. Then there is the great economic value of these creatures, which, as veritable “insects of the sea,” do inestimable service as scavengers and as the primitive and staple food supply of larger marine animals, such as fishes and cetaceans. Nevertheless, no group of animals has been more neglected by the zoologist, at least in America. This is probably attributable to a natural disinclination to take up the study of so large and intricate a subject—a disinclination which would have deterred the present writer from undertaking this study, had he not found in the recently published masterly monograph of Giesbrecht such an adequate treatment of the free-swimming copepods that the identification and study of our species has become a pleasant and easy task. That I have followed him closely, without extensive reference to preceding writers—although I have consulted the monographs of Dana, Claus, Brady, and Thompson—is warranted by the undisputed superiority and the comprehensive character of his work. Still, Giesbrecht’s work is only a magnificent beginning.

During the few brief months that I have been able to devote to a study of our species I have gained the conviction that many new species, and even genera, occur in American waters. In the present paper I have described a few of the common species that are new, but a description of certain forms which seem to be types of new genera are reserved for closer study and subsequent publication.

The materials for the following study were collected in the tow at the U. S. Fish Commission wharf, Woods Hole, Mass., in July and August 1899; Vineyard Sound, near Gay Head, Marthas Vineyard, July; Gulf Stream, 60 to 80 miles due south of Marthas Vineyard, July; and Plymouth Harbor, Massachusetts, August. The last two localities, one representing an arctic, the other a tropical fauna, are within a day’s journey of Woods Hole, and have been included in my study because they are easily accessible on the schooner *Grampus* and the steamer *Fish Hawk* and because many of the species of these regions will probably be found as stragglers at Woods Hole when

the fauna of the latter locality has been more extensively studied. To my friend, Prof. H. C. Bumpus, director of the Woods Hole station, I wish to express my sincere gratitude for many kindly and helpful suggestions during the progress of the work.

It was thought best to publish the work in its present form in order that it might be useful, even as a fragment, in a quantitative determination of the Woods Hole plankton soon to be undertaken. The dichotomic table, the synopses of the genera of which I have been able to find representatives, and the salient specific characters are translated from Giesbrecht. Simple camera drawings, in nearly all cases from the actual specimens, have been introduced for the purpose of facilitating identification.

The body of a free-swimming copepod is readily separable into two portions, a cephalothorax and an abdomen. The former consists of the head and 5 thoracic segments (first suborder, *Gymnoplea*). The head is often fused with the first thoracic, the fourth with the fifth. In the second suborder of the group, the *Podoplea*, the last thoracic segment is drawn into the portion known as the abdomen. The abdomen, consisting typically of 5 segments in the male and always of less than 5 in the female, may have the number reduced through fusion to 2, or even to a single segment. The first abdominal segment bears the reproductive openings and is known as the genital segment; the last contains the orifice of the alimentary canal and is called the anal segment. This segment bears the furca, a pair of appendages each of which is fringed with a series of bristles, typically 6 in number, varying in their relative length and character. The anterior portion of the cephalic segment is called the front. It terminates in the rostrum, which consists of 1 or 2 pointed projections.

The pairs of appendages which articulate with their respective segments in the cephalothorax are in their order: (1) the anterior pair of antennæ; (2) the posterior pair of antennæ; (3) the mandibles; (4) the maxillæ; (5) the anterior maxillipeds; (6) the posterior maxillipeds; (7) four pairs of swimming feet; (8) the fifth pair of feet, which are peculiarly modified in both sexes. Appendages 3 to 6 are known as the mouth parts. All except the first pair of antennæ are typically biramous; i. e., each appendage consists of an unpaired 2-jointed basal portion, bearing a 2 or 3 jointed inner and outer ramus (endopodite and exopodite) at its tip. One or both of the rami may be suppressed. The first pair of appendages, the anterior antennæ, consists typically of 25 joints, numbered from the base to the tip, but this number may be much reduced by fusion. The joints bear modified bristles and sense-hairs, or æsthetasks, as Giesbrecht appropriately calls them. In the *Gymnoplea* each joint commonly bears a cluster, consisting of a pair of bristles and an æsthetask. In the male one of the anterior antennæ (usually the right), or both, may be modified to form a geniculating grasping organ. Since nearly all of the appendages are more or less flattened, it is convenient to distinguish certain regions, with reference to the body of the animal, as the anterior and posterior surfaces, inner and outer, and proximal and distal margins of the various joints. The number, arrangement, and character of the bristles on these different surfaces are of considerable taxonomic value. The mouth parts may be provided with bristle-fringed lobes.

For identification only adult copepods should be selected. This is not always an easy matter, as the tow frequently contains immature specimens. The adult male is most easily recognized, because in the majority of the genera it has striking secondary sexual characters either in the fifth pair of legs or in one or both of the anterior antennæ. The adult female is less easily distinguished unless found carrying eggs or with spermatophores attached to the genital segment. It is usually necessary to

dissect off the appendages, especially the feet, in order to determine the genus to which a particular form belongs. Permanent preparations of these or of the whole animals are easily made by simply adding a drop of Farrant's medium to the sea water or formalin under the cover-glass.

## TABLE OF THE GENERA.

[Genera represented in the Woods Hole fauna are indicated by an asterisk.]

- Inner ramus of first to third foot 3-jointed, of fourth foot 3-jointed to lacking. (*Arietellus*, *Augaptilus*, *Calanus*\*, *Centropages*\*, *Disseta*, *Hemicalanus*, *Heterochæta*, *Isias*, *Leuckartia*, *Metridea*\*, *Phyllopus*, *Pleuromma*, *Ægisthus*, *Clytemnestra*\*, *Microsetella*, *Monstrilla*, *Oithona*\*, *Thaumaleus*).... A
- Inner ramus of first foot 3-jointed, of the second to fourth foot 2-jointed. (*Anomalocera*\*, *Parapontella*, *Pontella*\*, *Pontellina*, *Monops*\*, *Corynura*\*)..... B
- Inner ramus of first foot 2-jointed, of the second foot 2 or 3 jointed, of the third and fourth foot 3-jointed. (*Acrocalanus*, *Calocalanus*\*, *Eucalanus*\*, *Leuckartia*, *Paracalanus*\*, *Rhincalanus*, *Temora*\*, *Ægisthus*, *Euterpe*, *Miracia*\*, *Setella*\*)..... C
- Inner ramus of first to fourth foot 2-jointed. (*Acartia*\*, *Calanopia*, *Candace*\*, *Centropages*\*, *Corynura*\*, *Labidocera*\*, *Temora*\*)..... D
- Inner ramus of first foot 1-jointed, of second to fourth foot 3-jointed (anterior antennæ about twice as long as cephalothorax; fifth foot with 3-jointed outer ramus and no inner ramus)... *Mecynocera*\*
- Inner ramus of first foot 1-jointed, of second foot 2-jointed, of the third and fourth foot 3-jointed. (*Clausocalanus*\*, *Ctenocalanus*, *Drepanopus*, *Gaëtanus*, *Mebianus*, *Phatma*, *Pseudocalanus*, *Scolecithrix*, *Spinocalanus*, *Xanthocalanus*)..... E
- Inner ramus of first and second foot 1-jointed, of the third and fourth foot 3-jointed. (*Actidius*, *Chiridius*, *Euchæta*, *Euchiriella*, *Undeuchæta*)..... F
- Inner ramus of first and second foot 1- or 2-jointed, of the third and fourth foot 1-jointed... *Mormonilla*
- A. Between anterior antennæ and first pair of feet no appendages ..... (*Monstrillida*) A 1
- Between anterior antennæ and first pair of feet usually all 5, or at least (*Copilia* ♂) 2 pairs of appendages (posterior antennæ, posterior maxillipeds)..... A 2
- A 1. Anterior antennæ not geniculating; ventral surface of genital segment with furcate, setiform appendage..... A 1 ♀
- Anterior antennæ geniculating; ventral surface of genital segment with a pulvilliform outgrowth terminating in two lateral projections..... A 1 ♂
- A 1 ♀ Only 1 segment between the genital segment and the furca; furca with 3 bristles on either side..... *Thaumaleus* ♀
- Two to 3 segments between genital segment and furca; furca with 5 to 6 bristles on either side..... *Monstrilla* ♀
- A 1 ♂ Two segments between the genital segment and the furca; furca with 3 to 4 bristles on either side..... *Thaumaleus* ♂
- Three segments between the genital segment and the furca; furca with 5 to 6 bristles on either side..... *Monstrilla* ♂
- A 2. Cephalothorax with 5 pairs of feet, the last of which is of variable structure and sometimes reduced to 1 or 2 joints. First abdominal segment without foot rudiments. Posterior antennæ biramous, their outer ramus with at least 5 joints; both rami with plumose or hooked bristles (*Gymnoplea* in part)..... A 3
- Cephalothorax with 4 pairs of feet. First (short) abdominal segment with rudiments of feet, which are inserted laterally or ventrally as paired (rod-, leaf-, or bristle-shaped) appendages. Posterior antennæ uni- or bi-ramous, in the latter case with at most 3-jointed, small, external ramus; tip of inner ramus with a few nonplumose, curved or hook-shaped bristles (*Ampharthrandria* in part)..... *Isokerandria* A 13
- A 3. On right or left sides of first thoracic segment in antero-lateral corner is a small brown knob..... *Pleuromma*
- With no such knob..... A 4
- A 4. First joint of inner ramus of the second foot with proximally curved hooks along the inner edge..... \* *Metridia*
- First joint of inner ramus of second foot normal, resembling corresponding joint in other feet..... A 5

- A 5. Third joint of outer ramus of second to fourth foot with 2 spines on external border, the distal one inserted on tip of border; terminal bristle of joint with broad, smooth edge.... \**Calanus*  
Third joint of outer ramus of second to fourth foot with 3 spines on outer border, the distal one of which is inserted at tip of border; terminal bristle of joint denticulate (sometimes faintly) on its outer edge ..... A 6  
The 3 spines on outer margin of third joint of outer ramus of second to fourth foot and the denticulation of terminal bristle obsolete ..... *Augaptilus* (in part).
- A 6. One bristle of left limb of furca much longer and thicker than other bristles of furca..... A 7  
Furcal bristles symmetrical..... A 8
- A 7. Mandibular blade with 3 or 4 teeth, of which the ventral one is uncinat and separated from others by a long diastema; inner ramus of maxilla rudimental ..... *Heterochata*  
Mandibular blade with at least 8 teeth; inner ramus of maxilla well developed ..... *Disseta*
- A 8. Abdomen with 3 to 4 segments; first segment with genital opening on its convex ventral surface.  
Anterior antennae symmetrical..... A 8 ♀  
Abdomen with 5 segments (anal segment, however, sometimes obsolete); its first segment with lateral genital opening. One of anterior antennae a geniculating prehensile organ.... A 8 ♂
- A 8 ♀ Inner and outer rami of fifth foot 3-jointed ..... A 9 ♀  
Inner and outer rami of fifth foot 2-jointed..... *Augaptilus* (in part)  
Outer ramus of fifth foot 3-jointed, inner ramus 2-jointed ..... *Isochata* ♀  
Outer ramus of fifth foot 3-jointed, inner ramus 1-jointed ..... *Isias* ♀  
Outer ramus of fifth foot 3-jointed, inner ramus lacking..... *Phyllopus* ♀
- A 9 ♀ Second joint of outer ramus of fifth foot with a stout, thorn-like process on its inner border; third joint with 4 inner and 1 terminal bristle; third joint of inner ramus of fifth foot with 6 bristles..... \**Centropages* ♀  
Second joint of outer ramus of fifth foot with a thin, awl-shaped inner bristle; third joint of same with 3 inner and one terminal bristle; third joint of inner ramus of the fifth foot with 5 bristles..... *Leuckartia* ♀  
Second joint of outer ramus of fifth foot with a thin, awl-shaped, or very rudimental inner bristle; third joint of same with 3 inner and 1 terminal bristle; third joint of inner ramus of fifth foot with at least 6 bristles ..... A 10 ♀
- A 10 ♀ Abdomen with 4 segments; inner ramus of maxilla at least 1-jointed..... *Hemicalanus* ♀  
Abdomen with 3 segments; inner ramus of maxilla lacking ..... *Augaptilus* ♀
- A 8 ♂ Right anterior antenna prehensile ..... A 9 ♂  
Left anterior antenna prehensile ..... A 11 ♂
- A 9 ♂ Both inner rami of fifth pair of feet 3-jointed, provided with plumose bristles..... A 10 ♂  
Inner rami of fifth pair of feet rudimental, altogether without plumose bristles..... *Isias* ♂
- A 10 ♂ Outer rami of fifth pair of feet differing in structure, the right provided with forceps, the left 2-jointed; mandibular blade richly dentate..... \**Centropages* ♂  
Outer rami of fifth pair of feet of similar structure; mandibular blade with few teeth ..... *Augaptilus* ♂
- A 11 ♂ Outer and inner rami of left fifth foot 3, of right 2-jointed ..... *Leuckartia* ♂  
Both outer rami of fifth pair of feet 3-jointed, the inner rudimental, mamilliform.... *Arietellus* ♂  
Both inner and outer rami of fifth pair of feet 3-jointed ..... A 12 ♂
- A 12 ♂ Inner ramus of maxilla at least 1-jointed; distal bristles of anterior maxillipeds provided with points or naked..... *Hemicalanus* ♂  
Inner ramus of maxilla lacking; distal bristles of anterior maxillipeds with fungiform appendages..... *Augaptilus* ♂
- A 13. Head with 2 large chitinous lenses, usually on edge of front, but sometimes shifted to ventral surface of the head (*Corycaidea*) ..... A 14  
Head without chitinous lenses ..... A 17
- A 14. Inner ramus of fourth foot (2- or) 3-jointed..... A 15  
Inner ramus of fourth foot 1-jointed or bristle-shaped ..... A 16
- A 15. Abdomen with 4 or 5 segments, which are laterally dilated ..... \**Sapphirina*  
Abdomen with 2 segments, which are not broadened ..... *Corina* ♀
- A 16. Eye lenses separated by a distance at least equal to their diameter; two last cephalothoracic segments without lateral projections, the last with a median dorsal spine..... *Copilia* ♀  
Eye lenses close together; two last cephalothoracic segments prolonged into pointed lateral projections, last without a dorsal spine ..... \**Corycaeus*

- A 17. Cephalothorax and abdomen flattened, leaf-shaped; mandibles, maxillæ and anterior maxillipeds lacking or reduced to minute stumps; furca very long and rod-shaped ..... *Copilia* ♂  
Cephalothorax of varying form, rounder or sometimes depressed in cross section, but never leaf-shaped; cephalic appendages all present; furca shorter, at most 6 times as long as broad.. A 18
- A 18. Outer ramus of first foot 1-jointed; posterolateral corners of the four cephalothoracic segments and front drawn out into processes ..... *Clytemnestra*  
Outer ramus of first foot 2 to 3-jointed ..... A 19
- A 19. Outer ramus of posterior antennæ 1-jointed; furca very short, on either side with 1 very long bristle (at least twice as long as trunk); limbs of furca and the 2 bristles fused in median line; remaining furcal bristles obsolescent..... *Egisthus* ♀  
Outer ramus of posterior antennæ 3-jointed, thin; furca short, with separate limbs and on either side with one long bristle, at least as long as trunk and at least twice as long as any of remaining bristles..... \**Microsetella*  
Outer ramus of posterior antennæ lacking; furca longer than broad, with separate limbs.. A 20
- A 20. Anterior and posterior maxillipeds of similar structure, both of them provided with long prickly bristles ..... \**Oithona*  
Posterior maxilliped with few (or no) short bristles and a terminal hook (*Oncaidæ*) ..... A 21
- A 21. Fifth pair of feet 1-jointed, each terminating in 2 lanceolate appendages, which are provided with denticulate edges; cephalothorax long and slender ..... *Lubbockia*  
Fifth pair of feet 2-jointed, 1-jointed, or button-shaped, provided with naked or plumose bristles; cephalothorax less slender ..... A 22
- A 22. Anterior antennæ with very long and robust æsthetasks (sense hairs) on terminal joint; fifth pair of feet 2-jointed..... *Ratania* ♀  
Anterior antennæ with numerous penicillate æsthetasks on proximal joints; fifth pair of feet papillate; cephalothorax robust, pear-shaped ..... *Pachysoma*  
Anterior antennæ with few and very delicate æsthetasks; fifth pair of feet small rods or knobs, sometimes reduced to a pair of bristles ..... A 23
- A 23. Hooked bristles on terminal joint of posterior antennæ of medium length; inner ramus of posterior feet at least as long as the outer ramus, its terminal joint in the fourth pair at least 1½ times as long as first and second together ..... \**Oncaea*  
Hooked bristles on elongated terminal joint of posterior antennæ very long; inner ramus of posterior feet shorter than outer ramus, its terminal joint in fourth pair not longer than either of the two proximal joints ..... *Conaca*
- B. Head without dorsal chitinous lenses or lateral hooks..... B 1  
Head with 1 or 2 pairs of chitinous lenses and hook on either side of lateral border..... B 3
- B 1. Posterior maxilliped 4-jointed; mandible with the rudimental outer ramus articulating proximally before the middle of second basal joint; rami of the posterior antennæ of nearly equal length ..... *Parapontella*  
Posterior maxilliped 5 to 7-jointed; mandibular rami articulating with second basal joint at about same level; outer ramus of posterior antennæ much shorter than inner ramus..... B 2
- B 2. Abdomen with asymmetrical protuberances ..... \**Monops*  
Abdomen symmetrical (except in fusion of right furcal limb with anal segment in the female)..... *Pontellina*
- B 3. Head with one pair of dorsal eye lenses; base of rostrum with lenticular thickening .... \**Ponte*  
Head with two pairs of dorsal eye lenses; the base of the rostrum without lenticular thickening ..... \**Anomalocera*
- C. Posterior antennæ biramous; outer ramus with several joints; first abdominal segment without rudiments of feet; anterior antennæ at least 15-jointed (*Gymnoplea* in part) ..... C 1  
Posterior antennæ either uni- or bi-ramous; in the latter case with small, 1-jointed outer ramus; first abdominal segment with rudimental (rod- or leaf-shaped) feet; anterior antennæ at most 9-jointed. (*Ampharthrandia* in part) ..... C 7
- C 1. Both feet of fifth pair biramous, rami 2- or 3-jointed..... *Leuokartia*  
Fifth pair of feet absent, or, if present, not more than left foot biramous..... C 2
- C 2. Furca long and narrow, at least 6 times as long as broad; terminal bristle of third joint of outer ramus of second to fourth foot denticulate..... \**Temora*  
Furca, at most, 3 times as long as broad; terminal bristle of third joint of outer ramus of second to fourth foot with a smooth border..... C 3

- C 3. In third and fourth foot the second joint of inner ramus has 2, the third joint 7 bristles; scapelliform terminal bristle of third joint of outer ramus in second to fourth foot much broader than in first pair ..... C 4  
 In third and fourth foot the second joint of inner ramus has 1, the third joint 5 bristles; scapelliform terminal bristle of third joint of outer ramus in the first foot similar to that of second to fourth foot ..... C 6
- C 4. Second joint of inner ramus of first foot without an inner marginal bristle; outer border of outer ramus not denticulate; terminal joint of inner ramus of first foot with 4 bristles; (female: abdomen with 2 or 3 segments; fifth foot 3 or 4-jointed; terminal joint of anterior antennæ at least twice as long as penultimate joint)..... \**Calocalanus*  
 Second joint of inner ramus of first foot with an inner marginal bristle; outer border of outer ramus in more posterior feet denticulate; terminal joint of inner ramus of first foot with 5 bristles; (female: abdomen with 4 segments; fifth foot 2-jointed to lacking; terminal joint of anterior antennæ, at most, 1½ times as long as penultimate joint)..... C 5
- C 5. Third and fourth foot with denticulate outer border to the second joint of the outer ramus and to the proximal portion of the outer border in the third joint of the outer ramus; scapelliform terminal bristle of the outer ramus of third foot little more than half as long as the third joint of the outer ramus; third joint of inner ramus of second foot with 6 bristles (female: fifth pair absent or knob-shaped; male: right fifth foot absent).... \**Arocalanus*  
 Third and fourth foot denticulate only on proximal portion of third joint of outer ramus; not on second joint; scapelliform terminal bristle of outer ramus of third foot longer than third joint of the outer ramus; third joint of inner ramus of second foot with 7 bristles; (female: fifth foot 2-jointed; male: fifth foot 2-jointed)..... \**Paracalanus*
- C 6. Outer ramus of first foot 3-jointed; thorax without prickles (female: fifth foot wanting; male: neither foot of fifth pair biramous; right fifth foot sometimes wanting)..... \**Eucalanus*  
 Outer ramus of first foot 2-jointed; middle thoracic segments with 1 or 2 pairs of prickles; (female: fifth foot 3-jointed; male: fifth foot 2-jointed)..... \**Rhincalanus*
- C 7. Front with 2 large chitinous lenses..... \**Miracia*  
 Front without chitinous lenses ..... C 8
- C 8. Front conical, rounded anteriorly; cephalothorax very narrow; outer ramus of posterior antennæ wanting..... \**Setella*  
 Front pointed; cephalothorax broader; outer ramus of posterior antennæ 1-jointed ..... C 9
- C 9. Furca with separate limbs (about twice as long as broad) and bristles much shorter than cephalothorax..... \**Eutirpe*  
 Limbs of the very short furca as well as their two unusually long bristles fused in the middle line ..... \**Egisthus*
- D. Head with dorsal eye-lenses; (posterior maxilliped 6-jointed, 6th joint very minute).... \**Labidocera*  
 Head without dorsal eye-lenses ..... D 1
- D 1. Fifth pair of feet biramous with jointed inner ramus ..... \**Centropages*  
 Fifth pair of feet uniramous..... D 2
- D 2. Posterior maxilliped 7-jointed ..... D 3  
 Posterior maxilliped 3- to 4-jointed..... D 5
- D 3. Furca long and slender, at least 6 times as long as broad; posterior maxilliped twice as long as anterior..... \**Temora*  
 Furca at most 4 times as long as broad; posterior maxilliped shorter than anterior ..... D 4
- D 4. Anterior maxilliped with short bristles on its proximal, and long, thick, sickle-shaped bristles on its distal portion, proximal basal joint of posterior maxilliped with a few short bristles ..... \**Candace*  
 Proximal and distal portions of anterior maxilliped and also proximal basal joint of the posterior maxilliped with long, prickly bristles ..... \**Calanopia*
- D 5. Outer ramus of posterior antennæ shorter than distal joint of the inner ramus; anterior maxilliped provided on its proximal and distal portions with long, prickly bristles.... \**Acartia*  
 Outer ramus of posterior antennæ longer than distal joint of inner ramus; anterior maxilliped with short bristles on proximal and powerful hooked bristles on distal part..... \**Corynura*
- E. Third joint of outer ramus of 2d to 4th foot with 5 inner marginal bristles..... \**Spinocalanus* ♀  
 Third joint of outer ramus of 2d to 4th foot with 4 inner marginal bristles ..... E 1

- E 1. Surfaces of rami of second to fourth pairs of feet without larger spines; appendages of anterior maxilliped bristle-shaped ..... E 2  
 Surfaces of outer ramus and especially of the second and third joints of the inner ramus of the third and fourth pairs of feet armed with stout spines; distal bristles of the anterior maxillipeds in part soft, vermiform or penicillate ..... E 7 (a, b)
- E 2. Second and third foot differing from fourth as follows: Basal joints and outer ramus broader and stouter, distal edge of second basal joint notched on posterior surface; terminal bristle (especially on third foot) with broader margin ..... \* *Clausocalanus*  
 Second and third foot not differing from fourth in above-mentioned particulars ..... E 3
- E 3. Outer marginal spines of second and third joints of outer ramus in fourth foot pectinate, lying in deep notches ..... *Ctenocalanus*  
 Outer marginal spines of outer rami of feet of usual form ..... E 4
- E 4. Abdomen of 4 segments; its first segment with genital orifice on convex ventral surface, longer than the succeeding segments; fifth pair of feet symmetrical or wanting ..... E 4 ♀  
 Abdomen of 5 segments; its first segment with genital orifice on left side, shorter than next following segments; fifth pair of feet asymmetrical ..... E 4 ♂
- E 4 ♀ On the antero-dorsal surface of head there is a median spine pointing forward; lateral portions of last thoracic segment prolonged on either side into a powerful point ..... *Gaëtanus* ♀  
 Head without a median spine; lateral portions of last thoracic segment rounded or at most (on one side) with a short point ..... E 5 ♀
- E 5 ♀ Fifth pair of feet 2-jointed, terminating in a stout, curved, denticulate bristle ..... E 6 ♀  
 Fifth pair of feet wanting ..... *Pseudocalanus* ♀
- E 6 ♀ Rostrum ending in two flaccid threads; last thoracic and genital segment symmetrical; first joint of outer ramus of first foot with external bristle; terminal bristle of fifth foot much longer than the two joints of the same taken together ..... *Drepanopus* ♀  
 Rostrum wanting; last thoracic and genital segment asymmetrical; first joint of outer ramus of first foot without external bristle; terminal bristle of fifth foot about as long as the two joints of same taken together ..... *Mobianus* ♀
- E 4 ♂ Feet of fifth pair, especially swollen left one, with a considerable number of peculiarly shaped appendages at its tip ..... *Mobianus* ♂  
 Feet of fifth pair long and slender, stylet-shaped ..... *Pseudocalanus* ♂  
 Feet of fifth pair short, right one with uncinatè terminal joint ..... *Drepanopus* ♂
- E 7(a). Outer ramus of posterior antenna more than 1½ times as long as inner ramus; cephalothorax globose in the female, and stout even in male (fifth pair of feet wanting in the female; in the male there are two uniramous feet) ..... *Phaëna*  
 Outer ramus of posterior antenna less than 1½ times as long as inner ramus; cephalothorax elliptical ..... E 8(a)
- E 8(a). Surfaces (especially posterior surface) of the second and third joints of outer ramus of second (and fourth) foot armed with groups of small points; second joint of outer ramus of fourth foot without lamellæ; fifth foot of female wanting or 1 or 2 jointed; not denticulate on inner margin; female with well-developed right and 1-jointed inner ramus in left fifth foot ..... *Scolecithrix*  
 Surfaces of outer ramus of second (and third) foot naked; second joint of outer ramus of fourth foot on posterior surface with a series of delicate lamellæ; fifth foot of female 2 or 3 jointed, denticulate on inner margin of the first joint; male with uniramous left and lacking right fifth foot ..... *Xanthocalanus*
- E 7(b). Twenty-fifth joint of anterior antenna fused with twenty-fourth ..... *Scolecithrix*  
 Twenty-fifth joint of anterior antenna separate from the twenty-fourth ..... E 8(b)
- E 8(b). Fifth pair of feet wanting in female and consisting of two uniramous feet in male.. *Phaëna*.  
 Fifth pair of feet 2 or 3-jointed on either side in female; in male reduced to a single foot (the left) ..... *Xanthocalanus*
- F. Abdomen of 4 segments; its first segment (with the genital opening on the convex ventral surface which is often provided with protuberances) at least as long as the following and longer than its last segment; fifth pair of feet wanting; mouth parts well developed ..... F ♀  
 Abdomen of 5 segments (with very short, concealed, anal segment), its first segment with genital opening on left side, shorter than the next succeeding segments; fifth pair of feet asymmetrical; blade of mandible, anterior maxilliped, and in part also the maxilla, obsolete ..... F ♂

- F ♀. Lateral corners of last thoracic segment each prolonged into a long-pointed process; outer ramus of first foot 3-jointed ..... F 1 ♀  
 Lateral corners of last thoracic segment rounded, sometimes slightly pointed; outer ramus of first foot 2-jointed. .... F 2 ♀
- F 1 ♀. Rostrum ending in 2 stout, strongly chitinized prongs; rami of posterior antennæ of about same length ..... *Aëtidius*  
 Rostrum wanting; inner ramus of posterior antennæ about half as long as outer ramus. *Chiridius*.
- F 2 ♀. Rami of posterior antennæ of about the same length ..... *Euchata*  
 Outer ramus of posterior antennæ at least  $1\frac{1}{2}$  times as long as inner ramus ..... F 3 ♀
- F 3 ♀. Inner border of first basal joint of fourth foot naked or with a few small hairs; median bristles of outer ramus of maxillæ shorter than the proximal and distal bristles. .... *Undeuchata*  
 Inner border of first basal joint of fourth foot with spinose or crenate bristles; median bristles of outer ramus of maxillæ not abbreviated. .... *Euchirella*
- F ♂. Only one foot of the fifth pair present and this is uniramous; lateral portions of last thoracic segment pointed ..... *Aëtidius* ♂  
 Feet of fifth pair both powerfully developed; lateral portions of the last thoracic segment rounded ..... F 1 ♂
- F 1 ♂. Inner ramus of posterior antenna considerably shorter than outer ramus; right fifth foot chelate ..... *Euchirella* ♂  
 Rami of posterior antennæ about same length; fifth foot not chelate, the right, sometimes also the left, bearing a stylet-shaped appendage ..... *Euchata*.

### Suborder GYMNOPLA.

#### Family CALANIDÆ.

##### CALANUS Leach.

*Female:* Head free or fused with first thoracic segment; fifth thoracic segment free, sometimes asymmetrical; rostrum ending in two points; abdomen composed of 4 segments; genital segment symmetrical; furca occasionally slightly asymmetrical. Anterior antennæ sometimes not reaching hind end of body, sometimes extending a considerable distance beyond, and not always of symmetrical length, 25-jointed, with very uniformly distributed short antero-marginal bristles and delicate aesthetascs, and 2 long and plumose postero-marginal setæ on terminal joints. Rami of posterior antennæ of about equal length, outer ramus 7-jointed. Mandibular blade with 8 rather flat teeth; rami of about equal length, proximal joint of inner ramus with sack-shaped appendage. Maxillæ with 3-jointed inner ramus, articulating with basal; outer lobe with bristle. Anterior maxilliped relatively long, with long curved bristles on inner and a plumose bristle on outer margin. Posterior maxilliped with long 5-jointed inner ramus, provided with long, stiff, usually naked bristles.

*Male:* Abdomen composed of 5 segments; genital orifice sinistral; furcal bristles abbreviated. Anterior antennæ held in an unusual position and sometimes abbreviated, the number of their joints reduced (at least the first two joints fused), twenty-fifth joint usually abbreviated, aesthetascs enlarged and increased in number, bristles, with rare exceptions, reduced. Posterior antennæ stouter than in female, with in part abbreviated bristles; outer ramus with an S-shaped curvature. Mandibular blade weaker and in some species stunted; in these same forms the inner marginal appendages of maxillæ and of the anterior maxillipeds are decidedly stunted. In general a stronger development of outer marginal bristles at end of posterior maxilliped, which in some species are also stunted, owing to shortening, obliteration of joints, and absence of bristles. In some species differences as compared with the female are found also in separation of head from first thoracic segment, in form of last thoracic segment, and in the feet.

#### 1. *Calanus finmarchicus* Gunner.

*Female:* Head separated from first thoracic segment; front and lateral portions of fifth thoracic segment rounded; furcal bristles symmetrical. Anterior antennæ reaching about to end of trunk; aesthetascs not duplicated on any joints. Distal margin of second basal joint of second to fourth pairs of legs with pointed projection; ratio of lengths of portions of outer margins of third joint of outer ramus in second to fourth pairs as 2:1; 2:1; 3:1. First basal of fifth pair with concave, denticulated inner border.

*Male:* Head separated from first thoracic segment. Anterior antennæ straight (joints 1 and 2 fused). Mouth parts similar to those of female (outer bristle of fourth joint of inner ramus of posterior

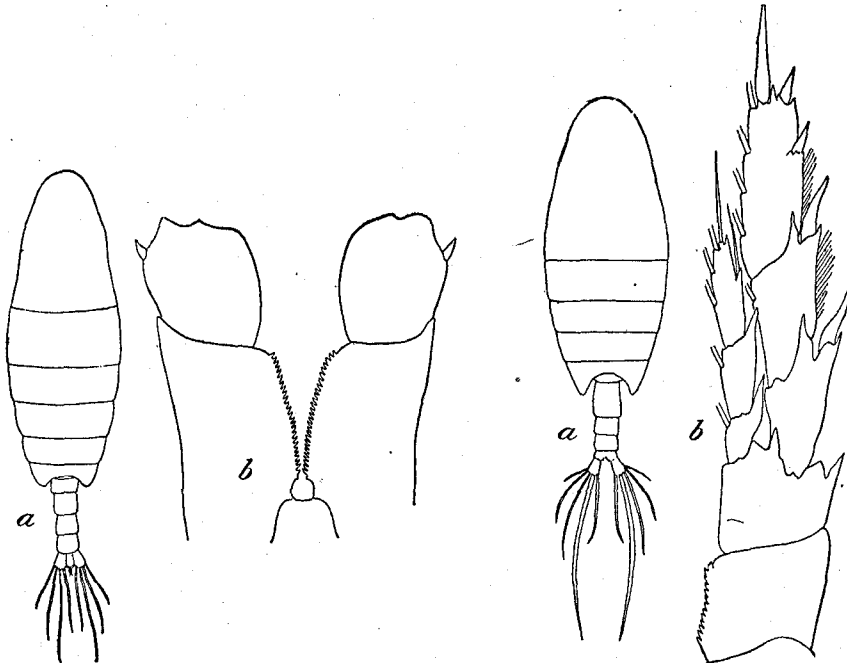


maxilliped reaching down about to distal edge of second basal). Right fifth foot has outer ramus without an internal bristle; terminal bristle thorn-shaped, sometimes denticulate; left fifth foot has inner ramus, as on right side; basal and first and second joints of outer ramus elongated, so that right outer ramus (exclusive of terminal bristle) reaches at least to middle, at most as far as end of second joint of left outer ramus; third joint of outer ramus abbreviated.

Coloration: Rather transparent, with rather irregularly distributed red pigment in body and sometimes in appendages. In some individuals color is lacking except in anal region. Eggs yellowish or reddish.

Length of female, 2.7 to 4.5 mm; of male, 2.35 to 3.2 mm.

Numerous colorless female specimens of this thoroughly pelagic, widespread, and economically very important species were taken in the tow by the *Fish Hawk* in Vineyard Sound, near Gay Head,



1. *Calanus finmarchicus* Gunner; a, female, dorsal aspect; b, basal portion of fifth pair of legs.

2. *Calanus minor* Claus; a, female, dorsal aspect; b, female, fifth foot.

Marthas Vineyard, July 10. My specimens do not show a marked concavity of inner border of basal joints of fifth pair of legs, but in other respects they conform with Giesbrecht's description.

## 2. *Calanus minor* Claus.

*Female*: Head and first thoracic segment united; front and lateral portions of fifth thoracic segment rounded; furcal bristles symmetrical, the longest twice as long as abdomen and twice as thick as other bristles. Anterior antennæ not reaching to posterior end of trunk; aesthetascs not duplicated on any joints. Distal margin of second basal joint of second to fourth pairs with pointed projection; ratios of lengths of pieces of third joint of outer ramus as 5:4; 10:7; 2:1. First basal joint of fifth pair of feet along inner border with straight margin, less finely denticulated than in *C. finmarchicus*.

*Male*: Head and first thoracic segment fused. Anterior antennæ curved (joints 1 and 2, 3 to 5, 24 and 25 fused). Mouth parts similar to those of female (outer bristle of fourth joint of inner ramus of posterior maxillipeds extending down nearly to distal edge of second basal). Right fifth foot has third joint of outer ramus with only 2 inner bristles and a short, thorn-shaped terminal bristle; left fifth foot with only 3 small bristles on third joint of inner ramus.

Length of female, 1.8 to 2 mm.; of male, 1.7 to 1.8 mm.

Numerous female specimens taken in Gulf Stream tow, July 25, 1899. This species has a very wide range of distribution.

## EUCALANUS Dana.

Anal segment and furca fused; furca asymmetrical. Mandible of female longer than maxilla and more than two-thirds as long as fourth pair of feet; its second basal joint forms with outer ramus a cylindrical body, with which the very small inner ramus articulates much further proximally than outer ramus. Inner ramus of posterior maxillipeds longer than first or second basal joint. First pair of feet with 3-jointed outer and 2-jointed inner ramus. Fifth pair of feet wanting in female; in male both of these feet are uniramous, the left 4-jointed, the right 1 to 4 jointed or lacking.

*Female:* Trunk usually elongated; head fused with first thoracic segment, two last thoracic segments less intimately united; head triangular, often elongated, with transverse dorsal furrow; rostrum ending in thin threads; abdomen short, with 3 or 4 segments; genital segment symmetrical; anterior antennæ reaching beyond end of body, sometimes of asymmetrical lengths, 23-jointed, owing to fusion of first and second and of eighth and ninth joints; the first joint elongated, the last



3. *Eucalanus attenuatus* Dana; female; dorsal aspect.  
After Giesbrecht.

4. *Eucalanus monachus* Giesbrecht male; a, dorsal aspect; b, fourth foot; c, left fifth foot.

joint longer than penultimate; aesthetascs long and delicate; bristles usually plumose, those of terminal joints in part with long and sometimes gorgeously colored plumes; inner ramus of posterior antennæ longer than outer ramus, sometimes more than twice as long, the latter 7 or 8 jointed; proximal outer marginal lobe of maxillæ strongly projecting, second basal joint elongate, inner ramus distinctly jointed, outer ramus relatively small; anterior maxilliped with a long, plumose outer marginal bristle; inner ramus of posterior maxilliped relatively long and provided with long bristles; feet short, outer ramus 3-jointed; inner ramus of first pair 2-jointed, of remaining pairs 3-jointed.

*Male:* Trunk shortened; peculiarities in form of head of female not apparent; abdomen of 5 segments; furca and furcal bristles similar to those of female; first 2 joints of anterior antennæ separate, terminal joint abbreviated; bristles abbreviated, with rudimental plumes; aesthetascs enlarged and increased in number; posterior antennæ stouter than in female, part of bristles absent; mandibular

blade in some species slightly, in others considerably, reduced; second basal joint shortened, inner ramus inserted nearer end of joints; appendages of inner border of maxillæ and of anterior maxilliped not generally reduced; modification of posterior maxillipeds like that of *Calanus*.

### 3. *Eucalanus attenuatus* Dana.

*Female*: Only one segment between genital and anal segments; front triangular, indented on either side, tapering decidedly; genital segment longer than broad; furca and second terminal bristle asymmetrical; first and second joints of outer ramus of posterior antennæ separated; inner ramus  $1\frac{1}{2}$  times as long as second joint of inner ramus and four times as long as broad; second basal of mandibles with 2 inner marginal bristles; tip of inner ramus not reaching distal edge of second basal joint by more than length of ramus; first joint of inner ramus without bristles, second joint with 4 bristles; second inner lobe of maxillæ present; third inner lobe with 4 bristles, second basal joint with 5 bristles. Posterior maxilliped has first joint of inner ramus with 3 bristles, third joint with 4 bristles.

*Male*: Pronounced secondary sexual characters; right fifth foot present, left much shorter than the fourth foot.

Coloration: Transparent, with a variable amount of red pigment in body and often in some of basal joints of anterior antennæ and proximal terminal joints of appendages; terminal plumes of anterior antennæ colorless, or red, with iridescence.

Length of female, 4.2 to 4.85 mm.; of male, 3.1 to 3.25 mm.

A single female specimen taken in the Gulf Stream tow July 25, 1899. The plumes at the tip of the anterior antennæ are much damaged, but there can be no doubt of the specific identity. In life the translucent body contains more or less bright-red pigment, irregularly and often asymmetrically distributed. In my specimen the antennal plumes are colorless, at least in part, but in specimens studied by Giesbrecht they were sometimes bright orange with blue or violet iridescence.

### 4. *Eucalanus monachus* Giesbrecht.

*Female*: Only one segment between genital and anal segments; genital segment somewhat broader than long; asymmetry of furca slight; first and second joints of outer ramus of posterior antennæ fused; first joint of inner ramus shorter than second and about twice as long as broad; second basal joint of mandibles with 3 inner marginal bristles; inner ramus almost reaching dorsal margins of second basal joint; first joint of inner ramus with 2, second with 4 bristles; second inner lobe of maxilla lacking, third inner lobe with 3 bristles, second basal with 4 bristles; first and second joints of the inner ramus of posterior maxilliped each with 3 bristles.

*Male*: Less pronounced secondary sexual characters; right fifth foot wanting.

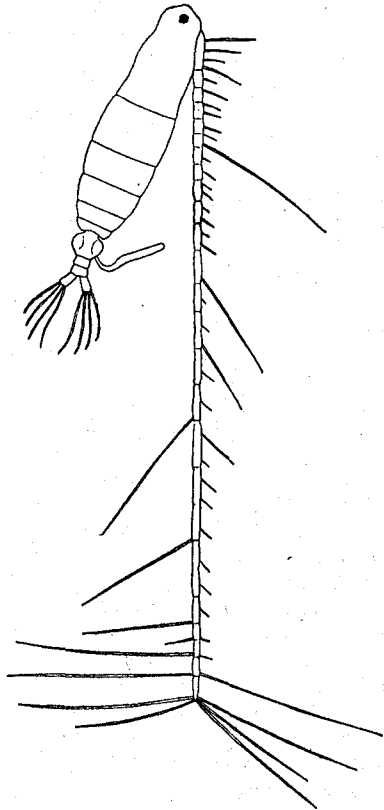
Length of male, 2.13 to 2.35 mm.; of female, 2.2 mm.

A single male specimen taken in Gulf Stream July 25, 1899. Hitherto this species has only been taken at Gibraltar (Giesbrecht, 1888).

### MECYNOCERA J. C. Thompson.

Furca symmetrical, articulating with anal segment; mandible shorter than maxilla and less than half as long as fourth pair of feet; its structure similar to that of *Calanus*, but inner ramus is nearly as long as second basal and twice as long as outer ramus; inner ramus of posterior maxillipeds at least as long as first or second basal; first pair of feet with 3-jointed outer and 1-jointed inner ramus; fifth pair of feet present, on either side 5-jointed.

*Male*: Unknown.



5. *Mecynocera clausii* Thompson; female; dorsal aspect.

*Female*: Head distinct from thorax; rostral threads delicate; abdomen short, with 3 segments; genital segment and furca symmetrical; anterior antennæ of asymmetrical length, more than twice as long as the body, 23-jointed, with a few very long bristles; inner ramus of posterior antennæ nearly twice as long as outer ramus; the succeeding appendages similar to those of *Calanus*; feet short; outer rami 3-jointed, inner ramus of first pair 1-jointed, of second to fourth pairs 3-jointed; fifth pair of feet with 2-jointed basals and 3-jointed outer rami, without inner rami.

##### 5. *Mecynocera clausii* J. C. Thompson.

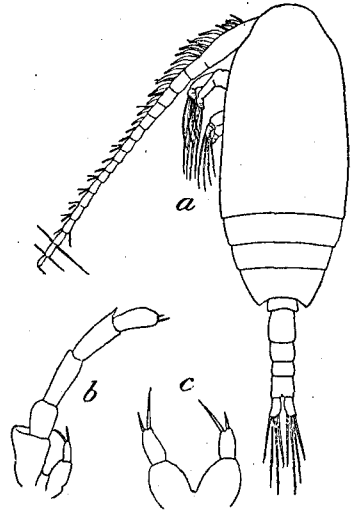
The only species of this genus; very transparent, colorless, or with a few red spots. In exceptional cases the bristles of furca and of anterior antennæ are red. Length, 0.92 to 1 mm. A single specimen was taken in the Gulf Stream July 25, 1899; the male is unknown. Thompson took the species near the Canary Islands and at Malta. Giesbrecht gives the following localities: Naples; Pacific Ocean, to 138° W., between 3° S. and 15° N., from surface to a depth of 1,000 meters.

#### PARACALANUS Bœck.

Second basal joint of first pair of feet with an inner marginal bristle; proximal portion of outer margin of third joint of outer ramus in fourth pair of feet more than twice as long as distal portion; outer margin of second joint not denticulate; proximal portion of outer margin of third joint of outer ramus in third and fourth pairs denticulate; scalpelliform terminal bristle of outer ramus in third pair longer than end joint; second joint of inner ramus of first pair with 5 bristles; third joint of inner ramus of second pair with 7 bristles; abdomen of female with 4 segments; last joint of anterior antennæ less than  $1\frac{1}{2}$  times as long as penultimate joint; fifth foot short, 2-jointed; right fifth foot of male 2-jointed, left 5-jointed.

*Female*: Head fused with first thoracic segment and fourth fused with fifth thoracic segment; rostrum ending in two flaccid threads; genital segment and furca symmetrical, the latter without an outer marginal bristle; anterior antennæ 25-jointed, with obliterated separation between first and second, also between eighth and ninth joints; outer ramus of posterior antennæ shorter than inner ramus; mandibles with broad blades; the sack-like appendage on first joint of inner ramus small; maxillæ with indistinct jointing of inner ramus, without a bristle on second outer marginal and with only one bristle on second inner marginal lobe; anterior maxilliped with an outer marginal bristle; inner ramus of first foot 2-jointed, of the second to fourth 3-jointed.

*Male*: Abdomen with 5 segments; number of joints in anterior antennæ reduced by fusion of first to sixth and of seventh with eighth; terminal joint abbreviated but separated; æsthetascs enlarged and increased in number; mandibular blade, appendages of inner margin of maxillæ and of anterior maxilliped, stunted; to a less extent also the posterior maxilliped, the outer bristle of which is long and densely plumose. Minor peculiarities are also exhibited by the feet.



6. *Paracalanus parvus* Claus; a, male, dorsal aspect; b, male, fifth pair of feet; c, female, fifth pair of feet.

##### 6. *Paracalanus parvus* Claus.

*Female*: Inner bristle of furca scarcely longer than furca; anterior antennæ reaching to posterior edge of third abdominal segment; first joint of inner ramus of maxillæ with 2 bristles on anterior border; third lobe of first basal joint of posterior maxilliped with 2 bristles; inner margin of first basal of fourth pair of feet extending out into 1 or 2 points; anterior and posterior surfaces of first basal of second to fourth pairs of feet beset with hairs and points; surfaces of first and second joints of outer ramus of third pair and of second joint of inner ramus of fourth pair naked.

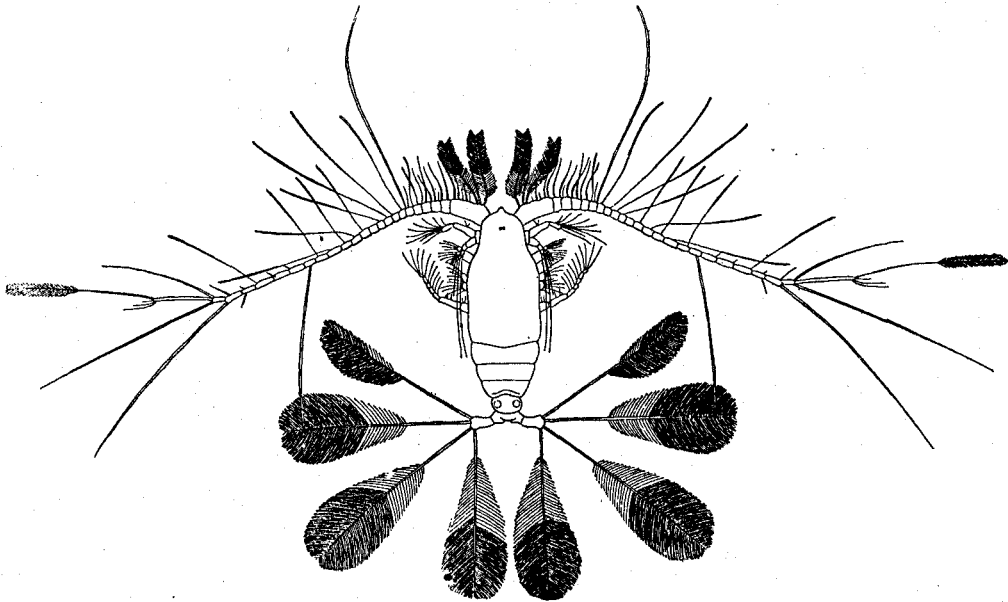
*Male*: Abdomen with very short genital segment; feet longer than in female; mouth parts abbreviated as in *Calocalanus*; æsthetascs present on some joints of anterior antennæ where they are lacking in female; they are not very large on distal portion of antennæ, but on joints 3 to 6 and 1 to 2 they have the form of rather thick, long, dependent sacs; the bristles are short; fifth pair of feet similar to that of *Calocalanus*, but right foot has only 2 joints.

Coloration: Rather transparent, with red pigment, variable in amount but never very abundant. Length of female, 0.8 to 1 mm.; of male, 0.91 to 1 mm.

Numerous specimens of this species were taken in the Gulf Stream at 6 a. m., July 29, 1899, about 70 miles south of Martha's Vineyard. This species has been frequently taken on the coasts of Europe and also in the Pacific Ocean (west of South America, between 10° and 55° S., 108° W., and at Hong-kong), but its presence in the Western Atlantic has not been noted hitherto.

#### CALOCALANUS Giesbrecht.

First pair of feet without an inner marginal bristle on the second basal joint; the proximal portion of outer margin of last joint of outer ramus in fourth pair more than twice as long as distal portion; outer margin of outer rami not denticulate; terminal bristle of outer ramus in third pair longer than end joint; second joint of the inner ramus of first pair with 4 bristles; third joint of inner ramus of second pair with 7 bristles. Abdomen of female with 2 or 3 segments; last joint of anterior antennæ at least twice as long as penultimate joint. Fifth pair of feet of female 3 or 4 jointed; right fifth foot of male 4-jointed, left 5-jointed.



7. *Calocalanus pavo* Dana; female, dorsal aspect. After Giesbrecht.

*Female*: Head fused with thorax, fourth with fifth thoracic segment; rostrum terminating in soft filaments; abdomen short; furca sometimes asymmetrical, provided with gorgeously plumed setæ; antennæ extending beyond the end of body, 25-jointed, but with obliterated boundary between first and second and between eighth and ninth joints; many of the bristles long, pigmented or beautifully plumose. Posterior antennæ with rami of equal length, or with shorter outer ramus. Mandible with but slightly dilated blade and small, sac-shaped appendage on proximal joint of inner ramus; maxillæ and maxillipeds similar to those of *calanus*; inner ramus of first foot 2-jointed, of second to fourth foot 3-jointed.

*Male*: Head distinctly separated from first thoracic segment; abdomen with 5 segments, furcal bristles less richly plumose; anterior antennæ abbreviated; joints 1 and 2, 3 to 6, and 24 and 25 are fused, the twenty-fifth shortened; bristles reduced, aesthetascs powerfully developed. Peculiarities of succeeding appendages similar to those of *Paracalanus*.

#### 7. *Calocalanus pavo* Dana.

*Female*: Abdomen with 2 segments; genital segment onion-shaped; furca and furcal bristles symmetrical. Terminal joint of anterior antennæ 5 times as long as penultimate and more than 7 times as long as twelfth joint. Outer ramus of posterior antennæ nine-tenths as long as inner ramus;

outermost terminal bristle of seventh joint of outer ramus more than 5 times as long as outer ramus. First basal joint of first pair of feet with inner marginal bristle; third joint of inner ramus of third and fourth pairs of feet each with a cluster of spines; proximal piece of outer border of third joint of outer ramus in fourth pair about twice as long as distal piece. Fifth pair of feet as long as basal of fourth pair.

*Male*: Separation between head and first thoracic segment more distinct than in female, whereas line of separation between fourth and fifth thoracic segments has disappeared. Abdomen consisting of 5 segments, of which third and fourth are shortest, the genital and anal segments longest. Furca smaller than in female, its bristles shorter and much less richly plumose. Feet much longer in proportion to trunk, especially to cephalothorax and posterior antennæ; maxillæ and maxillipeds much shorter than in female.

*Coloration*: Female very transparent, with orange or brick-red pigment not only in trunk but also in appendages, especially in long bristles of anterior antennæ and furca, and in broad plumes of latter, which have besides a metallic iridescence. These plumes can be spread, making Dana's specific name a very appropriate one. Male transparent, with bright-red anterior antennæ, antennal, mandibular, and furcal bristles.

*Length*: Female, 0.88 to 1.2 mm.; male, 1.04 mm.

Numerous female specimens with much-damaged furcal plumes were taken in Gulf Stream July 25, 1899, at 8 p. m. It is a truly tropical species hitherto known only from the following localities: 12° N. 24° W. (Dana) Western Pacific to 175° W., between 3° S. and 19° N. from the surface to a depth of 1,000 (4,000?) meters (Giesbrecht); Canary Islands; Malta (Thompson).

#### 8. *Calocalanus plumulosus* Claus.

*Female*: Abdomen 3-jointed; genital segment cuboidal; furca and furcal bristles asymmetrical (left limb the larger of the two, fused with anal segment and furnished with an enormously long bristle). Terminal joint of anterior antennæ twice as long as penultimate and twelfth joint. Outer ramus of posterior antennæ five-sevenths as long as inner ramus; outermost terminal bristle of seventh joint of outer ramus but little longer than the others. First basal joint of first pair of feet with an inner marginal bristle; third joint of inner ramus of third pair with 2 groups, of fourth pair with 1 group of spines; proximal piece of outer border of third joint of outer ramus in fourth pair 4 times as long as distal piece. Fifth pair of feet considerably longer than basal of fourth pair.

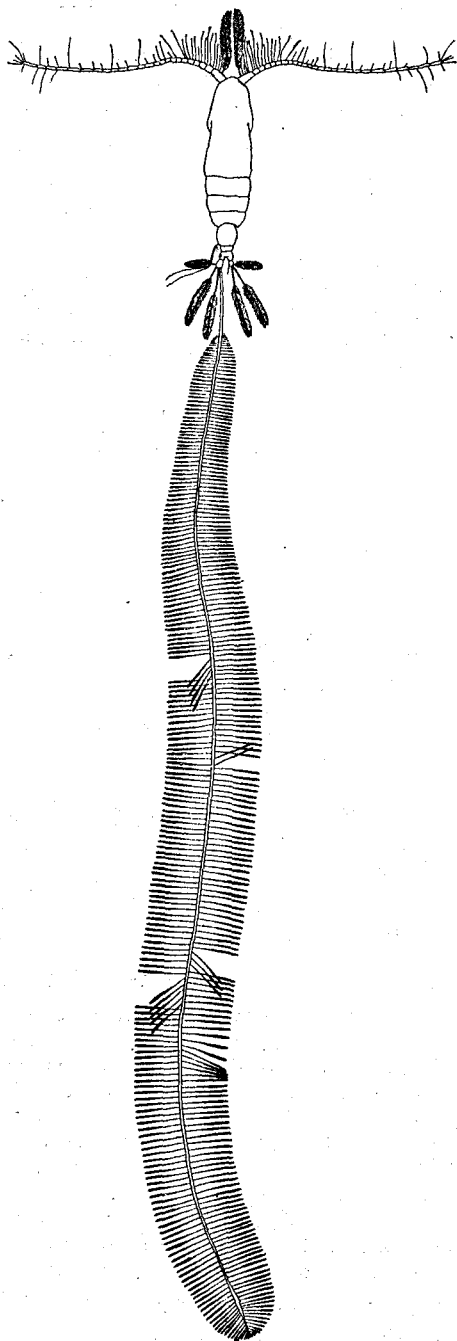
*Male*: Unknown.

*Coloration*: Female transparent, with orange or brick-red pigment scattered through the body and in antennal and furcal plumes.

*Length*: 0.93 to 1.2 mm.

Several female specimens of this interesting form were taken in the tow with the preceding species.

In all specimens the greater portion of the huge furcal bristle had been broken off in the tow net, but



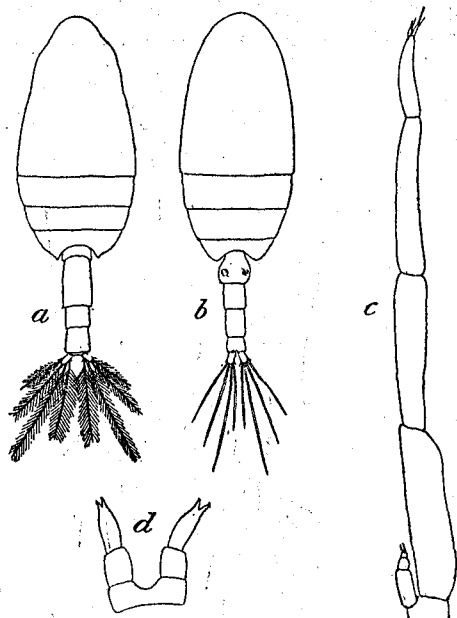
8. *Calocalanus plumulosus* Claus; female, dorsal aspect. After Giesbrecht, with modifications.

the other plumes were present. There could be no mistaking the specific identity of my specimens. It is known to occur in the Mediterranean (Claus and Giesbrecht) and in the Pacific Ocean 108° to 124° W. and 0° to 11° N. (Giesbrecht).

#### CLAUSOCALANUS Giesbrecht.

Rostrum ending in two points; terminal joint of anterior antennæ fused with penultimate joint; second and third pairs of feet with broad, calyculate basal joint, crenated on its distal border, and also with broad outer rami. Mouth parts of male much reduced, as is also the number of joints in anterior antennæ of the same sex.

*Female*: Head fused with first thoracic segment, fourth with the fifth thoracic segment; rostrum with 2 short, rather stiff filaments. Abdomen with 4 segments; genital segment and furca symmetrical. Anterior antennæ reaching beyond thorax, 23-jointed, eighth joint fused with ninth, twenty-fourth with the twenty-fifth; æsthetascs short, bristles of terminal joint elongated. Outer ramus of posterior antennæ  $1\frac{1}{2}$  times as long as inner ramus; the former 6-jointed, with short bristles on the proximal joints. First joint of inner ramus of mandible, with a very short, sac-shaped appendage. Maxillæ and maxillipeds similar to those of *Calanus*; outer marginal bristle lacking in anterior maxilliped. Outer rami of third pair of feet, inner ramus of first pair 1-jointed, of second pair 2-jointed, of third and fourth pairs 3-jointed; terminal joint of outer ramus with finely denticulate terminal saw and 4 inner marginal bristles on the second to fourth pairs. Fifth pair of feet short, consisting of 2 uniramous, 3-jointed feet.



9. *Clausocalanus arcuicornis*; a, female, dorsal aspect; b, male, dorsal aspect; c, male, fifth pair of feet; d, female, fifth pair of feet.

*Male*: Head and first thoracic segment fused, lengthened at expense of free thoracic rings; rostrum reduced; abdomen with 5 segments, of which the anal is very short. In anterior antennæ the first fuses with swollen second joint, the eighth to tenth, thirteenth to sixteenth, the twentieth and twenty-first; æsthetascs enlarged. Outer ramus of posterior antennæ more than twice as long as inner ramus. Mandibular blade, appendages of inner border of maxillæ, and anterior maxilliped stunted; this is less the case with posterior maxilliped, the outer marginal bristles of which are not enlarged. Feet elongated. Left foot of fifth pair long, uniramous and 5-jointed, right foot short and 1 to 3 jointed.

#### 9. *Clausocalanus arcuicornis* Dana.

*Female*: Genital segment longer than third or fourth abdominal segment; furca about as long as broad. No æsthetascs on joints 4, 6, 8, 18, 22 of anterior antennæ.

*Male*: Second abdominal segment as long as third and fourth segments together; right fifth foot 3-jointed.

*Coloration*: Not very transparent, with red pigment in some parts of thoracic segments, on dorsal and ventral surfaces and in genital segment. In male the pigment is on the whole more abundant and may extend into basal joints of anterior antennæ. In rare instances all the chitinous cuticle has a violet color. The eggs are rose-colored.

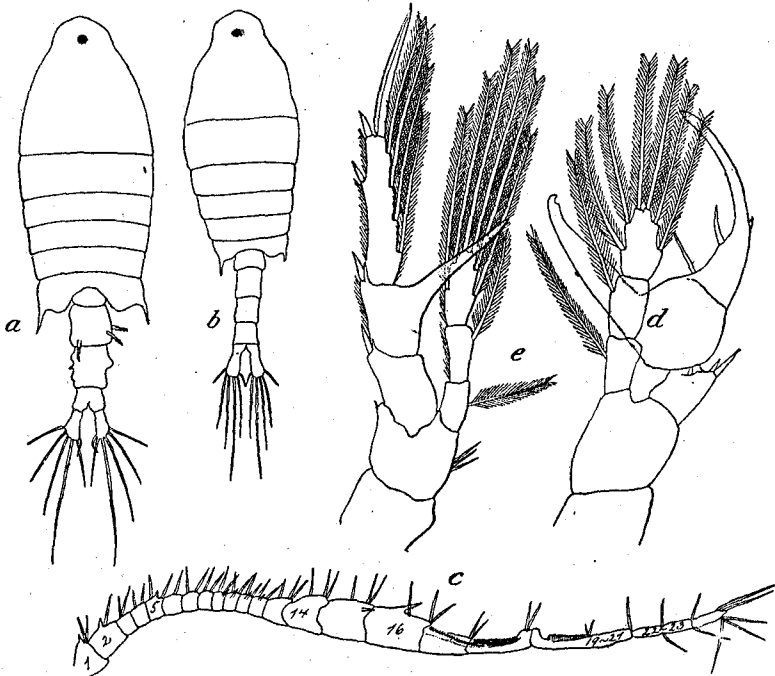
Length of female, 1.15 to 1.6 mm.; of male, 1.12 to 1.2 mm.

Three male and numerous female specimens were taken in the Gulf Stream July 29, 1899. The males all had the chitinous cuticle of a pale pellucid violet color.

## Family CENTROPAGIDÆ.

## CENTROPAGES Kröyer.

*Female*: Head separated from thorax and 4th from 5th thoracic segment; ventral eye sometimes protruding from ventral surface of head; abdomen with 3 segments, genital segment asymmetrical, Anterior antennæ 24-jointed (joints 24 and 25 fused); their appendages very complete; bristles naked, short and flaccid, with difficulty distinguishable from æsthetasks. Posterior antennæ similar in structure to those of *Calanus*, outer ramus 7-jointed, as much as  $1\frac{1}{2}$  times as long as inner ramus. Also mandible and maxilla similar to those of *Calanus*, but in certain of species with fewer appendages. Distal bristles of anterior maxillipeds (those of the second basal joint and the inner ramus) hook-shaped, with spinose plumes, much thicker and longer than proximal bristles; lobes rather short. First basal joint of posterior maxillipeds with strongly projecting lobes and long bristles with spinose plumes on two median



10. *Centropages typicus* Kröyer: a, female, dorsal aspect; b, male, dorsal aspect; c, male, right anterior antenna; d, male, right fifth foot; e, female, fifth foot.

lobes; outer marginal bristles of the 5-jointed inner ramus well developed and plumose as in *Calanus*. Rami of all 5 pairs of feet 3-jointed (in exceptional cases the inner ramus is 2-jointed). First basal joint with an internal marginal bristle in first to fourth pairs of feet, second basal with such a bristle in the first pair. First basal of fifth pair without an internal marginal bristle; number of bristles on rami as follows: Outer marginal bristles of outer ramus in first pair, 1, 1, 2, inner marginal bristles 1, 1, 4; in the second to fourth pairs the outer marginal bristles are 1, 1, 3; the inner 1, 1, 5; in the fifth pair, outer marginal bristles 1, 1, 2; inner, 0, 1, 4; inner ramus with 0, 0, 1 outer, and 1, 2, 5 inner marginal bristles in first pair; 0, 0, 2 outer and 1, 2, 6 inner marginal bristles in second and third pairs; 0, 0, 2 outer, 1, 2, 5 inner marginal bristles in fourth pair, and 0, 0, 2 outer, 1, 1, 4 inner marginal bristles in fifth pair; the internal bristle of second joint of outer ramus in the fifth pair is thorn-like and fused with its joint.

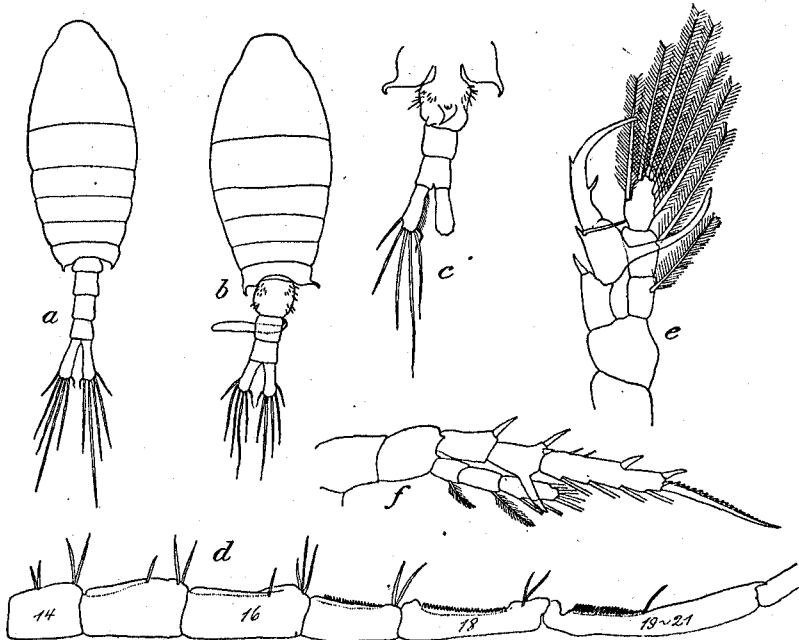
*Male*: Sexual peculiarities in structure of abdomen, of right anterior antenna, in fifth pair of feet; to some extent also in fifth thoracic segment and third and fourth pairs of feet. Abdomen consisting of 5 segments, usually with a very short anal segment; genital orifice sinistral; right anterior antenna a prehensile organ, in which joints nineteenth to twenty-first and usually also twenty-second



to twenty-third are fused, the articulation being between the eighteenth and nineteenth joint; in the outer ramus of left fifth foot the inner bristle is wanting, and second joint is fused with third, which sometimes bears awl-shaped appendages; outer ramus of right fifth foot remains 3-jointed, and its two terminal joints are modified to form a forceps, one limb of which is the terminal joint, the other the incrassated inner marginal bristle of the second joint.

#### 10. *Centropages typicus* Kröyer.

Unpaired eye with ventral convexity; fifth thoracic segment with lateral hooks, which are not quite symmetrical in male; anal segment of male obsolescent; outer furcal bristle short, inserted near tip of margin, not plumose in male, awl-shaped; genital segment of female with 4 thorn-like bristles; fourth abdominal segment with a knob-like swelling on right side; anterior antennæ exceeding end of furca by about their last two joints; second joint sharply separated from first, at least twice as long as third; joints 3, 6, and 25 without proximal bristle; anterior margin of joints 1, 2 *b*, and 5 with a tooth. Outer ramus of posterior antennæ but little longer than inner. Rami of mandibles of about equal length. Second outer lobe of maxilla with a small plumose bristle; second inner lobe pyriform, with 3 bristles; second basal joint with 5 bristles. First joint of inner ramus and third to fifth of posterior maxillipeds each with 2 marginal bristles; second joint of inner ramus with 3 inner marginal bristles. Prong of second joint of outer ramus in fifth foot of male robust, longer



11. *Centropages hamatus* Lilljeborg; a, male, dorsal aspect; b, female, dorsal aspect; c, female, ventral aspect of abdomen; d, male, fourteen to twenty-first joints of right anterior antennæ; e, male, right fifth foot; f, female, fifth foot.

than joint, erect. Middle joints of male grasping antenna broad (joints 13 and 14 broader than long); anterior border of joint 15 with a small tooth, joint 16 with a larger tooth; second joint of right outer ramus of third and fourth foot in male with enlarged outer marginal bristle. Forceps of male grasping foot stout; distal hook longer than proximal; outer bristle on end joint of left outer ramus short.

Coloration: Not very transparent; with reddish-brown pigment variously distributed through the cephalothorax and abdomen, especially in neighborhood of mouth and insertions of posterior feet (also in the grasping antenna).

Length of female, 1.6 to 2 mm.; of male, 1.42 to 1.85 mm.

This species is nearly always present in small numbers in the tow taken from the Fish Commission's wharf at Woods Hole and in the neighboring Vineyard Sound. Very abundant in tow from Plymouth Harbor and from the Gulf Stream 70 miles south of Marthas Vineyard. In the latter tow the specimens were full of a dark blackish-blue pigment.

### 11. *Centropages hamatus* Lilljeborg.

No teeth on joints 1, 2, 5, 15, and 16 of anterior antennæ; lateral corners of last thoracic segment terminating in hooks, asymmetrical in the female. Inner ramus of first to third pairs of feet 3-jointed; inner marginal bristle of first joint of inner ramus of fifth foot in female a normal plumose bristle; outer marginal bristle of second joint of outer ramus of fourth foot in male symmetrical. A spine in front of genital orifice.

Length of female, 1.3 to 1.42 mm.; of male, 1.15 to 1.3 mm.

Nearly always present in considerable numbers in tow taken from Fish Commission's wharf at Woods Hole and elsewhere in vicinity.

### 12. *Centropages bradyi* new species.

Brady in his report on the Copepoda of the *Challenger* expedition (1883, p. 83, pl. xxvii) describes and figures, as *C. violaceus* Claus, a species which, as Giesbrecht has shown, can not possibly be

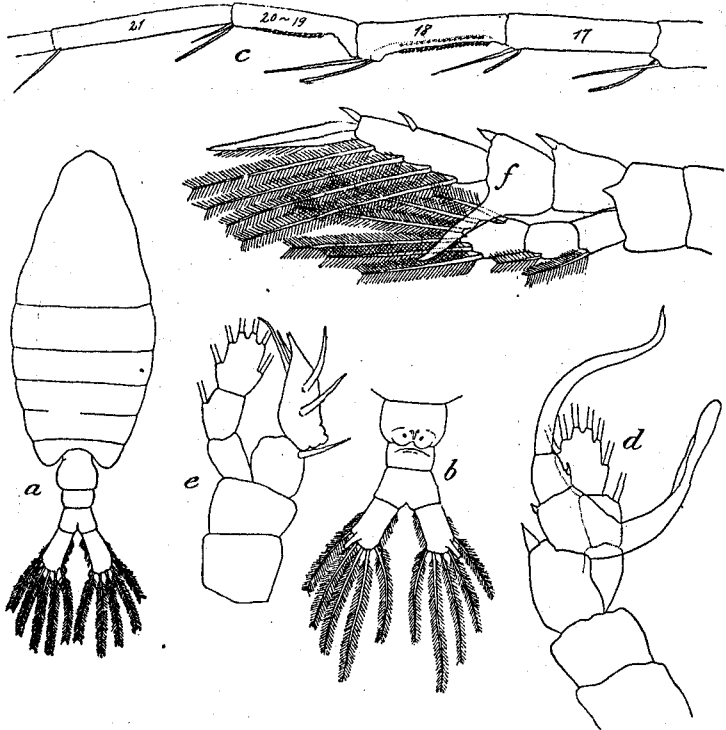
Claus's species. From a number of specimens of both sexes, of what is undoubtedly Brady's species, taken in the Gulf Stream 70 miles south of Marthas Vineyard, July 25, 1899, it is very evident that this form must be added to the species described and enumerated by preceding authors. It differs from *C. violaceus* Claus in the following salient characters:

*Female*: Second joint of outer ramus of fifth foot with a stout, smooth spine. Sides of inflated genital segments without spines or knob-shaped projections. Furca symmetrical with a peculiar, short, truncated, peg-shaped projection between insertions of two outer bristles.

*Male*: Joint 17 of right anterior antenna with a smooth anterior border, not serrate; joints 19 and 20 fused, separated from joint 21; joint 18 with an accessory series of teeth on lower surface. Forceps of fifth pair of feet differing in many respects from same pair of

feet in *C. violaceus* (see fig. 12, *d* and *e*). The peg-shaped appendage between two outer furcal bristles is not attached to a bristle, as in Brady's fig. 1, pl. xxvii. In both sexes the antennæ are very long and slender and exceed the furca by at least their 3 or 4 terminal joints.

*Coloration*: Rather opaque, with a large purplish spot in middle of body. Plumes of posterior antennæ and maxillæ orange-yellow toward their tips.



12. *Centropages bradyi* new species; *a*, female, dorsal aspect; *b*, female, abdomen, ventral aspect; *c*, male, right anterior antennæ, joints 17-21; *d*, male, right fifth foot; *e*, male, left fifth foot; *f*, female, fifth foot.

### TEMORA Baird.

Furca long, slender, at least 7 times as long as broad. Anterior antennæ 24-jointed; the twenty-fourth and twenty-fifth joints fused, the first separated from the undivided second. First pair of feet with 3-jointed outer and 2-jointed inner ramus; in the second to fourth pairs the line of division

between the proximal joints in both rami of the female is obliterated, whereas outer ramus usually remains 3-jointed in the male. Fifth pair of feet rudimental in the female, 3-jointed on either side; in male, on the left, 4-jointed, forcipate; on the right, 3-jointed, uncinat. Grasping antenna of male on right side.

*Female*: Cephalothorax consisting of 5 segments; last two thoracic segments fused; rostral filaments soft. Abdomen with 3 segments; furca long, narrow, and sometimes asymmetrical. Anterior antennæ with delicate aesthetascs and short, flaccid bristles on anterior margin. Posterior antennæ similar to those of *Centropages*, but outer ramus is more slender and with a shorter end joint. Mandibular blades voluminous. The succeeding 3 pairs of appendages resembling those of *Calanus*, anterior maxilliped with long lobes. First pair of feet with 3-jointed outer ramus and 2-jointed inner ramus (first and second joints coalesced); in second to fourth pairs the articulation between the two proximal joints of both rami has disappeared; first basal joint in second to fourth and usually also in first pair with a plumose inner marginal bristle. Bristles in rami as follows: In first pair outer ramus with 1, 1, 2 outer and 1, 1, 4 inner marginal bristles; in second to fourth pairs outer marginal bristles 1, 1, 3, inner 1, 1, 5; inner ramus of first pair with 0, 1 outer, 1, 5 inner marginal bristles; second and third pairs with 0, 0, 1 outer, 1, 2, 5 inner marginal bristles; fourth pair with 0, 0, 1 outer, and 1, 2, 4 inner marginal bristles.

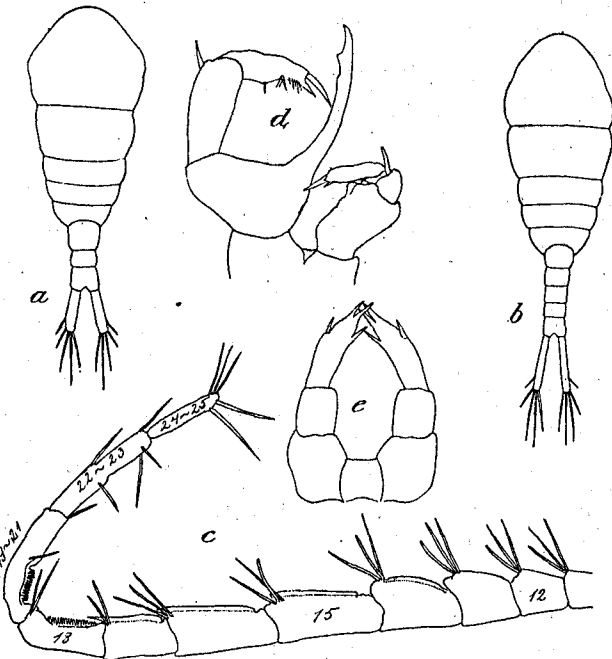
*Male*: Sexual peculiarities in structure of trunk, of right anterior antenna, and in feet, especially those of fifth pair. Last thoracic segment asymmetrical; abdomen consisting of 5 segments, the genital opening sinistral. Grasping antenna dextral, similar to that of *Centropages*; the articulation between the eighteenth and nineteenth joints; joints 19 to 21, 22 to 23, 24 to 25 fused. Outer ramus of feet sometimes 2-jointed in left foot of second pair, otherwise 3-jointed.

Length of female, 1 to 1.5 mm.; of male, 1 to 1.35 mm.

### 13. *Temora longicornis* O. F. Müller.

Lateral corners of last thoracic segment rounded; furca symmetrical; furcal bristles short, none of them as long as furca, outermost bristle near tip of outer margin, second bristle slightly thickened at its base. Joint 17 of grasping antenna not pectinated; number of appendages on proximal joints of grasping antenna differing somewhat from those on left. First basal joint of first foot without an inner marginal bristle; second and fourth foot symmetrical, even in male; inner marginal prong on terminal joint of fifth foot of female somewhat shorter than two terminal prongs; terminal joint of left fifth foot in male irregularly rod-shaped.

A very common species in tow taken from the Fish Commission's wharf at Woods Hole. A glance at the tow collected throughout the year by Mr. Edwards shows that the species is much more abundant during winter than summer. During July and August, 1899, it was rarely seen. It is an essentially boreal form as shown by the list of localities given by Giesbrecht.



13. *Temora longicornis* O. F. Müller; a, female, dorsal aspect; b, male, dorsal aspect; c, male, distal portion of right anterior antenna; d, male, fifth pair of feet; e, female, fifth pair of feet.

### METRIDIA Beck.

Closely related to *Pleuromma* (*g. v.*), but without lateral pigmented knob; terminal saw of outer ramus of third pair of feet of normal structure; feet of male (especially those of second pair) agreeing with those of the female. Furca 2 to 5 times as long as broad.

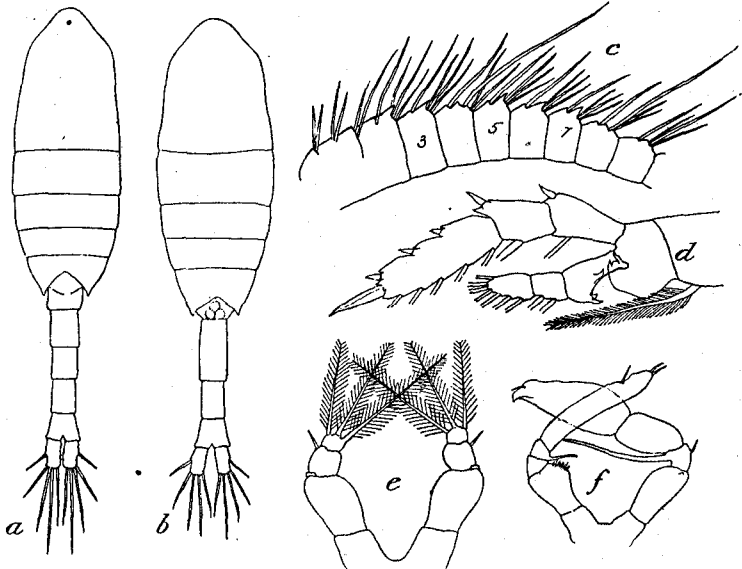
14. *Metridia hibernica* Brady & Robertson.

*Female*: Cephalothorax about  $1\frac{1}{2}$  times as long as abdomen; lateral corners of fifth thoracic segment slightly pointed; genital segment somewhat shorter than fourth and fifth abdominal segments together, and fifth abdominal only three-fourths as long as fourth; furca somewhat shorter than fifth abdominal segment and twice as long as broad. Anterior antennæ scarcely reaching posterior margin of genital segment, joints 2 *a*, *b*, *c*, and 3 to 11 each with 2 æsthetasks. Terminal bristle of third joint of outer ramus of fourth foot but little more than one-fourth as long as joint. Fifth foot 3-jointed with 3 long bristles on terminal joint.

*Male*: Grasping antenna on right side. Fifth foot has second joint of outer ramus of left foot without, first joint of outer ramus of right foot with, a long thorn; the latter and the third joint of right outer ramus relatively shorter than in *M. longa* Lubbock.

Length of female, 2.45 to 2.85 mm.; of male, 2 mm.

This species was very common in the tow taken by the *Fish Hawk* in Plymouth Harbor in August, 1899. A single female specimen was found in tow taken at Woods Hole, December 15, 1898. Like *Temora longicornis*, *M. hibernica* is distinctively a boreal species.



14. *Metridia hibernica* Brady & Robertson; *a*, male, dorsal aspect; *b*, female, dorsal aspect; *c*, female, proximal joints of right anterior antenna; *d*, female, second foot; *e*, female, fifth pair of feet; *f*, male, fifth pair of feet.

## PLEUROMMA Claus.

A dark, pigmented, chitinous knob on side of first thoracic segment. Furca at most twice as long as broad. Anterior antennæ 23-jointed; joints 1 and 2 *ab* fused (2 *c* separate), 7 to 9 fused, 24 and 25 separate. Rami of first to fourth pairs of feet 3-jointed; first joint of outer ramus of third pair with deep incision on the outer margin; terminal bristle of third pair short, bent over to outside; first joint of inner ramus of second pair with hooks on inner margins, in female on both sides, in male only on one side; fifth pair of feet in female rudimental, 2 to 4 jointed; in male 5-jointed on either side, without true forceps. Grasping antenna of male sinistral or dextral.

*Female*: Cephalothorax with 5 segments, the last two thoracic segments fused; rostral filaments plumose, inserted on a papilla; pigmented chitinous knob of first thoracic segment on left or right side. Abdomen with 3 segments, symmetrical. Anterior antennæ toothed along anterior margin of proximal joints; joints 1, 3, 7, 14, 18, 21, 24 with elongated distal bristle; æsthetasks short, filiform. Outer ramus of posterior antennæ longer than inner, 7-jointed. Mandibles and maxillæ similar to those of *Calanus* and *Centropages*; anterior maxilliped with strongly projecting fifth lobe; posterior maxilliped with elongated inner ramus. The first four pairs of feet with 3-jointed rami; first basal joint with well-developed inner bristle on all, second basal joint with inner bristle on first pair. Bristles of rami: Outer ramus with 1, 1, 2 outer bristles, 1, 1, 4 inner bristles in first, with 1, 1, 3 outer bristles, 1, 1, 5 inner bristles in second pairs; inner ramus with 0, 0, 1 outer bristles, 1, 2, 4 inner bristles on first, 0, 0, 2 outer and 0, 2, 6 inner bristles on second, 0, 0, 2 outer and 1, 2, 6 inner bristles on third, and with 0, 0, 2 outer and 1, 2, 5 inner bristles on fourth pairs.

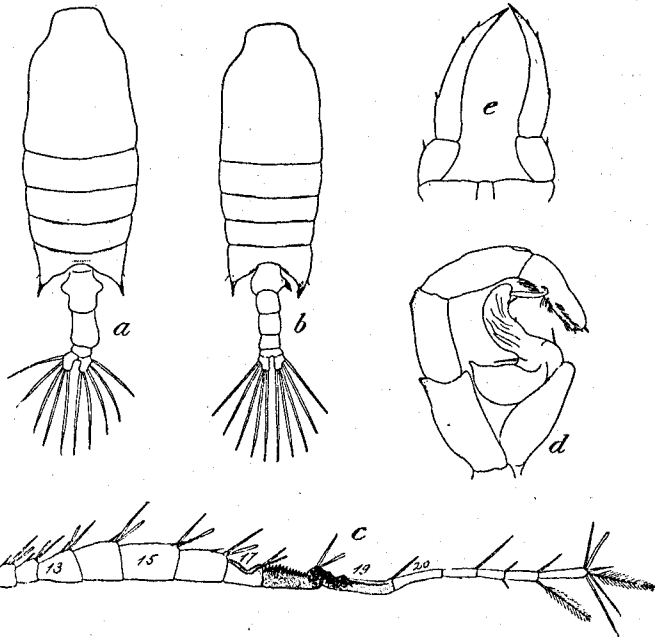
*Male*: Sexual peculiarities in structure of trunk, anterior antennæ, fifth and other pairs of feet. Abdomen with 5 segments, sometimes asymmetrical, with dextral or sinistral genital orifice.

## Family CANDACIDÆ.

## CANDACE Dana.

*Female*: Fourth and fifth thoracic segments fused; head anteriorly rectangular; rostral filaments replaced by one or two small projections; lateral corner of last thoracic segment pointed. Abdomen consisting of 3 segments, often with asymmetrical genital segment. Anterior antennæ 23 or 24 jointed (twenty-fourth and twenty-fifth joints always, second and third often, fused), their proximal joints incrassated, with crenated anterior margin; bristles stiff, some elongated; aesthetascs delicate, in part rather long. In posterior antennæ the distal basal is fused with proximal joint of inner ramus to form a thick joint; rami short, outer ramus slender, with elongated second and much shortened end joint. Mandible with voluminous basal, short rami and two-pronged blades (Kaulade). Second inner marginal lobe of maxilla much elongated, whereas remaining lobes and rami remain small, and third inner marginal lobe and outer marginal lobe are wanting; some of the usually stiff bristles much elongated. Anterior maxilliped elongated, without lobes; distal bristles robust, falcate. Posterior maxilliped small and weak, its second basal joint and inner ramus abbreviated. First to fourth pair of feet with 3-jointed outer and 2-jointed relatively narrow inner rami; proximal basal joint with an inner marginal bristle on second and third and usually also on first pair; distal basal joint of first pair rarely with an inner marginal bristle. Bristles of rami, as follows:

In outer rami of first pair, outer marginal bristles 1, 1, 2, inner 1, 1, 4; in the second to fourth pairs, outer marginal bristles 1, 1, 3, inner 1, 1, 5; inner rami of first pair with 0, 1 outer and 3, 5 inner marginal bristles; second to third pairs with 0, 2 outer and 3, 6 inner marginal bristles; fourth pair with 0, 2 outer, 3, 5 inner marginal bristles. Outer border of outer rami denticulate. Fifth pair of feet abortive, 3-jointed on either side.



15. *Candace pectinata* Brady; a, female, dorsal aspect; b, male, dorsal aspect; c, male, right anterior antenna; d, male, fifth pair of feet; e, female, fifth pair of feet.

*Male*: Sexual differences in structure of trunk, anterior antennæ, and fifth pair of feet. Last thoracic segment often asymmetrical; its right posterior corner characterized by peculiarities in structure, size, and coloration; abdomen with 5 segments; genital segment also often asymmetrical, with outgrowths on right side; genital orifice sinistral. Left anterior antenna usually with an increased number of aesthetascs; right antenna a grasping organ, usually with joints 17 and 18, 19 and 20, and occasionally also 8 to 10 fused. Right fifth foot 3-jointed, left 4-jointed; right foot terminating in forceps or in a bristle.

15. *Candace pectinata* Brady.

Genital and succeeding segment asymmetrical in female, the latter projecting backward on right side; last thoracic segment of male asymmetrical. Anterior antennæ 23-jointed, comb of eighteenth joint of grasping antenna coarsely toothed; the joints before and after the articulation stout, joint 17 rather distinctly separated from 18, and 19 from 20. Proximal hook-like bristle of second basal of anterior maxillipeds as thick and nearly as long as distal ones. Terminal joint of fifth foot of female long, claw-shaped, without inner marginal bristles; right fifth foot of male with forceps.

Coloration: Moderately transparent with a reddish tinge to cephalothorax, chitin of posterior edges of thoracic segments, lateral points of last thoracic segment, genital orifice, bristles of outer and sometimes of inner rami of feet, and the eighteenth and to some extent the nineteenth joint of the grasping antenna blackish brown.

Length of female, 1.95 to 2.4 mm.; of male, 1.7 to 2.12 mm.

A considerable number of both sexes of this handsome and widely distributed species were taken in Gulf Stream July 25 and 29, 1899.

#### Family PONTELLIDÆ.

##### LABIDOCERA Lubbock.

Fourth and fifth thoracic segments fused; head sometimes with lateral hooks; one pair of dorsal eye lenses, which are larger in male than in female; ventral eye pyriform; rostrum without lenses, its prong short, pointed; fifth thoracic segment produced on either side into a process or point, not always symmetrical; abdomen of female with two or three segments; genital segment and sometimes also furca asymmetrical; in male symmetrical. Anterior antennæ of female 23-jointed; in right one of male the thirteenth and fourteenth and the nineteenth to twenty-first joints fused. Mandibular blade with hook-like, pointed teeth. Second basal joint of maxilla about twice as long as second inner lobe; third inner lobe present. Posterior maxilliped 6-jointed (terminal joint very minute). Inner ramus of first pair of feet 2-jointed.

*Female:* Cephalothorax 5-jointed; rostral hooks rather strongly chitinized. Anterior antennæ 23-jointed, joints 6 and 7 and 24 and 25 fused, but there are other incompletely-separated joints; some of the bristles on the proximal and distal joints plumose, æsthetasks filiform. In posterior antennæ the distal basal joint is almost completely fused with proximal joint of inner ramus; outer ramus nearly as broad as inner and as long as proximal joint of inner ramus, or somewhat longer; terminal joints of outer ramus reduced. Mandible with rather long basal and 5 to 7 teeth on its blade. Distal basal joint of maxilla with rami bent over to outside; first outer marginal lobe short, with 7 bristles, second with one plumose bristle; first inner marginal lobe relatively small, second about half as long and broad as distal basal joint which is fused with first two joints of inner ramus. Anterior maxilliped stout and provided, especially on its distal half, with robust hooked and curved bristles. Posterior maxilliped in its entire form similar to that of *Calanopia*, but its second basal joint and inner ramus are longer and the latter is only 4-jointed, first to fourth pair of feet with 3-jointed outer and 2-jointed inner rami; first basal joint with a plumose inner marginal bristle on all pairs, second to fourth pairs with short plumose outer marginal bristle; number of bristles on rami as in *Calanopia*; fifth pair of feet abortive, consisting on either side of a 2-jointed basal and two 1-jointed rami, of which only the inner is sometimes produced into a papilliform appendage.

*Male:* Sexual differences in the structure of the trunk (eyes), anterior antennæ, and fifth pair of feet. Dorsal eye lenses larger than in the female, contiguous in the median line; last thoracic segment symmetrical or with more strongly developed right posterior corner. Abdomen with 5 segments, symmetrical; genital opening sinistral. Left anterior antenna with longer æsthetasks, and sometimes also with other modifications, which remind one of the peculiarities of right anterior antenna; in the latter joints 6 and 7, 13 and 14, and 19 to 21 are fused, whereas the twenty-second, twenty-third, and twenty-fourth to twenty-fifth remain separate, middle joints quite strongly incrassated, and the two in front and behind articulation are provided with furrowed ridges; in some species, perhaps in all, the eighteenth can be drawn up against the seventeenth toward posterior margin of latter. Fifth pair of feet consisting on either side of four joints, of which the two distal ones of right foot constitute powerful forceps; left foot sometimes with a rudiment of an inner ramus.

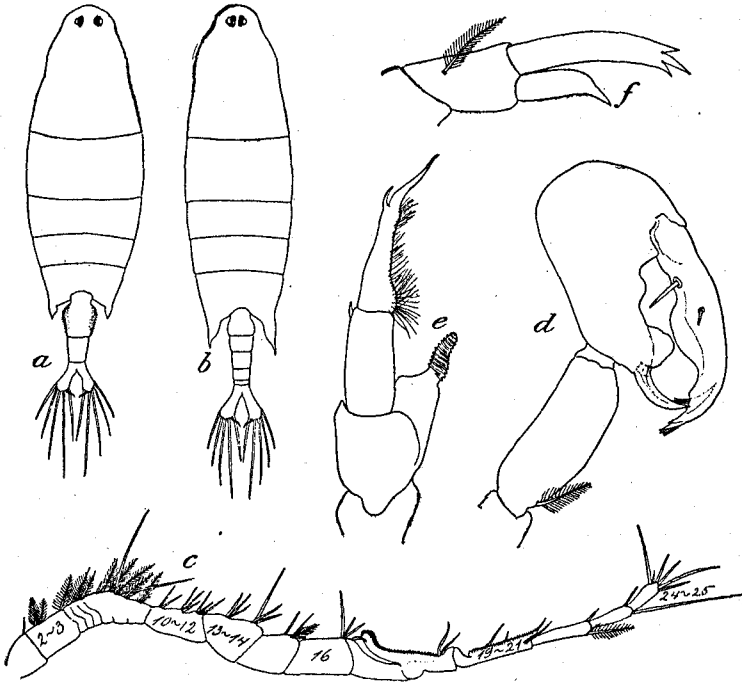
#### 16. *Labidocera æstiva* new species.

*Female:* Cephalothorax evenly rounded anteriorly, devoid of crista on front or hooks on front or sides of the head. Last thoracic segment symmetrical, produced on either side into a sharp point. Abdomen consisting of 2 segments, first much longer than second, perfectly symmetrical and projecting over second, covered with minute hairs on sides. Genital orifice in middle of its ventral surface. Second abdominal segment about twice as long as broad. Furca symmetrical, its limbs at least 2½ times as long as broad. Anterior antennæ reaching to hind end of genital segment. Fifth pair of feet symmetrical; outer ramus terminating in 3 teeth, the middle nearly twice the length of other two; inner ramus more than half the length of outer, articulating with basal, and ending in a single strong, pointed tooth.

*Male:* Differs from the female in following characters: Eyes with larger lenses, nearly con-

tiguous. Last thoracic segment produced into longer points, the one on right side being distinctly longer than that on left. Abdomen consisting of 5 segments; anal segment very short, first segment without hairs on its sides. Anterior antennæ reaching to base of furca; joints 16 and 17 of about equal length, the latter provided with a recurved spine on its anterior basal surface; teeth on eighteenth joint uniform, somewhat larger and more hook-like than teeth on fused nineteenth and twentieth, which are fully one third longer than twenty-second joint and terminate in a distinct point distally. Bristles on joints 23 and 24 to 25, not plumose. For structure of fifth pair of feet, see fig. 16, *d* and *e*. Coloration, transparent, without pigment. Length, 1.75 to 2 mm.

This species appears to be sufficiently distinct from any of the described 13 species of *Labidocera*, nor can it be referred to any of the insufficiently described and figured species of *Pontella* in Dana's monograph. Of known forms it approaches *L. nerii* Kröyer, but may be distinguished by the sym-



16. *Labidocera aestiva* new species; *a*, female, dorsal aspect; *b*, male, dorsal aspect; *c*, male, right anterior antenna; *d*, male, right fifth foot; *e*, male, left fifth foot; *f*, female, fifth foot.

metrical genital segment of female and the acute tooth terminating inner ramus of fifth foot. The male may be distinguished from the male *nerii* by the asymmetry of the last thoracic segment and many differences in configuration of fifth pair of feet. (Conf. Giesbrecht's fig. 45, pl. 24.)

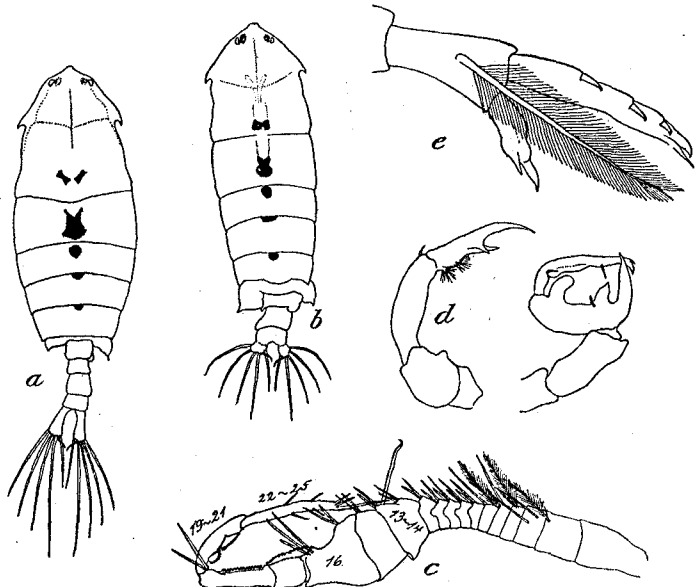
*L. aestiva* was very common in the tow taken from the Fish Commission wharf at Woods Hole during July and early August, 1899.

#### PONTELLA Dana.

Fourth and fifth thoracic segments separated; head with lateral hooks; one pair of dorsal eyelenses and a rostral lens in front of ventral eye, the latter sometimes thicker in male than in female; rostral prong stout; last thoracic segment with pointed lateral corners, not always symmetrical; abdomen of female with 2 or 3 segments, asymmetrical; that of male (apart from one-sided genital orifice) symmetrical. Anterior antennæ of female 24-jointed; right one of male with fused thirteenth and fourteenth, nineteenth to twenty-first, twenty-second to twenty-fifth joints. Mandibular blade with hooked, pointed teeth; second basal joint of maxilla about  $1\frac{1}{2}$  times as long as second internal lobe; third internal lobe present. Posterior maxilliped 7-jointed; inner ramus of first pair of feet 3-jointed.

*Female*: Cephalothorax 6-jointed; rostral prongs stout, with a common broad base, the cuticle of which is converted into a lenticular thickening; last thoracic segment prolonged on either side into 1 or 2 points, sometimes asymmetrical. Anterior antennæ short, 24-jointed (twenty-fourth and twenty-fifth joints fused), with indistinct boundaries between several of the joints; appendages similar to those of *Labidocera*. In posterior antennæ the distal basal joint is only incompletely separated from proximal joint of inner ramus; outer ramus narrower than inner and about as long as proximal joint of latter. This appendage as well as mandible (blade with 7 teeth), the maxilla (distal basal joint  $1\frac{1}{2}$  times as long as second inner marginal lobe), and also the anterior maxilliped similar to that of *Labidocera*. Posterior maxilliped with 7 joints (inner ramus 5-jointed); first to fourth pair of feet with 3-jointed outer ramus; inner ramus of first pair 3-jointed, of second to fourth pairs 2-jointed; first basal joint with plumose inner marginal bristle on all pairs, second basal joint with plumose outer marginal bristle on fourth, and sometimes with an inner marginal bristle on first pair. Number of bristles of rami as in *Calanopia*; fifth pair of feet as in *Labidocera*.

*Male*: Sexual differences in structure of trunk, of anterior antennæ, and of fifth pair of feet. Dorsal eye-lenses as in female; rostral lens often much thicker than in that sex; last thoracic segment departing from that of the female, usually symmetrical. Abdomen with 5 segments; genital opening sinistral, otherwise symmetrical. In left anterior antennæ the middle joints are shortened, aesthetascs larger; right anterior antenna a powerful grasping organ with some times much dilated middle joints; joints 13 and 14, 19 to 21, 22 to 25 are fused; also in incrasated proximal region there are some less complete fusions of joints; anterior border of seventeenth to twentieth joints with ridges and projections, which are usually striated. Fifth pair of feet like that of *Labidocera*, but without a rudiment of an inner ramus in left foot.



17. *Pontella meadii* new species; a, male, dorsal aspect; b, female, dorsal aspect; c, male, right anterior antenna; d, male, fifth pair of feet; e, female, fifth foot.

#### 17. *Pontella meadii* new species.

This species closely resembles *P. lobiancoi* Giesbrecht, but may be readily distinguished from this and other species by peculiarities in structure of last thoracic segment, abdomen, fifth pair of feet in both sexes, and by grasping antenna of male. In the male there is no projection on anterior surface of eighteenth joint of grasping antenna, and first joint of outer ramus on right fifth foot is provided with two flattened lobes separated by a diastema; terminal joint of left fifth foot end in three claws, of which one is more than twice the length of the others. In the female the inner ramus of fifth pair of feet is half the length of outer, whereas in *lobiancoi* it is much shorter. In both sexes the last thoracic segment is asymmetrical. Abdomen of female with three segments, of which the first and second are asymmetrical, the first having a projection on its right posterior, the second on its left posterior corner. Furca nearly symmetrical.

Coloration: Dark bluish-green, especially on head, abdomen, and along edges of cephalothorax. More dorsal portions of cephalothorax glistening silvery white, more or less suffused with green, along sides with some reddish pigment, especially in young specimens. In middorsal line is a series of deep-black blotches, one to each segment, blotch on posterior portion of cephalic segment sometimes divided. Some black pigment along sides of posterior thoracic segments. Chitin of ventral surface and appendages pale green.



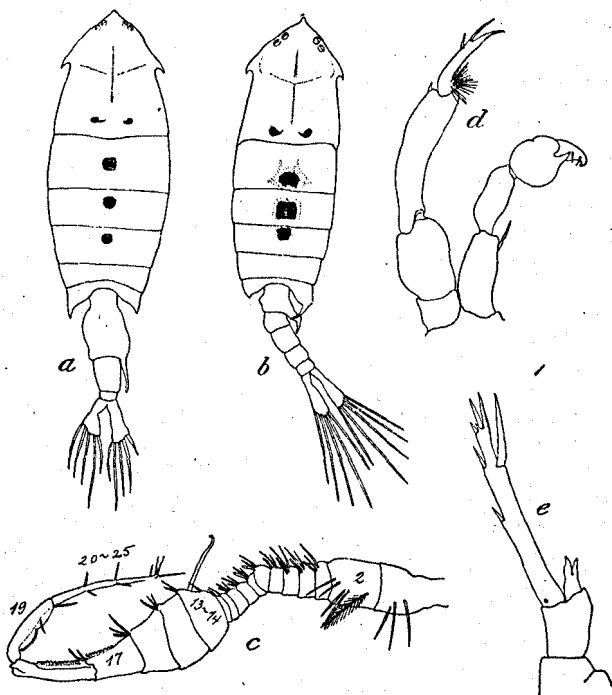
A few males and females of this handsome species were taken only on two occasions, July 17 and July 26, 1899, at 8 a. m., from the Fish Commission wharf at Woods Hole. The night before each of these days had been very stormy, with wind from southeast.

**ANOMALOCERA** Templeton.

Fourth and fifth thoracic segments separated; head with lateral hooks; 2 pairs of dorsal eye-lenses; ventral eye in male more strongly protruding than in female; rostrum without lenses; rostral prong powerful; fifth thoracic segment pointed on either side, asymmetrical in male. Abdomen of female with 3 segments, in female and male asymmetrical. Anterior antennæ of female 20-jointed; in right one of male joints 13 and 14, 19 to 21, 22 to 25 are fused. Mandibular blade with hook-like, pointed teeth. Second basal joint of maxilla as large as second inner lobe; third inner lobe present. Posterior maxilliped 7-jointed, inner ramus of first pair of feet 3-jointed.

*Female:* Cephalothorax 6-jointed; the last thoracic segment on each side extending out into a pointed projection. Abdomen with 3 segments, asymmetrical. Anterior antennæ short, 20-jointed; joints 6 to 8, 9 to 11, 24 and 25 fused; appendages similar to those of *Pontella*. Outer ramus of posterior antennæ short and slender, about one-third as thick as proximal joint of inner ramus, which is fused with second basal joint. Basal joint of mandibles thicker, second inner marginal lobe of maxilla larger than in *Pontella* (somewhat longer than second basal joint, which is fused with two joints of inner ramus); the succeeding appendages similar to those of *Pontella*, but outer ramus of fifth pair of feet is 2-jointed.

*Male:* Sexual differences in structure of trunk, anterior antennæ, and fifth pair of feet. Ventral eye pyriform, more strongly protruding; last thoracic segment asymmetrical, on right side with a curved hook. Abdomen with 5 segments; genital openings sinistral; the anterior segments asymmetrical, first with an outgrowth on right side. Slight differences in left anterior antenna; right similar to that of *Pontella*, and same is true of fifth pair of feet, the forceps of which, however, is less powerfully developed.



18. *Anomalocera pattersonii* Templeton; a, female, dorsal aspect; b, male, dorsal aspect; c, male, right anterior antenna; d, male, fifth pair of feet; e, female, fifth foot.

**18. Anomalocera pattersonii** Templeton.

The strongly-marked character of the only species of the genus *Anomalocera* may be gleaned in great part from the above figure. In its coloration it is rather opaque dark-blue or blue-green, occasionally ferruginous red. There is a series of median dorsal black blotches of very constant occurrence, with much more variable irregularly ramifying dark-blue markings on sides of thoracic segments. Gut usually bright green. Eggs white or reddish.

Length of female, 3.5 to 4.1 mm; male, 3.2 to 3 mm.

At Woods Hole this species is taken, so far as I have observed, only after stormy weather with prevailing southwest winds, either alone or in company with *Pontella meadii*. It was far more abundant in the tow collected by the *Grampus* in the Gulf Stream, about 70 miles south of Marthas Vineyard.

## MONOPS Lubbock.

Fourth and fifth thoracic segments fused; head without lateral hooks; no dorsal or rostral eyes; ventral eye rather flatly convex to club-shaped; rostral filaments delicate, long and flaccid; fifth thoracic segment with pointed lateral corners, usually asymmetrical in male; abdomen of female with 1 or 2 joints, asymmetrical in both male and female. Anterior antennæ of female 16-jointed, in the right antenna of male joints 13 and 14, 16 and 17, 19 to 21, and 22 to 25 fused. Mandibular blade with blunt teeth. Second basal joint of maxilla scarcely half as long as second internal lobe; third internal lobe present. Posterior maxilliped 5-jointed. Inner ramus of first pair of feet 3-jointed.

*Female:* Cephalothorax 5-jointed. Anterior antenna short, 16-jointed, joints 2 to 5, 6 to 8, 9 to 11, 13 and 14, and 24 and 25 fused; appendages similar to those of *Pontella*, though reduced in number and length. In posterior antennæ the distal basal joint is fused with proximal joint of inner ramus; outer ramus short and slender. Mandibular blade scarcely dilated toward tip, usually with short, blunt teeth. In maxilla the second inner marginal lobe is more than twice as long as second basal joint, which is fused with the two joints of inner ramus. Distal unciniate bristles of anterior maxillipeds long in comparison with proximal ones, sparsely provided with prickly plumes. Proximal basal joint of posterior maxillipeds broad, lobular, followed by only 4 further joints. Feet similar to those of *Pontella*.

*Male:* Sexual differences in structure of trunk, anterior antennæ, and fifth pair of feet. Anterior portion of cephalothorax asymmetrical, and usually the right projection of last thoracic segment is longer than left and of a peculiar form. Abdomen with 5 segments; genital opening sinistral; third segment with an outgrowth on right side. Left anterior antenna differing from that of female, especially in separation of thirteenth and fourteenth joints; proximal joints of right anterior antenna incrassated, middle joints dilated, disciform. Besides joints 2 to 5, 6 to 9, 10 to 12, 13 to 14, 19 to 21, and 22 to 25, joints 16 and 17 are also fused. Fifth pair of feet on the whole similar to that of *Pontella*.

19. *Monops regalis* Dana.

Last thoracic segment pointed on either side, in the male prolonged on right side into a powerful slightly curved hook. Abdomen of female with 2 segments, asymmetrical with outgrowths. Furca short. In male the proximal hook in forceps of right fifth foot is somewhat longer than distal hook.

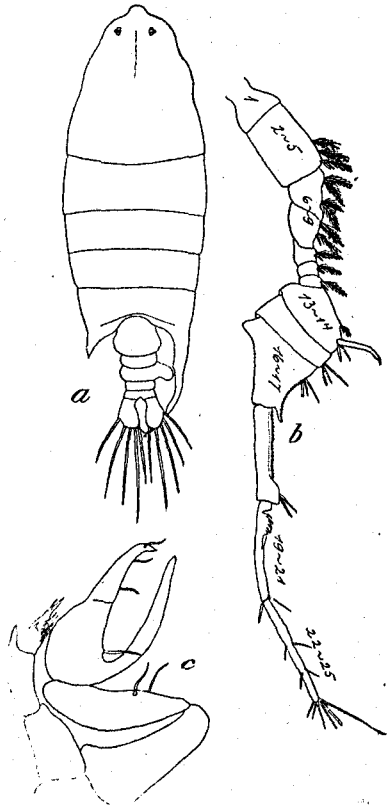
Coloration: Dark blue-green, and similar to that of *Pontella* and *Anomalocera*.

Length of female, 4 to 4.4 mm; male, 3.4 to 3.5 mm.

A single male specimen of this species was taken in Gulf Stream tows, 70 miles south of Martha's Vineyard, July 25, 1899.

## ACARTIA Dana.

Fifth thoracic segment and abdomen of male symmetrical; the latter with abbreviated anal segment. Anterior antennæ of female 17-jointed, throughout of nearly uniform thickness, with knob-like projections at insertions of the long, usually plumose but sometimes spinose bristles; grasping antenna of male with but slightly incrassated middle joints. Outer ramus of posterior antennæ much shorter than inner ramus; second joint of inner ramus elongated, first joint with 9 bristles on its inner border. Mandible with rather elongate second basal joint; rami incompletely jointed; outer ramus articulating about on middle of margin of second basal. First outer lobe of maxilla with long bristles; outer ramus rudimental, represented by 2 bristles. Proximal lobes of anterior maxillipeds

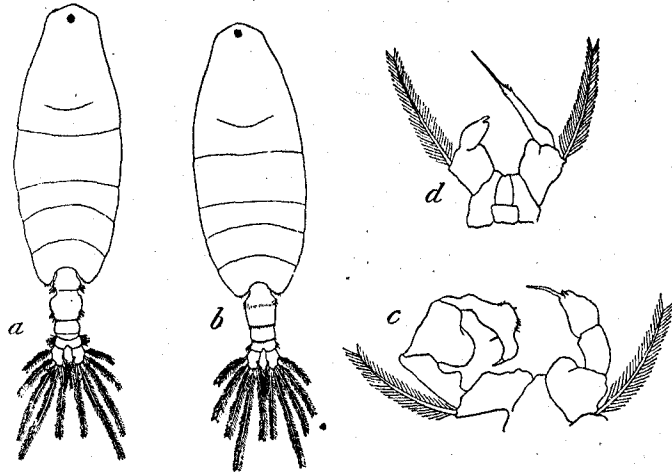


19. *Monops regalis* Dana; male; a, dorsal aspect; b, right anterior antenna; c, fifth pair of feet.

well-developed, with long bristles. Posterior maxilliped 4-jointed. Inner ramus of first pair of feet 2-jointed; fifth pair of feet of female without inner ramus, with a long outer bristle on second basal joint.

*Female:* Cephalothorax with 5 segments; the two last thoracic segments fused; the last sometimes terminating in lateral joints. Rostral filaments delicate or wanting. Abdomen with 3 segments, symmetrical. Anterior antennæ 17-jointed; joints 2 to 4, 5 and 6, 7 and 8, 9 and 10, 12 and 13, 24 and 25 fused; aesthetascs delicate, filamentous. Posterior antennæ very slender, their distal basal joint fused with proximal joint of inner ramus; inner ramus with much elongated terminal joint; the very short outer ramus with relatively long proximal (first and second joints fused) and very short distal joints. Mandible with feeble, 7-toothed blade. Maxilla with abortive rami, represented only by long bristles, but with well-developed lobes. Anterior maxilliped with long curved bristles even on proximal lobes. Posterior maxilliped

similar to that of *Parapontella*, but without outer marginal bristles and with three inner marginal bristles on third joint. First to fourth pair of feet with 3-jointed outer and 2-jointed inner rami; first basal joint without a bristle, second basal joint with a rather long outer marginal bristle on fourth pair; bristles of rami as follows: Outer ramus of first pair with 1, 1, 2 outer and 1, 1, 4 inner marginal bristles; second to fourth pairs with 0, 0, 0 outer and 1, 1, 5 inner marginal bristles; inner ramus of first pair with 0, 1 outer and 1, 5 inner marginal bristles; second and third pairs with 0, 1 outer and 2, 6 inner marginal bristles, fourth pair with 0, 1 outer and 3, 5 inner marginal bristles.



20. *Acartia tonsa* Dana; a, female, dorsal aspect; b, male, dorsal aspect; c, male, fifth pair of feet; d, female, fifth pair of feet.

The much reduced fifth pair of feet consists on either side of 2 or 3 joints; end joint a thick, stylet-shaped bristle, and on outer margin of second basal is a delicate plumose bristle.

*Male:* Sexual differences in structure of trunk, anterior antennæ, and fifth pair of feet. Peculiarities in articulation of thoracic segments and sometimes in form. Abdomen with 5 segments; genital orifice sinistral; fourth segment and furca abbreviated. In both anterior antennæ the proximal joints are incassated, and the ninth is separated from tenth, the twelfth from thirteenth joint; spines wanting; right anterior antenna transformed into a grasping organ, and joints 19 to 21, and 22 to 25 are fused. Fifth pair of feet consisting of a common median piece, a right 4-jointed, and a left 3-jointed uniramous foot; especially the right is claw-shaped, and forms an incomplete forceps, with a process on penultimate joint.

#### 20. *Acartia tonsa* Dana.

Rostral filaments present; last thoracic segment rounded on sides. Abdomen relatively short, without thorns; anal segment hairy on either side; in male with fine points on second segment. Anterior antennæ of female not reaching posterior border of genital segment. For fifth pair of feet, see fig. 20, c and d.

Colorless and translucent.

Length of female, 1.3 to 1.5 mm.; of male, 1.05 mm.

This species was found to be one of the commonest copepods in tow taken from wharf of Fish Commission at Woods Hole during July and August, 1899. It appeared abundantly also in tow from Plymouth Harbor, but was very scarce in Gulf Stream 70 miles south of Marthas Vineyard. Hitherto the species has been taken only at Port Jackson, Australia (Dana), and west of South America, between Valparaiso and Callao (Giesbrecht). *Acartia clausii* Giesbrecht, which one would expect to find in our waters, could not be recognized in the samples of the tow.

## CORYNURA Brady.

Fifth thoracic segment and abdomen of male symmetrical. Anterior antennæ of female 17-jointed; long bristles with lamelliform margin. Posterior antennæ with rami of nearly equal length; terminal joints of outer ramus abortive, scarcely distinguishable. Mandibles with elongated second basal joint, with end of which the rami articulate. Maxilla consisting only of first basal, with the very bristly first and second inner lobes. Proximal lobes of anterior maxillipeds minute. Posterior maxilliped 3-jointed. Inner ramus of first pair of feet 2-jointed. Fifth pair of feet of female without inner ramus, sometimes asymmetrical.

*Female*: Cephalothorax with 5 to 6 segments, according as last two thoracic segments are fused or separate; a large median eye, without lens; rostrum wanting, in front of upper lip a horseshoe-shaped fringed lamella. Abdomen with 2 to 3 segments, asymmetrical, sometimes twisted about longitudinal axis. Anterior antennæ resembling those of *Acartia*, 17-jointed, with joints 1 to 7, 9 and 10, 24 and 25 fused. Posterior antennæ resembling those of *Parapontella*, but outer ramus with completely abortive distal joints. Mandibular blade usually rather narrow, with 5 teeth; outer ramus scarcely jointed. Maxillipeds similar to those of *Parapontella*, but proximal lobes of anterior pairs are more decidedly reduced and inner ramus of posterior pair shorter and 1-jointed. First to fourth pair of feet with 3-jointed outer and 2-jointed inner rami; first basal joint with an inner marginal bristle on all four pairs; second basal joint without a bristle on first, with a plumose outer marginal bristle on the fourth pair; bristles of rami as follows: Outer ramus of first pair with 0, 0; 1 (2) outer and 1, 1, 4 inner marginal bristles; second to fourth pairs with 1, 1, 3 outer and 1, 1, 5 inner marginal bristles; inner ramus of first pair with 0, 1 outer and 3, 5 inner marginal bristles, of second to fourth pairs with 0, 1 outer and 3, 6 (5) inner marginal bristles. Fifth pair strongly abortive, consisting of a common median piece and a couple of 2-jointed, not always symmetrical, feet.

*Male* (known only in few species): Sexual differences in structure of abdomen, right anterior antenna, and fifth pair of feet. Abdomen with 5 segments; genital orifice sinistral. In right anterior antenna sixth and seventh joints are separate from fused first to fifth, and the ninth is separated from tenth; the middle joints are more strongly dilated than in *Acartia*, and, as in that genus, the nineteenth to twenty-first and the twenty-second to twenty-fifth joints are fused. Fifth pair of feet resembles that of *Acartia*, but consists (besides middle piece) of 3 joints on either side, the left being the longer.

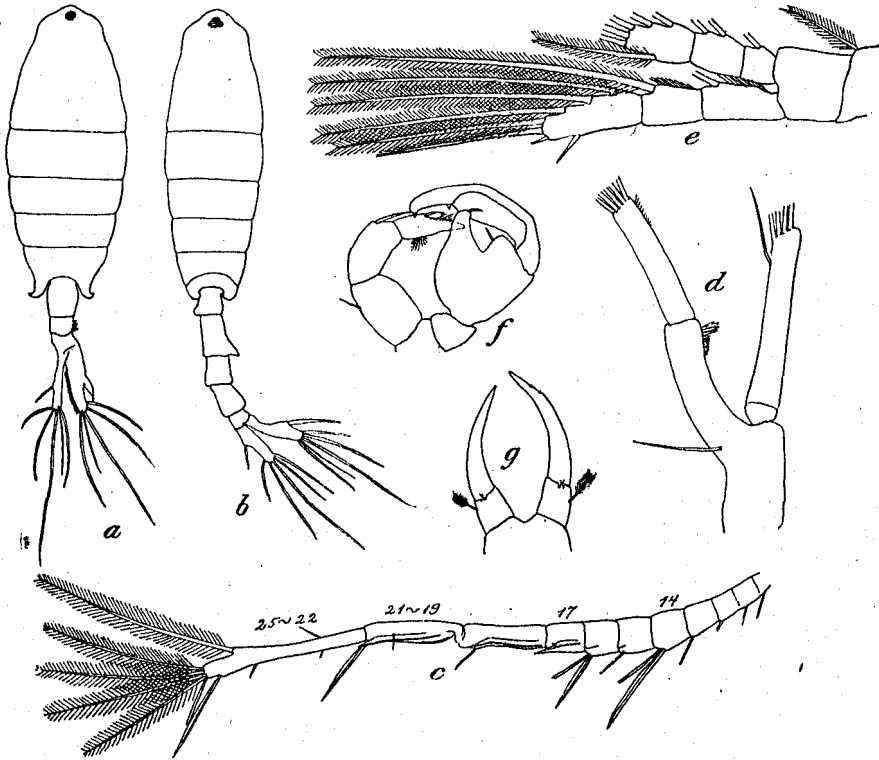
21. *Corynura bumpusii* new species.

*Male*: Body long and slender; separation between fourth and fifth thoracic segments not very pronounced, latter symmetrical, with rounded posterior corners. Abdomen consisting of 5 segments, its tip turned to right side and slightly twisted about longitudinal axis; first segment somewhat asymmetrical, with a rounded projection on left posterior corner; second with a similar but much more prominent and pointed outgrowth on right side; third and fourth segments of nearly equal length; fifth not half as long as fourth. Furca asymmetrical, its right limb distinctly longer than left, conspicuously constricted near base; inner edges of limbs fringed with delicate hairs; outermost bristle on the right side enlarged, blade-shaped, with a short, conical, dorsal, tooth-like projection a short distance beyond its base; innermost bristle slender, nearly as long as first bristle. Relative lengths of bristles  $4 < 1 < 3 < 2$ .

Eye large, without dorsal lenses. Rostrum absent, front of head evenly rounded in profile; mouth surrounded in front by a horseshoe-shaped, fringed lamella. Anterior antennæ reaching only to posterior edge of third abdominal segment; right anterior antenna not much widened in middle (joints 13 to 17), poorly furnished with bristles; joints 17, 18, 19 to 21 with delicate pectination; joints 22 to 25 fused, and bearing at tip 5 long plumose bristles. The long bristles on joints 14, 16, 21, and 24 provided along one edge with a very delicate, transparent lamina, often slightly sinuous in outline (effect of formalin?). Posterior antennæ with long, slender rami; first joint of inner ramus fused with second basal joint and bearing on its distal margin a short dense series of graduated spines; second joint with a few hairs in corresponding position; first joint of outer ramus very short; second joint reaching to middle of slender second joint of inner ramus; outer ramus terminates in 4, the inner in 6 long plumose bristles.

Mandibular blade with 5 teeth gradually decreasing in length from first, which is separated from second by a considerable diastema; second basal joint slender, fully 4 times as long as wide, rami inserted at same level on its tip, outer ramus but little longer than inner, the former with 5, the latter

with 4 plumose bristles, some of them twice the length of appendages; first joint of outer ramus scarcely one-third as long as second, first joint of inner ramus fully twice as long as second joint. Maxilla very much like that of *Corynura forcipata* Giesbrecht, rami absent, rounded inner lobe provided with 11 hook-shaped, coarsely plumose bristles, external lobe slender, terminating in 3 strong, hook-shaped bristles, which are edged with short points. Anterior and posterior maxillipeds closely resembling the corresponding appendages of *C. forcipata*, but the points on the 7 long hook-shaped bristles of former pair of appendages more strongly developed, and there are only 3, instead of 4, prickly bristles on first basal joint of latter pair; first pair of feet with 3-jointed inner rami; inner rami of second to fourth pairs 2-jointed. In other respects structure of feet closely resembles that of congeneric species. Thus, the first foot is very much like that of *C. denticulata*, Giesbrecht, except for the 3-jointed inner ramus; fifth pair of feet asymmetrical, each 3-jointed; right foot longer and more voluminous than left, its second and third joints forming massive forceps.



21. *Corynura bumpusii* new species; a, female, dorsal view; b, male, dorsal view; c, male, distal portion of right anterior antenna; d, male, posterior antenna; e, male, first foot; f, male, fifth pair of feet; g, female, fifth pair of feet.

*Female*: Fourth and fifth thoracic segments fused, the latter ending on either side in a curved, ventrally and laterally directed process. Abdomen with 3 segments, genital segment large, somewhat swollen, as long as the 2 succeeding subequal segments together. Second segment with a cluster of bristly hairs on right side. Anal segment asymmetrical, fused with furca. Two limbs of furca of equal length, but the right is more than twice as broad as left, fringed with hairs along its inner border and bearing in place of outermost bristle a rigid, flattened, and pointed spine. This and the very slender innermost furcal bristles are not plumose; plumes on the apical fourth of long second furcal bristle, coarse and sparse. Anterior antennae reaching to base of furca, resembling those of *C. forcipata*, with several of median and basal joints fused together; large bristles with lamelliform margins; bristles on two terminal joints very long and coarsely plumose. Both sexes rather opaque and without pigment except along mid-ventral line, where there are segmental accumulations of black coloring matter in the male.

Length of male, 1.8 to 2 mm.; of female, 2.25 mm.

The males of this species, which I take pleasure in dedicating to my friend, Prof. H. C. Bumpus, appeared in considerable numbers in tow taken off Fish Commission wharf July 10 and 11, 1899, and again in Vineyard Sound, near Gay Head, Marthas Vineyard, on the latter day. The single female specimen from which the above description was drawn was found in some tow collected by Mr. Vinal N. Edwards at Woods Hole, December 15, 1898.

*C. bumpusii* is remarkable in two respects. First, it differs from all the known species of *Corynura* in having 3 instead of 2 jointed inner rami on first pair of feet. Giesbrecht's diagnosis of the genus should be widened to receive this species. Second, the occurrence of a *Corynura* in the Atlantic has not before been recorded. The five species hitherto described are all from the east coast of Asia, thus: *C. forcipata* Giesbr. is from Amoy; *C. denticulata* Giesbr. and *C. reticauda* Giesbr. are from Assab; *C. gracilis* Brady and *C. barbata* Brady from the Philippines.

### Suborder PODOPLEA.

#### Family CYCLOPIDÆ.

##### OITHONA Baird.

*Female*: Cephalothorax and abdomen with 5 segments (first and second abdominal segments fused); front usually terminating in a pointed, beak-like process; genital opening lateral. Anterior antennæ in part indistinctly jointed, with long bristles, without æsthetascs. Posterior antennæ 2-jointed (first basal joint fused with second, first joint of inner ramus with second), with indistinct bipartition of second joint; outer ramus wanting. Mandible elongated, with small, 1-jointed inner, and 4-jointed outer ramus and denticulate blade. Maxilla with well-armed masticatory process (first inner lobe) and with unciniate bristles even on other portions of inner margin; rami 1-jointed, inner ramus small, first outer lobe rudimental. Maxillipeds slender, with powerful, prickly bristles, the posterior with 2-jointed inner ramus. Feet with 3-jointed rami; fifth foot very rudimental, on either side reduced to 2 bristles.

*Male*: Front obtuse. First and second abdominal segments separated; furcal bristles abbreviated, anterior antennæ grasping organs each geniculating at two points, with a terminal æsthetasc; feet with somewhat aberrant bristles.

##### 22. *Oithona plumifera* Baird.

*Female*: Front ending in a pointed beak, which is bent ventrally somewhat, but is still visible from dorsal aspect; furca shorter than anal segment, nearly 3 times as long as broad; its outermost bristle about 3 times as long as furca. Anterior antennæ reaching to posterior border of fourth abdominal segment. Second basal joint of mandibles with 2 hook-like bristles. Inner ramus of maxillæ with a few minute bristles. Outer ramus of first pair of feet with 1, 1, 2, the third with 1, 0, 2, the fourth with 0, 0, 2 outer marginal bristles; proximal outer bristle of third outer ramus of third and fourth pairs reduced.

*Male*: Genital segment broad. Proximal joint of distal portion of anterior antennæ with a semi-circular projection on inner margin. Third joint of outer ramus of first and fourth pairs of feet with 2, the second and third with 3 outer bristles.

Coloration: Very transparent, with ferruginous pigment very variously distributed through cephalothorax, especially in oral region, sometimes forming symmetrical spots in thorax, more rarely in abdomen; often in long bristles of anterior antennæ, furca, and feet; other individuals are quite colorless except for the ruby-red eye.

Length of female, .01 to 1.5 mm.; of male, .075 mm.

Three female specimens taken in the Gulf Stream, 70 miles south of Marthas Vineyard, July 25, 1899. These specimens were colorless.

##### 23. *Oithona similis* Claus.

*Female*: Front ending in a hooked, pointed beak which is bent ventrally at a right angle and hence not visible from dorsal aspect; genital orifices situated further posteriorly than in other species of the genus; furca shorter than anal segment, nearly  $2\frac{1}{2}$  times as long as broad, its outermost bristle about as long as furca. Anterior antennæ scarcely reaching to genital orifices. Second basal

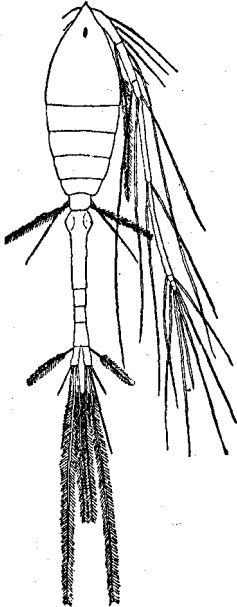
joint of mandibles with 2 hook-shaped bristles. Inner ramus of maxillæ with a minute bristle. Outer ramus of first pair of feet with 1, 1, 2, of second and third with 1, 0, 1, of fourth with 0, 0, 0, outer marginal bristles.

*Male*: Genital segment smaller than in *O. plumifera*. Proximal joint of distal portion of anterior antennæ with a semicircular process on inner margin. Third joint of outer ramus of first to fourth pairs of feet with 2 outer marginal bristles.

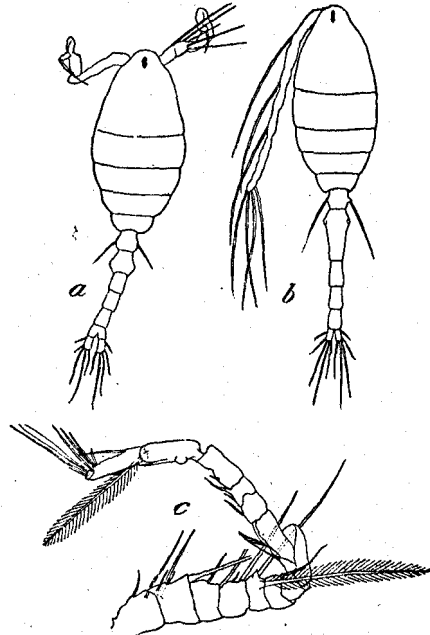
Coloration: Similar to *O. plumifera*, but usually less colored.

Length of female, 0.73 to 0.8 mm.; of male, 0.59 to 0.61 mm.

This species occurred occasionally in small numbers in the tow taken from the Fish Commission wharf at Woods Hole during July, 1899. All the specimens were colorless.



22. *Oithona plumifera* Baird;  
female.



23. *Oithona similis* Claus; a, male, dorsal aspect;  
b, female, dorsal aspect; c, male, anterior antenna  
(dorsal surface); after Giesbrecht.

### Family HARPACTICIDÆ.

#### SETELLA Dana.

*Female*: Trunk long and slender, laterally compressed. Cephalothorax with 4 segments (head fused with first thoracic), abdomen with 5 segments (first and second segments fused); rostrum movable; furca rod-shaped, with very long bristles. Anterior antennæ 8-jointed, with aesthetascs on fourth and eighth joints. Posterior antennæ short, 2-jointed (basal fused with first joint of inner ramus), without a trace of an outer ramus. Succeeding 3 pairs of limbs minute; mandible 1-jointed, without rami, with denticulate blade; maxilla also 1-jointed and without rami; anterior maxilliped with 2 lobes and short terminal hooks. Posterior maxilliped longer and more powerful, 2-jointed, with terminal hooks. Feet with very long and slender rami; inner ramus of first pair 2-jointed; remaining rami 3-jointed; fifth pair of feet rudimental, elongate leaf-shaped.

*Male*: With separate first and second abdominal segments; grasping antennæ 8-jointed, with articulation between fifth and sixth joint; fifth pair of feet similar to those of the female, but smaller, with weaker bristles; sexual differences also in first and especially in second pair of feet.

**24. *Setella gracilis* Dana.**

This single strongly marked species should include, according to Geisbrecht, besides *S. gracilis* Dana, some four other forms regarded by Dana as distinct species, also *Miracia gracilis* Dana, *Setella tenuis* Lubbock, and *S. messinensis* Claus. In color the chitin of body and of proximal portions of limbs is transparent violet; gut ferruginous red surrounded by oil drops which are colorless or yellowish and usually darker in the oral region; eye ruby-red.

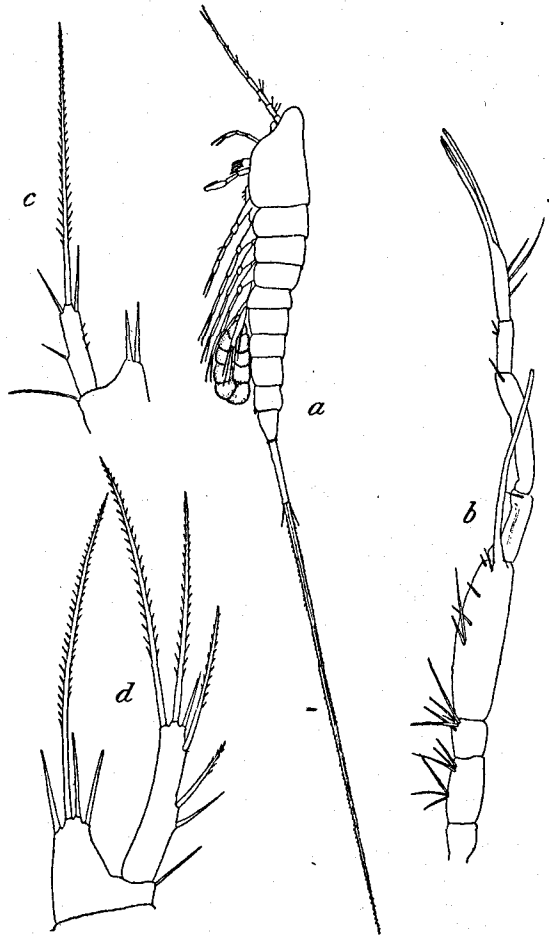
Length of female, 1.4 to 1.5 mm.; of male, 1.16 to 1.3 mm.

Several specimens, many ovigerous females and a few males, were taken in Gulf Stream, 70 miles south of Marthas Vineyard, July 25, 1899.

**MIRACIA Dana.**

*Male*: Cephalothorax with 4 segments (head fused with first thoracic), abdomen with 6 segments; head and first thoracic segment laterally compressed, with two large chitinous lenses on front; furca rather long. Anterior antennæ grasping organs, 9-jointed, articulation between the sixth and seventh joints; bristles short, one æsthetask on fourth joint. Posterior antennæ 3-jointed (second basal joint fused with first joint of inner ramus), with very small, 1-jointed outer ramus. Mandible (like succeeding limbs) small, with rudimental rami and denticulate blade. Posterior maxilliped elongated, rod-shaped, 2-jointed, with short terminal hooks. Feet elongated; outer ramus 3-jointed; inner ramus of first and second pairs 2-jointed, of third and fourth pairs 3-jointed; inner ramus of second pair of peculiar structure; fifth pair of feet rudimental, leaf-shaped.

*Female*: Differs from male (according to Brady), in fusion of first and second abdominal segments, in structure of 8-jointed anterior antennæ, of 3-jointed, normally constructed inner ramus of second pair of feet, and in fifth pair of feet.



24. *Setella gracilis* Dana; a, female, from the left side; b, male, anterior antenna; c, male, fifth foot; d, female, fifth foot.

**25. *Miracia efferata* Dana.**

Some 30 specimens of both sexes of this, the only species of the genus, were taken in the Gulf Stream about 60 miles south of Marthas Vineyard, July 28, 1899, late in the afternoon. The female is dark greenish-blue, more yellowish along edges of segments, with a large black spot on head, becoming blue over the eyes. There is a glistening metallic luster to upper surface of body. Eggs blue or red. The male is much paler than female.

Length of female, 1.75 to 2 mm.; of male, 1.5 mm.

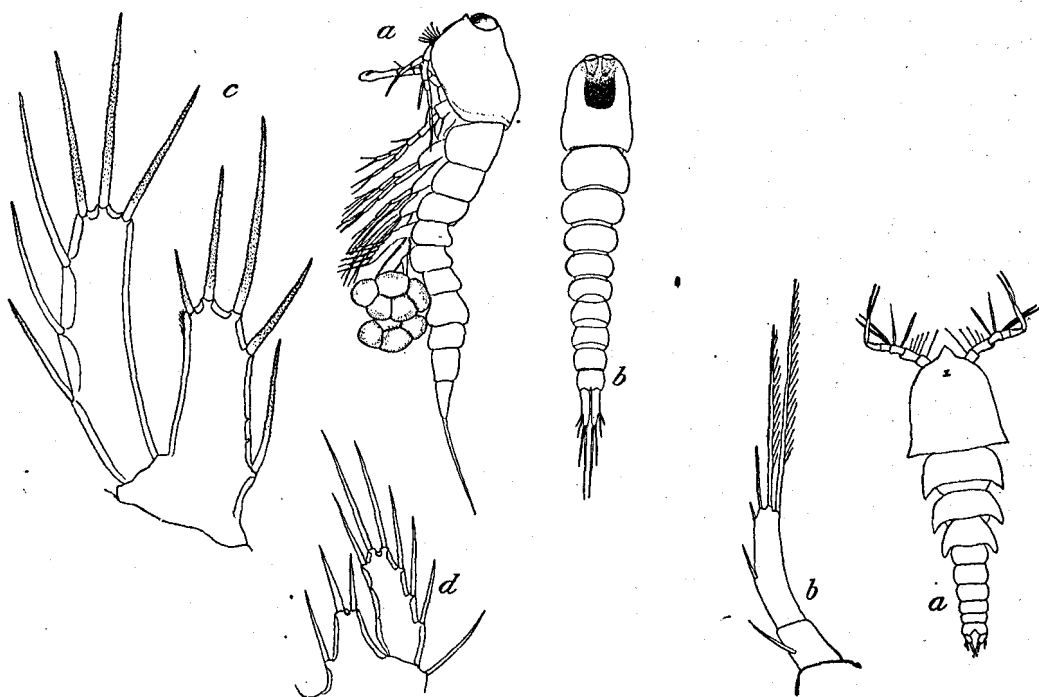
**CLYTEMNESTRA Dana.**

*Female*: Cephalothorax with 4 segments (head and first thoracic fused), abdomen with 5 segments (first and second abdominal fused); postero-lateral corners of segments in flattened cephalothorax prolonged into projections; furca short. Anterior antennæ 7 or 8 jointed, with short bristles and long æsthetasks. Posterior antennæ 3-jointed (first and second basal joints fused), with rudimental



outer ramus represented by 1 or 2 bristles. Mandible reduced to a stylet-shaped 2-pronged blade; maxillæ and anterior maxillipeds also strongly reduced. Posterior maxilliped 2-jointed, delicate, elongated, with short terminal hooks. Feet with long, slender rami, of which inner are longer; the inner rami of all of the pairs and outer rami of second to fourth pairs 3-jointed; outer ramus of first pair 1-jointed; fifth pair of feet rudimental, 2-jointed.

*Male*: Differs from female in structure of abdomen (with 6 segments; furcal bristles sometimes elongated), also in structure of anterior antennæ (grasping organs; joints of same number as in the female, but differing in relative lengths; articulation proximal to terminal joint), and posterior maxillipeds (longer than those of the female, second joint stouter, terminal hooks longer).



25. *Miracia efferata* Dana; a, ovigerous female, from left side; b, male, dorsal aspect; c, fifth foot of ovigerous female; d, male, fifth foot.

26. *Clytemnestra rostrata* Brady; male; a, dorsal aspect; b, fifth foot.

#### 26. *Clytemnestra rostrata* Brady.

Furca at most as long as broad, bristles not plumose, alike in both sexes. Anterior antennæ 7-jointed in both sexes; last joint in female 5 times as long as penultimate; no lancet-shaped thorn on antepenultimate joint in male. Outer ramus of posterior antennæ represented by a single bristle; second basal joint of first foot without an outer marginal bristle, outer ramus of same with 3 bristles, outer ramus of second foot with 1, 1, 2 outer marginal bristles; second joint of inner ramus of third foot longer than third joint. Fifth foot as long as outer-ramus of fourth foot, its terminal joint with 5 bristles, which are of same length in male and female.

*Coloration*: Reddish, owing to distribution through the whole transparent body of numerous pale rose-colored, pale ferruginous-brown or even light-green oil-globules. Eye, deep carmine-red; ovaries dark gray with a reddish tinge.

Length of female, 1 mm.; of male, 0.87 mm.

A few male specimens of this species were collected in the Gulf Stream tow, about 60 miles south of Marthas Vineyard, July 28 and 29, late in the afternoon.

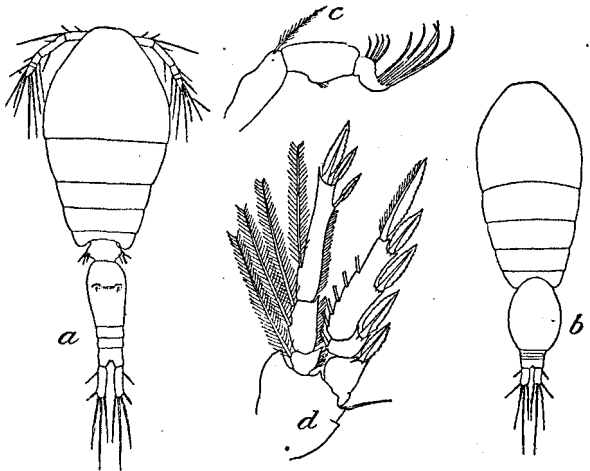
## Family ONCÆIDÆ.

## ONCÆA Philippi.

Form of body like that of *Cyclops*; cephalothorax and abdomen of female each with 5 segments (head distinct from first thoracic, first from second abdominal). Mandibles not hatchet-shaped, with movable, pectinate and bristle-shaped appendages. The maxillæ are 1-jointed lamellæ. Feet with long, slender third joint of inner ramus, that of fourth pair at least  $1\frac{1}{2}$  times as long as first and second joints of inner ramus taken together; fifth foot a small rod or knob. Mouth parts of male similar to those of female.

*Female*: Anterior antennæ 6-jointed, with long middle joint; æsthetasks poorly developed. Posterior antennæ 3-jointed, with uncinete bristles of medium length. Appendages of anterior maxillipeds in part pectinate with plumes. Posterior maxilliped 4-jointed, on inner border of second basal with rows of points. Outer ramus of first and second pairs of legs with 1, 1, 3, of third and fourth pairs with 1, 1, 2 usually denticulated outer marginal bristles. Inner ramus of first pair with 1, 1, 6, in second pair with 1, 2, 6 (5), in third pair with 1, 2, 5 (4), in the fourth pair with 1, 2, 4 (3) usually bristle-shaped appendages.

*Male*: Abdomen with 5 segments, with abbreviated middle segments; genital segment voluminous; genital valves with a lateral point. Posterior maxilliped with more movable insertion than in the female, with more muscular second basal joint and more strongly curved terminal hooks; the 3 short terminal joints of anterior antennæ fused to form a single piece; other minor sexual peculiarities.



27. *Oncæa venusta* Philippi; a, female, dorsal aspect; b, male, dorsolateral aspect; c, female, posterior antenna; d, female, fourth foot.

27. *Oncæa venusta* Philippi.

*Female*: Cephalothorax pyriform (head broad), usually with granulated outicle; genital segment but little longer than remainder of abdomen, succeeding segments broader than long; furca at least as long as fourth and fifth abdominal segments together, and at least 4 times as long as broad. Posterior antennæ, especially their inner rami, very short. Terminal hook of posterior maxillipeds with a few points on the concave surface; the 2 bristles on second basal joint rather long and slender. Outer ramus of feet with broad-margined, serrated outer marginal bristles; third joint of inner ramus of fourth pair without terminal pegs, with three lancet-shaped serrated bristles in second and fourth pairs.

*Male*: Short genital valves and short, broad anal segment.

Coloration: Rather opaque with carmine-red pigment, accumulated largely in the cephalothorax and genital segment, chitin of cephalothorax and appendages more or less violet; eggs blue.

Length of female, 1.1 to 1.27 mm; of male, 0.8 to 0.95 mm.

A few specimens of both sexes collected in the Gulf Stream tow, about 60 miles south of Marthas Vineyard, July 28, 1899, late in the afternoon.

## Family CORYCÆIDÆ.

## SAPPHIRINA I. V. Thompson.

Body flattened dorso-ventrally; thorax and abdomen of female each with 5 segments (head separated from first thoracic, first from second abdominal), with broadened middle abdominal segments; furca leaf-shaped, each limb with 5 bristles. Mandibles hatchet-shaped, their dorsal tip drawn out into a point. Maxillæ oval lamellæ. Rami of feet 3-jointed of varying relative size; fifth

pair rod-shaped, with two bristles. Male with leaf-shaped, broadened body-segments; iridescent; sexual peculiarities in mouth parts and feet not universal.

*Female*: Eye-lenses contiguous or lying near together; genital orifices pushed up some distance on sides of their segment. Anterior antennæ 3 to 5 jointed; aesthetascs wanting. Posterior antennæ with a short uncinuate bristle on terminal joint, otherwise with small, thin bristles. Terminal joint of anterior maxillipeds drawn out into a long point, terminal hook of posterior maxillipeds short and stout. Outer rami of feet with broad-margined, lancet-shaped outer marginal bristles as follows: 1, 1, 3 in first to third pairs; 1, 1, 2 (3) in fourth pair; inner rami of first pair with 1, 1, 6, in second with 1, 2, 6, in third with 1, 2, 5, in fourth with 1, 2, 2 (1) bristles.

*Male*: Abdomen with 5 segments; genital valves broad, but short, with a few bristles; terminal hook of posterior maxilliped elongated and articulating by means of an intermediate joint with second basal.

### 28. *Sapphirina gemma* Dana.

*Female*: Furca at least twice as long as broad, with a small, sometimes obsolete, point on tip of inner margin; insertion of innermost bristle further back than that of outermost. Eggs blue.

Anterior antennæ three-fourths as long as posterior ones, 5-jointed; second joint as long as 3 terminal joints together. Inner ramus of posterior antennæ more than two-thirds as long as second basal joint; terminal claw one-third as long as second joint of inner ramus. Inner ramus of fourth foot somewhat longer than outer ramus; third joint of inner ramus scarcely shorter than first and second joints together, with 2 bristles at its tip.

*Male*: Length of the body about  $2\frac{1}{2}$  times as great as its greatest breadth; eye-lenses on ventral surface, front projecting over them some distance. Furca, fourth pair of feet, anterior antennæ as in female, the succeeding appendages in part reduced. Third joint of inner ramus of second pair of feet with 3 lancet-shaped bristles and slightly elongated teeth.

Coloration: "Female colorless; bags of eggs dull bluish. Male with very brilliant blue reflections, dazzling in the sun's rays, with various other bright colors as the animal changes its position." (Dana).

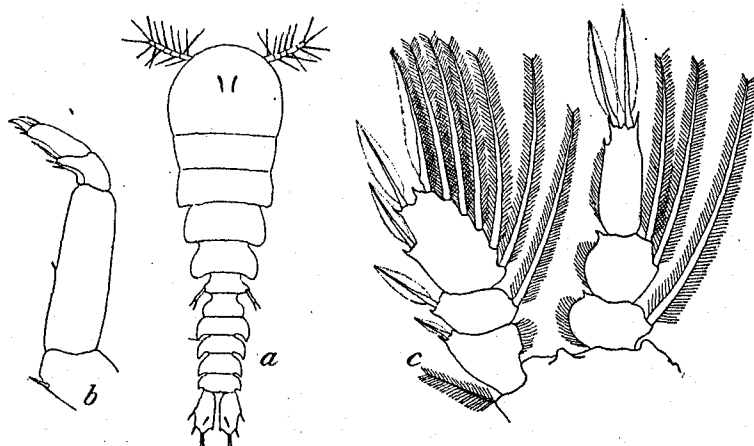
Length of female, 1.9 to 3.1 mm.; of male, 2.15 to 3.1.

Three female specimens collected in tow in Gulf Stream 70 miles south of Marthas Vineyard, July 27, 1899.

According to Giesbrecht *Sapphirina gemma* seems to prefer *Salpa democratica* as a host. My specimens were taken in company with chains of *Salpa cordiformis*.

### CORYCÆUS Dana.

Body cylindrical; cephalothorax with 2 to 4, abdomen with 2 or 3 segments; lateral portions of third and fourth thoracic segments prolonged into pointed projections. Furca rod-shaped, each limb with 4 bristles. Mandibles not hatchet-shaped, with movable appendages, similar to those of *Oncaea*. Maxillæ oval lamellæ. Rami of feet elongated; inner ramus of fourth pair a stub (Stummel) or reduced to a single bristle; fifth pair consisting on either side of 2 small bristles. Body of male not flattened and usually segmented like that of female, never with full number of abdominal segments. Mouth parts not abortive.



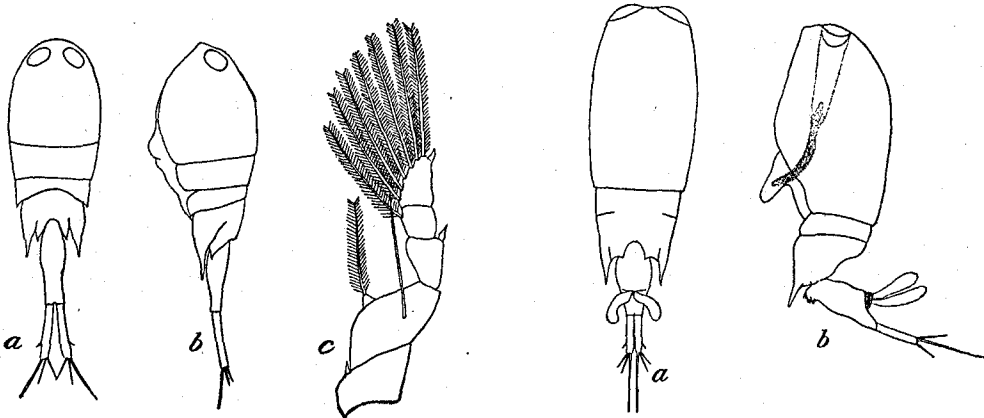
28. *Sapphirina gemma* Dana; female; a, dorsal aspect; b, posterior antenna; c, fourth foot.

*Female:* Eye-lenses close together, sometimes contiguous; fifth thoracic segment very short. Anterior antennæ 6-jointed, similar to those of *Oncawa*, but with naked bristles and without æsthe-tasks. Posterior antennæ with voluminous second basal joint and very short first joint to inner ramus; first and second basal joints each with a long, thick bristle and inner ramus with stout, much-curved uncinatè bristles. Terminal joint of anterior maxillipeds ending in a strong hook. Second basal of posterior maxillipeds with a bristle on inner margin; its end-hook more delicate than in *Sapphirina*. Outer ramus of feet longer than inner ramus; outer bristles of outer rami in first and second pairs have forms of denticulate lancets (1, 1, 3, more rarely 0, 0, 1) and are more or less abortive in succeeding pairs; inner rami of first pair with 1, 1, 5, in second with 1, 2, 4, in third with 1, 2, 2, in fourth with 1 or 2 bristles.

*Male:* Genital valves long, each with a single bristle; pronounced deviations are shown by the posterior antennæ and posterior maxillipeds, especially in the elongation of the terminal hook.

### 29. *Corycæus elongatus* Claus.

*Female:* Cephalothorax with 4 segments, abdomen with 1 segment; ventral keel rounded; furca between three-sevenths and four-sevenths as long as remaining abdomen. Bristles of first basal joint



29. *Corycæus elongatus* Claus; female; a, dorsal aspect; b, lateral aspect; c, fourth foot.

30. *Corycæus carinatus* Giesbrecht; female; a, dorsal aspect; b, lateral aspect.

of posterior antennæ but little longer than those of second basal joint. Third joint of outer ramus of first to third foot with 3 outer marginal bristles; inner ramus of fourth foot represented by a plumose bristle.

*Male:* Boundary between head and first thoracic segment indistinct. Abdomen with 2 segments, posterior portion of genital segment not tapering; furca one-third to one-half as long as remainder of abdomen; tooth on inner edge of second basal joint of posterior antennæ replaced by fine points.

*Coloration:* Rather opaque, with a variable amount of red, yellowish-red, and yellow pigment, especially in region of mouth, in wing-like extensions of posterior thoracic segments, and in genital segment. Eye red. Eggs yellowish or reddish.

Length of female, 1.45 to 1.65 mm.; of male, 1.3 to 1.4 mm.

A few females taken in tow in Gulf Stream, 70 miles south of Marthas Vineyard, July 28, 1899.

### 30. *Corycæus carinatus* Giesbrecht.

*Female:* Cephalothorax with 2 segments, abdomen with 1 segment; ventral keel beak-shaped, extending backward; abdomen tapering posteriorly; furca half as long as remainder of abdomen, four times as long as broad. Male unknown. *Coloration* as in the preceding species. Length, 0.85 to 0.9 mm. Several female specimens taken in company with preceding species in the Gulf Stream.