CONTRIBUTIONS TO THE NATURAL HISTORY OF THE ISOPODA.

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PREFACE.

The difficulties which meet the systematist are but little understood or appreciated by those engaged in other fields of biological work. The morphologist, the embryologist, the physiologist give him but little encouragement and sympathy. Prof. Charles C. Nutting very adequately described the situation in his recent address before the American Association for the Advancement of Science and made an urgent appeal for cooperation with and leniency toward the man who toils over the "hard and often thankless task" of classification.

Those who have studied special groups of animals or plants realize the difficulties that have to be overcome and the problems that must be faced. The path is not always easy nor the way clear.

In the following pages the object has not been to give an exhaustive treatment of the Isopod group. The attempt is made to bring together by way of introduction facts of general interest, describing briefly the systematic position, structure, habitat, distribution, mode of life, development, and other points of interest in connection with the group, and to present, in detail, descriptions and figures of a number of new species and genera, which are the result of independent work on material collected by several different parties. These collections were made (1) by the U. S. Fish Commission steamer *Albatross* and by the U. S. S. *Palos* in Japan; (2) by Messrs. Jordan and Snyder in Japan; and (3) by Dr. C. H. Gilbert at Panama and Mazatlan. Lastly, a large number of Bopyridæ in the U. S. National Museum collection have been worked up and also included.

No bibliography is given with the general introduction. A bibliography accompanies each section of the work. The publications which have been of great service in preparing the general account of the group and freely used are those of T. R. R. Stebbing, G. O. Sars, F. Beddard, O. Harger, C. E. A. Gerstæcker, J. P. McMurrich, J. C. Schiœdte and F. Meinert, James D. Dana, A. Giard and J. Bonnier, and H. G. Hansen. A large number of other papers have also been consulted.

Finally, I wish to express my gratitude to Dr. Theodore Gill, the distinguished naturalist, for his kindness in looking over the work and for his many suggestions in connection with it.

INTRODUCTION.

1. CLASSIFICATION AND SYSTEMATIC POSITION.

The Isopoda are a group of Crustacea belonging to the large subclass Malacostraca, which, in contradistinction to the Entomostraca, includes all those forms having a gastric mill in the stomach; green glands, functioning as excretory organs, situated in the basal joint of the antennules; and not having a free nauplius larva, the nauplius stage being passed in the egg.

The order Arthrostraca includes both the Isopoda and the Amphipoda, which have in common the following characters: The first thoracic segment is permanently fused with the head, and bears maxillipeds; the seven remaining segments are usually free and bear legs, although the first free segment and sometimes even the second free segment may be united with the head to form a carapace; the eyes are usually sessile.

The Isopoda differ from the Amphipoda (1) in the general form of the body which is compressed dorso-ventrally, while in the Amphipoda, it is flattened or compressed laterally; (2) in the fact that respiration is carried on by the abdominal appendages or pleopoda, which are modified gills, while in the Amphipoda the gills are borne on the thoracic appendages; (3) in the difference in structure correlated with a difference in function in the pleopoda. The abdominal appendages in the Isopoda are usually broad plates or lamellæ, all five pairs more or less similar in shape and size. In the Amphipoda, the first three pairs are similar in shape and size, are long narrow appendages suitable for swimming, while the last three pairs are adapted for jumping.

Seven superfamilies[a] or tribes are usually recognized in the suborder Isopoda. The classification given by G. O. Sars is the one now generally adopted. He divides the Isopods into tribes according to the following characters:[b]

[a] The term tribe was originally used by Latreille for subdivision of family, and such was for a time the general usage. The history of the group has been indicated by Dr. Gill in his address on Some Questions of Nomenclature (Science, n. s. IV, p. 598, etc.).

[b] The table has been modified to include the tribe Phreatoicoidea. Other slight changes have been made also. See Sars, Crustacea of Norway, II, 1899, p. 3.

a Legs of the first pair cheliform. Uropoda terminal. Pleopoda, when present, exclusively natatory ....I. CHELIFERA or TANAIOIDEA.
a' Legs of the first pair not cheliform.
b Uropoda lateral.
c Uropoda forming together with the terminal segment of the abdomen a caudal fan. Pleopoda for the most part natatory . II. FLABELLIFERA or CYMOTHOIDEA.
c' Uropoda valve-like, inflexed, arching over the pleopoda which to a great extent are branchial ....III. VALVIFERA or IDOTEOIDEA.
b' Uropoda terminal or infero-lateral.
c Uropoda infero-lateral. Outer branch of the second and following pairs of pleopoda two-jointed..............................IV. PHREATOICOIDEA.
c' Uropoda terminal. Outer branch of the pleopoda never two-jointed.
d Free forms.
e Pleopoda exclusively branchial, generally covered by a thin opercular plate (the modified first pair) ....V. ASELLOTA or ASELLOIDEA
e' Pleopoda fitted for air-breathing ....VI. ONISCOIDEA.
d' Parasitic forms. Pleopoda and uropoda sometimes absent. When present exclusively branchial, and not covered by any operculum.
VII. EPICARIDEA or BOPYROIDEA.

The following list includes the numerous families which are comprised under these seven tribes:

I. CHELIFERA or TANAIOIDEA.[a]
1. Apseudidæ.
2. Tanaidæ.

II. FLABELLIFERA or CYMOTHOIDEA.[a]
1. Anthuridæ.
2. Gnathiidæ.
3. Cirolanidæ.
4. Corallanidæ.
5. Alcironidæ.
6. Barybrotidæ.
7. Ægidæ.
8. Bathynomidæ.
9. Cymothoidæ.
10. Serolidæ.
11. Sphæromidæ.
12. Limnoriidæ.

III. VALVIFERA or IDOTEOIDEA.[a]
1. Arcturidæ.
2. Idoteidæ.
3. Chætiliidæ.

IV. PHREATOICOIDEA.
1. Phreatoicidæ.

V. ASELLOTA or ASELLOIDEA.[a]
1. Asellidæ.
2. Janiridæ.
3. Munnidæ.
4. Desmosomidæ.
5. Munnopsidæ.

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[a] The second name given above for the tribe or superfamily was suggested by Dr. Theodore Gill in order that the nomenclature might be more uniform.

VI. ONISCOIDEA.
1. Oniscidæ.
2. Armadillidiidæ.
3. Ligiidæ.
4. Trichoniscidæ.
5. Tylidæ.
6. Helleriidæ.

VII. EPICARIDEA or BOPYROIDEA.[a]
1. Bopyridæ.
2. Entoniscidæ.
3. Dajidæ.
4. Cryptoniscidæ.

Further subdivision into genera and species is not desirable, although the genera and species will be constantly referred to in the following pages.

2. EXTERNAL ANATOMY.

A. GENERAL FORM.

The body is generally flattened or compressed dorso-ventrally, differing in this respect from the Amphipoda, their nearest relatives, which have the body flattened or compressed laterally. The outline of the body varies considerably. Many forms are narrow and elongate, the extreme of this type being found among the Anthuridæ;[b] others are broadly oval, almost circular in outline (the Serolidæ). Bilateral symmetry prevails in the group as a whole. The adult females in the parasitic Isopoda deviate from the symmetry of the larval condition, owing to the parasitic mode of life, the parasitism being also accompanied in some of the Epicaridea by a degradation in structure of such an extent that the characters of the group are entirely lost, their relationship being known only through a study of the early larval stages and through the males which retain the characters of the group. Some of the Cymothoidæ, also parasites, are as symmetrical in the adult condition.

Sexual dimorphism occurs only in the parasitic tribe Epicaridea. The males in this superfamily are four or five times smaller than the females and are always found permanently attached to the body of the female.

In both sexes the body is segmented, the number of segments into which the thorax and abdomen is divided differing in the various subdivisions of the group. Fusion of the first and second segments with the head occurs sometimes, and often some or all of the abdominal segments are coalesced. The Dajidæ have the body very imperfectly

[a] The second name given above for the tribe or superfamily was suggested by Dr. Theodore Gill in order that the nomenclature might be more uniform.

[b] In *Hyssura vermiformis* Haswell, a member of this family, all the segments of the body are extremely narrow and elongated, giving the body an exceedingly long appearance.

segmented. In the Entoniscidæ alone there is no trace of segmentation whatever in the adult female, and in the Cryptoniscidæ but slight traces of segmentation.

Many of the terrestrial Isopoda, the pill bugs, and some of the Sphæromidæ, especially the genus *Sphæroma* Latreille, are able to roll the body completely into a ball.

B. HEAD.

The head may be considered as composed of seven coalesced segments, indicated by the number of paired appendages, the last coalesced segment, represented by the maxillipeds, being derived from the thorax. The eyes may be regarded as the appendages of a first or ocular segment; the antennæ and antennulæ, the appendages of a second and third segment; the mandibles and the two pairs of maxillæ representing the fourth, fifth, and sixth segments; the maxillipeds, as already stated, represent a first thoracic segment, which is permanently united with the head in all Isopods, the name foot-jaws indicating their origin and function. (Harger.)

A second thoracic segment, which is usually the first free segment, is also consolidated with the head to form a carapace in the Tanaidæ and the Serolidæ; in the latter family sutures may or may not be present. The Australian species *Crabyzos longicaudatus* Spence Bate, as well as *Arcturides cornutus* Studer, and *Stenasellus* Dollfus have the head and first free segment of the thorax united so as not to articulate, although they are separated by a suture in the first two mentioned. The males of the family Dajidæ also have the head fused with the first free segment of the thorax.

Still a third thoracic segment, or what is usually the second free segment, is united with the head in only one genus, the genus *Sphyrapus* Norman and Stebbing.

1. Eyes.—The eyes, when present, are always paired. They may be small and simple and situated some distance apart, or they may be large, composite eyes, formed of numerous ocelli and so close as to be contiguous. Except in the Tanaidæ, where the eyes are placed on stalks, which are, however, never movable, they are invariably sessile. The ocular lobes in the Apseudidæ are spine-like projections of the carapace upon which the eyes are situated.

Eyes are wanting in the following Isopod genera: *Typhlotanais* Sars, *Leptognathia* Sars, *Tanaella* Norman and Stebbing, *Strongylura* Sars, *Cryptocope* Sars, *Haplocope* Sars, *Anarthrura* Sars, *Cæcidotea* Packard, *Cirolanides* Benedict, *Syscenus* Harger, *Platyarthrus* Brandt, *Titanethes* Schiœdte, *Tanaopsis* Sars, *Calathura* Norman and Stebbing (eyes imperfectly developed or wanting), *Leptanthura* Sars, *Alaotanais* Norman and Stebbing (there are minute ocular lobes but no eyes) *Pseudotanais* Sars (eyes are imperfect or absent), *Anuropus* Beddard, *Pleurogonium* Sars, *Leptaspidia* Bate and Westwood, *Nannoniscus* Sars, *Dendrotion* Sars, *Ischnosoma* Sars, *Sphæromides* Dollfus, *Stenasellus* Dollfus, *Cæcosphæroma* Dollfus, *Hypsimetopus* Sayce, *Mesotanais* Dollfus, *Heterias* (new name for *Janirella* Sayce, preoccupied[a]), and *Phreatoicoides* Sayce.

In a number of species belonging to well-known genera eyes are also lacking. The list includes: *Trichoniscus cavernicola* Budde-Lund, *Astacilla cæca* Benedict, *Rocinela typhlops* Bonnier, *Munella danteci* Bonnier, *Brackenridgia cavernarum* Ulrich, *Trichoniscus stygius* Nemec, *Cirolana cubensis* Hay, *Monolistris cæca* Gerstæcker, *Asellus cavaticus* Schiœdte, *Pseudarmadillo carinulatus* Saussure, *Conilera stygia* Packard, *Phreatoicus typicus* Chilton, *Harponyx pranizoides* Sars, and *Serolis anartica* Beddard. None of the Munnopsidæ or Desmosomidæ have eyes. Eyes are likewise usually absent among the Epicaridea.

Stebbing says that the explanation for the fact that many of the genera of Tanaidæ are blind is to be found in their habit of living ensconced in the sand.

Many of the blind forms are deep-sea species, others are cave-dwellers, and some have been found in wells at great depths.

Structural degeneration of the eyes is found in some of the deep-sea Serolidæ, no retinula being present, although the vitreous body is represented (Beddard).

2. *Antennæ.*—There are two pairs of antennæ. The first pair are sometimes called antennules, superior or upper antennæ. These are rudimentary in the Oniscoidea, are inconspicuous, never more than three-jointed, and sometimes wholly wanting (Helleriidæ). Usually the antennules are composed of three peduncular joints and a many-jointed flagellum. The Valvifera, however, are without this multi-articulate flagellum, all the joints being consolidated to form a single clavate joint. The flagellum of the first pair of antennæ in the Tanaidæ is rudimentary or sometimes wanting in the female. This is also true of *Cyathura* Stebbing, females, *Leptanthura* Sars, females, *Janthopsis* Beddard, *Jæropsis* Koehler, *Macrostylis* Sars, and *Nannoniscus* Sars, all having a rudimentary flagellum to the antennules. In the genera *Anuropus* Beddard and *Nannoniscus* Sars, the first antennæ have but two joints. In *Plakarthrium*[b] Chilton, the antennules have but three joints, the first two of which are flattened and form plates surrounding the anterior margin of the head. The Apseudidæ are characterized by having two multi-articulate flagelli to the superior antennæ, the second flagellum being sometimes called the secondary filament.

The second pair of antennæ, inferior or lower antennæ, are usually composed of five peduncular joints and a multi-articulate flagellum.

[a] *Janirella* Bonnier, a new genus of *Asellidæ* is described, Ann. Univ. Lyon, XXVI, 1896.

[b] *Chelonidium* Pfeffer is a synonym of *Plakarthrium* Chilton.

Munnopsis M. Sars, *Paramunna* Sars, *Pleurogonium* Sars, *Nannoniscus* Sars, and *Eurycope* Sars are exceptions, having a six-jointed peduncle, and *Eurydice* Leach has only four joints to the peduncle of the second antennæ. In *Plakarthrium* Chilton the third and fourth joints of the peduncle of the second antennæ are flattened to form plates. Variations are found in the structure of the flagellum. The joints of the multi-articulate flagellum are all united in one tapering joint in the following genera: *Symmius* Richardson, *Erichsonella* Benedict, *Cleantis* Dana, and *Eusymmerus* Richardson. The flagellum of the lower antennæ is rudimentary in both sexes in the Tanaidæ, in the genus *Jæropsis* Koehler, *Edotea* Guérin-Méneville, *Epelys* Dana, *Leptanthura* Sars and *Cyathura* Norman and Stebbing; also in the males of *Paranthura* Bate and Westwood.

A few genera, *Apseudes* Leach, *Stenetrium* Haswell, *Janthe* Bovallius, *Janira* Leach, *Trichopleon* Beddard, *Janiropsis* Sars, and *Cruregens* Chilton are characterized by having an exopod or antennal scale, movable and ciliated, attached to the peduncle of the second pair of antennæ.

The inferior antennæ in the Epicaridea are greatly reduced. Both pairs in the females of the Entoniscidæ are transformed into lips. In the Cryptoniscidæ they are entirely wanting.

The antennæ are of great length in many Isopods. In the genera *Munnopsis* M. Sars, *Eurycope* G. O. Sars, and *Arcturus* Latreille they attain a great development, being many times longer than the body.

The greatly elongated second antennæ of the Arcturidæ are supposed to serve as a nursery for the young, which for some time after they have left the incubatory pouch are found clinging to the antennæ of the parent. In this way they are protected and are able to receive the nourishment which the parent secures for them and for herself.

3. Mouth parts.—"The upper lip usually forms a plate projecting from the top of the oral aperture over the cutting edges of the mandibles, and may have an inner plate lying parallel to the outer. The lower lip is bilobed, or forms two pairs of lobes, of which the inner pair is much the smaller."[a]

The maxillipeds are a pair of appendages, consisting of a basal part, the protopodite, usually composed of one segment; a palp or endopodite, with varying number of joints; an epignath or epipodite, which usually consists of one article, and is affixed to the protopodite at its external margin. In the Chelifera the epignath extends within the branchial cavity; in the Ægidæ it is fusel with the protopodite; in *Plakarthrium* Chilton it is wanting.

There are two pairs of maxillæ. The second, posterior or outer pair is three-lobed at the tip, the two outer lobes being articulated to the basal segment or protopodite. In the Oniscoidea the posterior maxillæ

[a] Stebbing, History of Crustacea, 1893.

are laminar, with only a slight indication of a division into lobes. The inner, anterior or first maxillæ are typically composed of two unequal lobes, the inner lobe being comparatively small, the outer lobe more robust. The Ægidæ have the anterior maxillæ composed of only a single lobe, the posterior maxillæ terminating in two lobes. The Tanaidæ also have but a single masticatory lobe to the anterior maxillæ; the posterior maxillæ are quite rudimentary, being simple rounded lobes. The posterior maxillæ are wanting in *Calathura* Norman and Stebbing; both pairs are wanting in both sexes of the Gnathiidæ. In the Chelifera there is a backward-directed palp attached to the anterior maxillæ. *Exosphæroma* Stebbing has a small exopod attached to the first maxillæ. The first maxillæ in *Nalicora* Moore have the outer joint in the form of a strong, curved spine, the inner joint covered by a cap at its tip; the second maxillæ are four-jointed. *Plakarthrium* Chilton has both first and second maxillæ, consisting each of a single lobe.[a]

The mandibles are a pair of strongly calcified structures, often toothed along the inner margin or consisting of a single large tooth. Just below the cutting part is the molar expansion. A three-jointed palp is usually present. The palp is wanting in the Tanaidæ, the Oniscoidea, the Idoteidæ, the Arcturidæ, and in the following genera: *Mancasellus* Harger, *Cruregens* Chilton, *Pleurogonium* Sars, *Macrostylis* Sars, *Ischnosoma* Sars, *Echinopleura* Sars, *Echinozone* Sars, *Plakarthrium* Chilton, and in the following species: *Munnopsis* (?) *australis* Beddard.

The Cymothoidæ, the Limnoriidæ, the Armadillidiidæ, the Oniscidæ, the Corallanidæ, the Alcironidæ, the Ægidæ, and the Barybrotidæ have no molar expansion to the mandibles, as is also true of the following genera: *Æga* Leach, *Tanaopsis* Sars, *Anarthura* Sars, and *Munnopsis* Sars.

In the females of the Gnathiidæ the mandibles are entirely wanting and the maxillipeds reduced. In the males the mandibles are powerful structures, extending some distance in front of the head.

The mouth parts of the Anthuridæ are suctorial. In some genera of this family the molar process of the mandibles is developed into a sort of semicircular saw.

With the exception of the maxillipeds all the mouth parts are lost in the males of the following genera: *Paratanais* Dana, *Typhlotanais* Sars, *Leptognathia* Sars, and *Alaotanais* Norman and Stebbing.

The oral parts in the Epicaridea are much reduced, only the mandibles and maxillipeds being distinctly developed.

C. THORAX.

The thorax, pereion or mesosome, is normally composed of seven free segments, articulating each with the other. Variation as to the

[a] According to Pfeffer.

number of segments is found; first, in the Tanaidæ, in the males of the Dajidæ and in the species *Crabyzos longicaudatus* and *Arcturides cornutus*, where the first free segment is fused with the head; secondly, in the Serolidæ, where the first free thoracic segment is united with the head, the five following segments being free, the seventh segment, however, differing in this respect that it is represented only on the ventral side by a short sternum, there being no indication of it on the dorsal surface; thirdly, in the genus *Sphyrapus* Norman and Stebbing, one of the Apseudidæ, where the first two free segments are fused with the head; fourthly, in the genus *Ischnosoma* Sars, where the fourth and fifth segments are united to form a columnar center; and finally in the females of the Gnathiidæ where consolidation occurs in the fourth, fifth, and sixth segments.

In many Isopods the lateral parts of the segments are produced as broad plates on either side of the body, these plates being often distinctly separated dorsally, with the exception of the first, from the segments. They are the epimeral plates or coxopodites. These epimera in many genera are firmly coalesced with the segments with no sutures evident as an indication of their union. The epimera of several segments may be fused with the segments, while those of the following segments may be quite distinct. In many species of *Nerocila* Leach the epimera are very long and greatly produced, as is also true of all the deep-sea species of the Serolidæ, especially in the males, with the exception of *S. antarctica* Beddard.

The segments of the thorax are more or less equal in length, the greatest deviation in this respect occurring in the genus *Astacilla* Cordinor and in the genus *Arcturus* Latreille, where the fourth thoracic segment attains great development, being elongated to such a degree in *Astacilla* that it becomes equal to all the other six segments in length. *Næsa* Leach has the sixth segment of the thorax larger than the others and produced backward in a bidentate process. *Haswellia* Miers, also a genus of the Sphæromidæ, has the last thoracic segment produced in a broad plate or shield over and beyond the pleon.

In *Colanthura* Richardson the last segment of the thorax is abruptly so small and short that it might easily be mistaken for the first abdominal segment. Not only the last segment, but also the first, in the Gnathiidæ is very small, the last segment being hardly distinguishable from the segments of the abdomen.

1. Legs.—The legs are usually fourteen in number, arranged in seven pairs, one pair for each of the seven thoracic segments. The Gnathiidæ have but six pairs of these appendages, those of the last segment being wanting. This is also true of the following genera of Anthuridæ; *Hyssura* Norman and Stebbing, *Cruregens* Chilton, and *Colanthura* Richardson. The genus *Uropodias* Richardson is unique among the Armadilliidæ, and *Harponyx* Sars among the Cymothoidæ, in also lacking the appendages of the last thoracic segment. In all these cases this embryonic or larval character is permanently retained in the adult condition.

Many of the parasitic Isopods, such as the Epicaridea, differ markedly in their structure from the free forms of other Isopods. For example, the females of the family Dajidæ have but five pairs of thoracic feet, crowded together around the oral area, and *Branchiophryxus* Caullery, a recently described genus of the family, has but four pairs of legs present in the adult female. *Phryxus abdominalis* Krøyer, an Epicarid species, has all the thoracic legs present on one side of the body in the female, while on the other side they have all disappeared with the exception of the first.

There is no trace of thoracic feet in the females of the Cryptoniscidæ, parasitic on the Amphipoda and other Isopoda, the Ostracoda and the Cirripedia, especially a parasitic family of Cirripedes, the Rhizocephala.

The males of the Entoniscidæ have the seventh thoracic segment without appendages, the other six segments sometimes with rudimentary feet; the female also has rudimentary feet.

The legs are composed of seven joints. Beginning at the proximal end, or their point of attachment with the thorax, these joints are: The coxa or coxopodite, the basis or basipodite, the ischium or ischiopodite, the merus or meropodite, the carpus or carpopodite, the propodus or propodite, and the dactylus or dactylopodite. The dactylus is sometimes furnished with an ungulus, which may be uni-, bi-, or tri-fid. The females in the genus *Kepon* Duvernoy have the feet ending in inflated joints without unguli.

Variation in the number of joints is found among the Gnathiidæ where the first gnathopods are only two-jointed with the males, are "opercular, the first joint being a large pyriform plate, fringed with setæ on the convex inner margin and containing three semitransparent calcareous plates, supposed to indicate the same number of original joints."[a] In *Eucognathia gigas* (Beddard) the first gnathopods in the male are only six-jointed. *Chætelia* Dana has the sixth and seventh pairs of legs terminating in an extremity composed of numerous joints.

In many Isopods (Oniscoidea) the legs or periopods are all similar in shape and size and are ambulatory in character. Difference of structure is to be found, however, in other groups. The Tanaidæ, for example, have the first pair of legs or gnathopods transformed into chelipeds. The chelæ of the males are much stronger and more robust than those of the females, and in some genera, as *Leptochelia* Dana, they are greatly elongated in many of the species. In the Apseudidæ the first and second gnathopods are modified, the first pair

[a] Stebbing, History of Crustacea, 1893, p. 336.

being chelate, the second pair, with the exception of *Pagurapseudes* Whitelegge, terminating in a broad flat joint surrounded with numerous flattened spines. The Arcturidæ have the four anterior pairs of legs differentiated from the other three pairs; they are slender, feeble, directed forward, and strongly ciliated on their inner margins with long slender hairs; the last three pairs are entirely different in structure, being ambulatory in character.

The Munnopsidæ have the first pair of legs shorter than the three following pairs and prehensile in structure; the three following pairs are ambulatory and greatly elongated; finally, the last three pairs are fitted for swimming, being natatory in character, and have the two distal joints flattened and provided with numerous hairs and spines. Among the Janiridæ there is more or less modification in the structure of the first pair of legs in several genera. *Stenetrium* Haswell and *Jamna* Bovallius have the first pair of legs chelate, these being the only genera of this group which are so characterized. The genus *Carpias* Richardson, belonging to the same family, is remarkable for the greatly elongated first pair of legs and the peculiar development and enlargement of the joints. In many genera and some families of Isopods the first pair, the first two pairs, the first three pairs, or all the legs are prehensile, the propodus being enlarged or dilated and the dactylus reflexed.

The Serolidæ have the last pair of legs small and feeble in proportion to the others, correlated with the rudimentary condition of the seventh thoracic segment. In *Tanais stanfordi* Richardson the second pair of legs are small and feeble, although similar in structure to those following.

Munna neozelandica Chilton from New Zealand is a species in which the first gnathopods of the adult male have a remarkable form, with the second joint small, the third "very thick and strong, hollowed anteriorly to receive the distal end of the limb when bent back; carpus expanded distally, mallet shaped; propodus small and rounded."

In certain genera of the Apseudidæ, *Apseudes* Leach, *Parapseudes* Sars, and *Sphyrapus* Norman and Stebbing, there is a minute and inconspicuous two-jointed exopod at the base of the first and second gnathopods. The exopod is absent on the first pair of legs in *Pagurapseudes* Whitelegge. The genus *Leiopus* Beddard, belonging to this family, has a three-jointed exopod at the base of both pairs of gnathopods. The supposed function of these exopods is to keep a constant current of water in the branchial chamber, and they are in rapid movement in the living animal (Stebbing).

Papillose adhesive processes, which are supposed to represent exopods, are developed on the coxal joint of all the legs of *Kepon* Duvernoy and *Leidya* Cornalia and Panceri, although they are in a rudimentary condition on the last three pairs of legs in *Kepon*. In *Grapsicepon* Giard and Bonnier, the adhesive processes are oval, not warty. In *Cancricepon* Giard and Bonnier, these processes are rudimentary; in *Ergyne* Risso and *Portunicepon* Giard and Bonnier, they are strong and muscular.

2. *Marsupium*.—The marsupium or brood cavity of the female consists on its outer surface of lamellæ or plates affixed to the sides of the segments at the origin of the legs and overlapping on the ventral side in the median line. Sometimes the plates do not completely cover the eggs which are contained in the brood cavity, as in some of the parasitic Isopoda, the Bopyridæ, a large area being left which discloses the eggs. The lamellæ or oostegites, which are probably modified epipodites, are usually in pairs of four, one pair for each segment from the first to the fourth, inclusive, or from the second to the fifth, inclusive.

The Cymothoidæ differ in having five pairs of plates attached to the first five segments and small supplementary plates on the last two segments. The Cirolanidæ also have five pairs of lamellæ and supplementary ones issuing from the epignath of the maxillipeds.

In *Anthura* Leach the incubatory pouch extends over only three segments of the thorax—the third, fourth, and fifth. In *Astacilla* Cordiner, *Arcturella* Sars, *Tanais* Audouin and Milne Edwards, *Pseudotanais* G. O. Sars, *Cryptocope* Sars, and *Munnopsis australis* Beddard, it is confined to a single segment, being formed of only two plates attached to the fourth segment in *Astacilla* and *Arcturella* and to the fourth free segment, otherwise the fifth segment in the three genera of Tanaidæ mentioned. The Gnathiidæ have no true incubatory pouch.

The lamellæ in the Epicaridea are usually in pairs of five as in the Cymothoidæ. With some genera, as, for example, *Phryxus* Rathke, those of the two sides are very unequally developed, the plates on one side being much larger than those on the other side. In the Dajidæ the brood cavity extends as sacs along the sides of the body.

The young are retained in the marsupium for some time after they are hatched from the egg.

It has been pointed out that the structure of the incubatory lamellæ indicates that they have a respiratory function, and are, to a certain extent, branchial in character, assisting in the oxygenation of the blood.

D. ABDOMEN.

The abdomen, pleon or metasome, is typically composed of six segments, five short ones and a large terminal or caudal segment, which comprises the telson. The following modifications occur: The five anterior segments are coalesced with the caudal segment in the superfamily Asellota with the exception of the genus *Stenasellus* Dollfus, which has the first three segments free and well developed; in the following genera of Idoteidæ, *Stenosoma* Leach, *Synidotea* Harger, *Crabyzos* Spence Bate, *Glyptidotea* Stebbing, *Eusymmerus* Richardson, *Erichsonella* Benedict, *Epelys* Dana; in the Sphæromid genus *Cæcosphæroma* Dollfus; in the genus *Anarthrura* Sars, one of the Chelifera; and in the Cymothoid genus *Ourozeuktes* Milne Edwards. The pleon is also unsegmented in the males of the genera *Dajus* Krøyer and *Notophryxus* Sars, in the females of *Aspidophryxus* Sars, in the males and females of *Zonophryxus* Richardson, all belonging to the family Dajidæ. *Phryxus* Rathke has the pleon fused in the male, as is also the case with *Argeia* Dana, *Stegophryxus* Thompson, *Diplophryxus* Richardson, *Munnidion* Hansen, *Pargeia* Hansen, *Bathygyge* Hansen, *Pleurocrypta* Hesse, *Parapenæon* Richardson, and *Ergyne* Risso, all Epicarid genera. Segmentation is indicated at the sides of the pleon but not on the dorsal surface in the adult female of *Bopyrus* Latreille and *Bopyrina* Kossman. In the Arcturidæ the segments of the pleon are more or less coalesced.

The first five segments are united into one in the Sphæromidæ, which, together with the terminal segment, forms a biarticulate abdomen, the first segment of which usually bears suture lines at the sides indicating coalescence. There are two exceptions: *Sphæromides raymondi* Dollfus, supposed by Dollfus to be an archaic form, has all five segments anterior to the caudal segment free; *Cæcosphæroma* Dollfus also differs from the other Sphæromidæ in having all the pleonal segments fused to form a single segment. The fusion of the five anterior segments into one is characteristic of the Helleriidæ, two pairs of short lateral sutures marking off the third from the fourth, and the fourth from the fifth segments. The first five segments are also united in the females of *Anthura* Leach, and *Cyanthura* Norman and Stebbing, though in the male they are partially distinct. *Paridotea* Stebbing also has a biarticulate pleon.

The pleon in *Idotea* Fabricius, *Colidotea* Richardson, and *Synmius* Richardson is made up of two short segments and a large terminal segment.

The family Serolidæ, the genera *Edotea* Guérin-Méneville, *Zenobiana* Stebbing, *Chiridotea* Harger, and *Chætilia* Dana have the pleon composed of three short segments and a terminal segment. *Stenasellus* Dollfus also has three segments anterior to the caudal segment.

The following genera, *Cleantis* Dana and *Glyptonotus* Eights of the Idoteidæ, have a five-jointed abdomen, four short segments preceding the caudal segment. This is also true of *Tanais* Audouin and Milne Edwards, with the exception of *T. robustus* Moore.

In the Anthuridæ the sixth segment of the abdomen is usually distinct from the telson, as, for example, in *Anthura* Leach, *Anthelura*

Norman and Stebbing, at least in the type species, *Paranthura* Bate and Westwood, *Calathura* Norman and Stebbing, and *Cruregens* Chilton.

The members of the family Phrætoicidæ have the fifth segment of the abdomen longer than any of the four preceding segments, and the telson distinct from the sixth segment at the sides, but fused dorsally. The former character distinguishes the Cumacea, but is not found in any other of the Ispoda.

The lateral parts of the abdominal segments in the Bopyrid genus *Ione* Latreille are produced into branched appendages, which are jointed in some species.

1. Uropoda.—The uropoda are appendages of the last abdominal segment. In the Chelifera they occupy a terminal position and are multiarticulate. In this group there is usually a peduncular joint and either one or two jointed branches. The Oniscoidea and Asellota have terminal uropoda, but the branches in these tribes are usually not jointed but styliform. Of the last-named superfamily the uropoda are simple, consisting only of a single branch in the genera *Munna* Krøyer, *Leptaspidia* Bate and Westwood, *Munella* Bonnier, and *Janirella* Bonnier; they are single branched but two-jointed in *Desmosoma* Sars, *Munnopsis* Sars, *Echinopleura* Sars, *Macrostylis* Sars, *Ischnosoma* Sars, and *Ilyarachna* Sars; single-branched but from three to five-jointed in *Acanthocope* Beddard. The last-named genera of *Asellota* resemble the Chelifera in the jointed character of the uropoda.

Still more remarkable is the genus *Dendrotion* Sars, in which the uropoda issue from the dorsal surface of the caudal segment.

The Flabellifera or Cymothoidea have uropoda which occupy a lateral position, and consist of a basal joint and two more or less oval branches, an exopodite and an endopodite. One family in this tribe, the Anthuridæ, have one branch, the outer branch, occupying a superior position and arching over the telson. In the Sphæromidæ the inner branch or ramus is fixed and immovable, only the outer branch being free. *Cæcosphæroma* Dollfus differs from the other Sphæromidæ in having the uropoda united with or consolidated to the sides of the pleon on the under side, the union of both branches being sometimes complete or perhaps the exopodite may be visible but altogether rudimentary. *Scutuloidea* Chilton has the outer branch of the uropoda wanting; in *Cassidina* Milne Edwards the outer branch is rudimentary. *Codonophilus* Haswell, a Cymothoid genus, has but a single ramus to the uropoda. The genera *Anuropus* Beddard and *Branchuropus* Moore have submembranaceous branches which are concealed beneath the telson.

The uropoda in the Valvifera or Idoteoidea are transformed into opercular valves, which close like doors over the pleopoda, meeting in the median ventral line. These valves are affixed to the terminal segment only along the lateral margin, and when folded meet in the center.

The uropoda of the Tylidæ and Helleriidæ, both families of the tribe Oniscoidea, are also transformed into opercular valves which fold over the terminal segment, below the pleopods, however, while in the Valvifera they inclose the pleopods.

Many of the Epicarid genera are without appendages to the terminal segment of the body, as, for example, *Dajus* Krøyer, males; *Aspidophryxus* Sars, females only; *Notophryxus* Sars, males and females; *Zonophryxus* Richardson, males and females; the Cryptoniscidæ, females only; the Entoniscidæ, males and females; and the following Bopyrid genera, *Athelges* Hesse, males and females; *Pleurocrypta* Hesse, males; *Pseudione* Kossman, males; *Ergyne* Risso, males; *Argeia* Dana, males; *Bopyrus* Latreille, males and females; *Probopyrus* Giard and Bonnier, males and females; *Bopyrina* Kossmann, males and females; *Stegophryxus* Thompson, males; *Pargeia* Hansen, males; *Munnidion* Hansen, males; *Branchiophryxus* Caullery, males and females; *Bathygyge* Hansen, males; *Bopyroides* Stimpson, males and females; *Portunicepon* Giard and Bonnier, males; *Cancricepon* Giard and Bonnier, males; *Gyge* Cornalia and Panceri, males; *Phryxus* Rathke, males and females; *Parapenæon* Richardson, males.

In a number of the Epicarid genera the uropoda are single branched appendages. This is true of *Dajus* Krøyer, females; *Pleurocrypta* Hesse, females; *Pseudione* Kossmann, females; *Leidya* Cornalia and Panceri, males and females; *Kepon* Duvernoy, females; *Grapsicepon* Giard and Bonnier, females; *Cancricepon* Giard and Bonnier, females; *Portunicepon* Giard and Bonnier, females; *Ergyne* Risso, females; *Gigantione* Kossmann, males and females; *Ione* Latreille, males and females; *Argeia* Dana, females; *Parargeia* Hansen, females; *Cryptione* Hansen, males; *Entophilus* Richardson, males; *Gyge* Cornalia and Panceri, females. With this tribe of Isopoda it is the exception for the uropoda to be biramous, although they are double-branched in some genera.

2. *Pleopoda.*—Respiration is effected by means of pleopoda, appendages of the abdominal segments, usually in pairs of five, one pair for each of the first five segments. The pleopoda in general consist on each side of a basal segment carrying two lamellæ or rami. In the male the inner lamellæ of the second pair bears a slender stylet.

The first three pairs of pleopoda in the Serolidæ are natatory, the two following pairs branchial; in the Arcturidæ, the two anterior pairs are natatory, the three posterior pairs exclusively branchial. The pleopoda are natatory or branchial in the Gnathiidæ; they are adapted for both swimming and respiration in the tribe Flabellifera, with the exception mentioned. In the Asellota and the Epicaridea and for the most part in the Idoteidæ the pleopoda are exclusively branchial.

Quite a different mode of respiration is effected in the tribe Chelifera from what is found in the other Isopoda. The pleopoda are used for swimming and are never branchial in character, the respiratory function being carried on by means of branchial chambers situated under the sides of the posterior part of the carapace (Stebbing).

The Oniscidæ, a terrestrial family, have air sacs developed in the pleopoda, sometimes the opercular branch of two or three pairs being provided with tracheæ, and sometimes the opercular branch of all the pairs containing tracheæ. This adaptation is probably due to their aerial mode of life.

Certain genera of Chelifera are remarkable for having no pleopoda, as, for example, *Tanaella* Norman and Stebbing, *Strongylura* G. O. Sars, and *Anarthrura* G. O. Sars. This character is usually correlated with a fusion of the abdominal segments. The genera *Cryptocope* G. O. Sars, and *Haplocope* G. O. Sars have rudimentary pleopoda in the female. There are but three pairs of pleopoda in *Tanais* Audouin and Milne Edwards and in the genus *Parapseudes* Sars there are but four pairs. The genera *Pseudotanais* G. O. Sars and *Leptognathia* G. O. Sars have pleopoda which are all developed and ciliated or altogether absent in the female, but always fully developed and ciliated in the male. *Pagurapseudes* Whitelegge has never more than three pairs of pleopoda, often only one pair, especially in the female.

The first pleopoda are wanting in both the Tylidæ and the Helleriidæ and in the females of the Asellidæ. *Leiopus* Beddard, a genus of the Apseudidæ, has one of the branches of all the pleopoda two-jointed, and the genera *Phreatoicus* Chilton, *Phreatoicopsis* Spencer and Hall, and *Hypsimetopus* Sayce have the outer branch of the second and following pairs of pleopoda also two-jointed, this jointed character of the pleopoda not being found elsewhere among the Isopoda, though a feature of the Amphipoda.

In *Bathynomus* Milne Edwards there are supplementary ramified branchiæ at the bases of the pleopoda.

As previously stated, the inner branch of the second pair of pleopoda carries a stylet in the males. In the Ligiidæ, the Oniscidæ, the Trichoniscidæ, and the Armadillididæ both first and second pairs of pleopoda are sexual in the males, the inner branches of which are modified into sexual organs, those of the first pair often being coalesced in the Oniscidæ; in the females these branches are rudimentary.

In the Asellidæ the pleon in both sexes has the first pair of pleopods quite small, while the outer lamellæ of the second pair are very large, forming a sort of operculum, the lamellæ of which are not fused together in either sex. The female has four pairs of pleopoda; the male has five pairs, with an additional pair of very small biramous appendages immediately behind the first pleopoda.

In the Janiridæ, the Desmosomidæ, and the Munnopsidæ the first pair of pleopoda in the female forms a subcircular operculum, while in the male the first pair together with the second forms a compound operculum, consisting of a small oval plate on either side of a median elongated plate, divided by a central suture and terminating in two pointed lobes.

In the genus *Conilera* Leach the first pleopoda are opercular, with both branches hard.

Pleopoda are wanting in the following Epicarid genera: *Argeia* Dana, males only; *Bopyrus* Latreille, males; *Bopyroides* Stimpson, males; *Gyge* Cornalia and Panceri, males; *Bopyrina* Kossmann, males; *Pseudione* Kossmann, males; *Dajus* Krøyer, males; *Aspidophryxus* Sars, females and males; *Notophryxus* Sars, males and females; *Bathygyge* Hansen, males; *Athelges* Hesse, males; *Branchiophryxus* Caullery, males and females; *Zonophryxus* Richardson, males; *Stegophryxus* Thompson, males; *Diplophryxus* Richardson, males; *Portunicepon* Giard and Bonnier, males; *Parapenæon* Richardson, males; *Phryxus* Rathke, males; *Pleurocrypta* Hesse, males; *Ergyne* Risso, males; males of the Entoniscidæ. The pleopoda are represented by fleshy ridges in the females of *Bopyroides* Stimpson.

The pleopoda are rudimentary in the following genera: *Dajus* Krøyer, females (except the first pair); *Leidya* Cornalia and Panceri, males; *Bopyrus* Latreille, females; *Probopyrus* Giard and Bonnier, males; *Cancricepon* Giard and Bonnier, males; *Gigiantione* Kossmann, males.

In some Bopyrid genera the appendages of the pleon are three-branched, as for example: *Phyllodurus* Stimpson, females; *Stegophryxus* Thompson, females; *Crancricepon* Giard and Bonnier, females; *Grapsicepon* Giard and Bonnier, females, has the appendages of the first four segments three-branched, those of the fifth segment biramous; *Stegias* Richardson, females, has the pleopoda of the first three segments three-branched, those of the last two segments two-branched.

Diplophryxus Richardson, females, has the pleopoda four-branched, eight for each of the four abdominal segments.

The appendages of the pleon are coarsely pinnate or fringed in *Grapsicepon*[a] Giard and Bonnier, *Leidya* Cornalia and Panceri, *Portunicepon*[a] Giard and Bonnier, and *Ergyne* Risso. In *Crancricepon*[a] Giard and Bonnier, the dorsal branch of the pleopoda is tubercular.

In a number of Epicarid genera the pleopoda are single-branched in the adult female.

3. INTERNAL ANATOMY.

In the typical form the alimentary canal is a straight tube, without convolutions. It consists (1) of a short, muscular œsophagus lined

[a] The dorsal branch in these genera is not homologous with the epimeral lamellæ of the abdomiral segments of *Ione* Latreille and *Kepon* Duvernoy.

with ectoderm; (2) a stomach also lined with ectoderm and provided with a "gastric mill," which is a chitinous apparatus consisting of nine plates, seven of which lie in the anterior part, two in the floor of the stomach; (3) an elongate intestine, more or less dilated at its anterior extremity, and lined for the most part with ectoderm, the endodermal portion extending but a short distance from its anterior connection with the liver lobes. There is no cæcal enlargement at its posterior extremity. The liver lobes or hepatic cæca consist of four elongate, more or less coiled, backwardly directed tubes, opening into the alimentary canal at the union of the stomach and the intestine.

The heart is an elongate tube, varying in length in the different groups, and situated in the pleon for the greater part, except with the Chelifera, where it occupies a position in the anterior part of the thorax. In the Asellidæ the heart is confined to the thorax, extending from the pleon forward. Surrounding the heart is a pericardium of connective tissue, a cavity or chamber intervening, in which the blood freely circulates. One, two, or three pairs of ostia place the heart into communication with the pericardial cavity. From the anterior extremity the dorsal aorta arises, sometimes being constricted off from the heart, and then again being simply an extension of the heart forward, with no differentiation of the two parts, the one vessel gradually becoming narrower from the posterior to the anterior extremity. Considerable variation exists in the manner in which the aorta subdivides. In some cases it extends forward to the lower lip without branching, arteries arising from the heart itself supplying the various parts of the body. It may divide very near the heart, each branch giving off arteries, or some little distance from the heart, or it may continue as a straight tube, giving off branches in each segment. Two valves open into the aorta from the heart. In position the main part of the circulatory system lies dorsal to the alimentary canal.

The nervous system consists of a brain or supra-œsophageal ganglion, composed of a number of more or less fused ganglia, connected by œsophageal commissures with an infra-œsophageal ganglion; from the infra-œsophageal ganglion there extends a double ventral nerve cord, connected by double ganglia more or less fused and inclosed in a single nerve sheath, one ganglionic mass being present in each segment of the thorax, the abdominal ganglia being more or less fused, so that from the fused mass it would be impossible to tell the number of corresponding abdominal segments. Commissural nerves are given off in each segment from the ventral nerve cord.

Lying in between and parallel to the commissures connecting the thoracic ganglia in the region of the thorax is a nerve which has been referred to the sympathetic system. It does not pass over the ganglia in each segment, but is fused with each anteriorly and starts again on the other side. At its union with the ganglia fibers extend to the commissures on either side.

From the anterior portion of the supra-œsophageal ganglionic mass two pairs of nerves are given off to the antennæ and antennules. They arise independently from the brain. Some little distance back of these is the place of origin of the optic nerves, which supply the eyes. From the central ganglionic masses of the ventral nerve cord branches go to two lateral ganglionic plexuses, lying under the hypodermis, which are the elements of the peripheral nervous system.

The visceral nervous system consists of an anterior and a posterior division. The anterior system starts from the circum-œsophageal commissure and innervates the œsophagus, stomach, and liver. There is a ganglion near the upper lip and one in front of the stomach. The posterior system has its origin in the fused abdominal ganglia and has no ganglionic differentiation.

The reproductive organs are paired organs lying on either side of the body in the region of the thorax and open by means of ducts at the base of the fifth pair of legs in the female, the male duct opening at the posterior margin of the seventh thoracic segment.

Respiration is effected by means of some or all of the branches of the pleopoda, these branches being thin and vascular in structure and acting as gills in aerating the blood.

4. DEVELOPMENT.

Within the last few years, Dr. J. P. McMurrich[a] has made a thorough and exact investigation of the development of some of the Isopods, having studied *Jæra*, *Asellus*, *Ligia*, *Cymothoa*, *Porcellio*, and *Armadillidium*.

He proved conclusively that the segmentation of the egg is centrolethical, the cells formed by the centrally situated segmentation cell gradually migrating to the surface and inclosing the yolk. The original centrally situated single cell is stellate in shape, with protoplasmic fibrils extending from it to the peripheral layer of protoplasm. The egg is inclosed in two membranes, the chorion, which surrounds it before the polar bodies are given off, and the vitelline membrane, which is formed by the activity of the protoplasm of the egg, during the period occupied by the maturation of the ovum.

The first plane of segmentation lies at right angles to the long axis of the egg, the division effecting only the centrally situated cell. The daughter cells thus formed remain connected by protoplasmic strands. The second division results in the formation of four stellate cells, the two pairs rotating through an angle of forty-five degrees; the cleavage in this stage bears most resemblance to the spiral form. The third division results in the formation of eight stellate cells. The next stage is the sixteen-celled stage. In the thirty-two-celled stage the cells

[a] Journal of Morphology, XI, 1895, pp. 63–155 from which this account is taken.

finally reach the periphery, when segmentation first begins to appear on the surface. The egg now becomes a syncytial blastula, the cavity being completely filled with yolk. At this stage the histological differentiation of cells is very complete, although it is indicated in the preceding stage. In *Jæra*, four cells, termed the vitellophags, occupy the posterior pole. Surrounding them is a circle of twelve cells, the mes-endoderm cells. The sixteen ectoderm cells are scattered over the remainder of the surface of the egg. In the next stage, the sixty-four-celled stage, the vitellophags have increased to eight in number, the mesoderm cells forming a double ring around them, each ring consisting of twelve cells, and the number of ectoderm cells is doubled. In the succeeding stage the vitellophag cells do not take part in the division. One cell of the posterior circle of mes-endoderm cells divides in a different plane from the others, and one of the daughter cells probably gives rise to the endoderm which forms the liver lobes. In *Asellus* the differentiation of vitellophags from the mes-endoderm is distinct at first but becomes inconspicuous later, and the differentiation of the liver endoderm is questionable. In *Armadillidium* and *Porcellio* no differentiation of the three parts of the mes-endoderm is recognizable, although the mes-endoderm in these forms is equivalent to the mesoderm, the liver endoderm, and the vitellophags as found in *Jæra*.

In the next stage the cells of the mesoderm, endoderm, and ectoderm increase in number and migrate to the ventral surface where the embryo is to be formed. The concentration of the mesoderm cells results in the formation of a mesoderm plug, which becomes gradually covered by ectoderm cells, the teloblasts, arising from the posterior row of ectoderm cells, and arranged in regular longitudinal and transverse rows. When the mesoderm plug is about half covered with ectodermal teloblasts, the vitellophags in *Jæra* begin to migrate into the interior of the yolk. The ectoderm cells of the anterior portion of the body, together with the mesoderm cells, contained in the mesodermal plug, which has gradually migrated and become distributed in that region, represent the naupliar part of the embryo. The liver endoderm migrates also to this region with the mesoderm. The posterior or metanaupliar region lies behind it and has resulted by the growth of the teloblasts.

The mesoderm cells in the naupliar region, lying beneath the ectoderm cells, become arranged in two divergent bands. In *Jæra* a transverse band joins the anterior ends of the two lateral bands, but this is not distinct in the other forms. As the appendages bud out the mesoderm cells migrate into their interior, forming a solid support for them. The liver lobes, formed from the liver endoderm, begin to appear about this time as hollow spheres, open toward the yolk, one on either side at the level of the first maxillæ.

The metanaupliar mesoderm is produced by teloblastic growth. The mesoblast cells become arranged in a very definite manner in transverse rows. Each row of cells is equivalent to a segment. The mesoderm cells divide more rapidly in the anterior segments, resulting in the formation of masses of cells on either side of the median line corresponding to the limb buds, which appear on all the segments anterior to the last seven. The last seven represent the six abdominal segments and the telson, the sixth abdominal segment in the adult being fused with the telson in all Isopods.

The limb mesoderm and the mesoderm of the lateral masses, which lies on either side of the limb mesoderm, become converted into muscle and a certain amount of connective tissue.

The liver lobes unite eventually with the posterior end of the stomodeal invagination, or stomach, and the anterior end of the proctodeal invagination or intestine. The stomodeal invagination appears early and comes to lie between the antennules and the antennæ. As the invagination deepens into the yolk, the posterior extremity enlarges to form the stomach, the posterior extremity of the stomach uniting with the liver lobes. The proctodeal invagination occurs later than the stomodeal invagination. It appears first as a patch of cells lying behind the teloblasts.

The vitellophags take part in the formation of connective tissue, muscle tissue, blood corpuscles, and perhaps even the heart. The vitellophags are therefore mesoderm cells.

The cerebral ganglia, the antennary ganglia, and the antennular ganglia of the nauplius fuse to form the syncerebrum of the adult.

The young leave the brood pouch with the last pair of legs undeveloped. In most Isopoda there is no metamorphosis, the young being similar to the adult. A transformation occurs in the family Gnathiidæ; the young when they leave the incubatory pouch are very unlike the adult males, but bear some resemblance to the female, though more slender. Larval forms exist also in some of the parasitic Isopods. The Cymothoidæ have several different larval stages; the body of the young is more symmetrical than that of the adult, the animal apparently losing its symmetry on assuming a parasitic mode of life.

The early development and larval forms of the Epicaridea, a parasitic tribe, have been most earnestly investigated by Giard and Bonnier. These authors write that the mode of segmentation in the forms they have studied belonging to this tribe is holoblastic, the segmentation of the egg being complete and unequal, and resulting in the formation of an epibolic gastrula.[a] The first free larva, which they call

[a] Prof. L. Roule also makes this statement about the egg of *Asellus* and *Porcellio*, but Dr. McMurrich has pointed out that his observations are erroneous. Although Giard and Bonnier have figured an eight-cell stage of the egg of *Portunion*, in which the segmentation appears to be complete and unequal, there may have been some error of observation, and until more thorough work is done on this group it is not wise to accept the results so far obtained, which are so very different from what has been found to be true of the other Isopods.

the larva of the first stage, is a free-swimming form, resembling the nauplius stage of other Crustacea. Death occurred with all the larvæ of the first stage at the critical moment when the transformation into the Cryptoniscian larva, or larva of the second stage was expected to take place. Giard and Bonnier infer from this that it is highly probable that under this form (the Cryptoniscian larva) the parasite penetrates into the branchial cavity of its host, where it becomes transformed into the adult.

Sars has pointed out that there is an intermediate larval stage between these two stages, and that this stage is the Microniscus stage. He has shown that a true *Microniscus* develops from the first stage of a normal Bopyrid larva, and that another form of *Microniscus* after having attained its normal development is transformed into the well-known second larval stage or Cryptoniscian stage; that these two forms of *Microniscus*, though similar in appearance, belong to two different families of Epicaridea. Therefore he maintains that *Microniscus*, which has been thought heretofore to represent a distinct genus, the type of the family Microniscidæ, must in the future be regarded as a transitory stage of development common to all Epicaridea. He is inclined to think that this stage is always parasitic on Copepoda.

The Cryptoniscian larvæ develop into adult males and females, the females passing through a transitory stage of hermaphroditism. The larvæ of the first stage and of the Cryptoniscian stage have but six pairs of legs, except in the Epicaridea, where the Cryptoniscian larvæ have seven pairs. The adult male in the Entoniscidæ has but six pairs of legs, due to retrogressive development.

5. SIZE.

The largest known Isopod is *Bathynomus giganteus* A. Milne Edwards from the Gulf of Mexico. This form is 11 inches in length and belongs to the family Bathynomidæ. Other very large Isopods are *Chiridotea sabini* (Krøyer) and *Chiridotea entomon* (Linnæus).

Perhaps the smallest Isopods are found among the Tanaidæ, the Apseudidæ, the Janiridæ, and the Gnathiidæ. Some of these forms are only 2 mm. in length.

Between these two extremes, 2 mm. and 11 inches, Isopods of various intermediate sizes are known.

6. HABITAT.

According to their habitat the Isopods are classified as marine, fresh-water, and terrestrial.

The Oniscoidea are mostly land forms, having air sacs developed in their pleopoda, fitted for the respiration of air. As members of this tribe *Haplophthalmus puteus* Hay, from an old well at Bloomington, Indiana, *Trichoniscus cavernicola* Budde-Lund, from grottos in the

Pyrenees, and *Trichoniscus stygius* Nemec, from a Gabroviza grotto near Trieste, are exceptions.

The family Asellidæ includes only fresh-water forms. *Janirella* Bonnier, a recently described genus, containing a single species from the Gulf of Gascony, is the only marine member of this family. The tribe Phreatoicoidea, represented only in Australia and Tasmania, has until recently had assigned to it only fresh-water forms, *Phreatoicus typicus* Chilton being obtained from a pump at Eryeton, New Zealand, *Phreatoicus assimilis* Chilton from wells at Winchester, South Canterbury, New Zealand, *P. australis* Chilton coming from Mount Kosciusko, in Australia, at a place known as Pipers Creek, *Phreatoicus shephardi* Sayce, and *Phreatoicoides gracilis* Sayce, all being found in fresh water. Two terrestrial forms have recently been described, belonging to two different genera of this family having affinities to the previously known genera, *Phreatoicopsis terricola* Spencer and Hall, and *Hypsimetopus intrusor* Sayce, the last-named species being found in the burrows of the land crayfish *Engæus cunicularus*, the former species leaving casts in the burrows and chambers in which it lives.

Other fresh-water species are: *Heterias*[a] *pusilla* (Sayce) and *Jæra guernei* Dollfus, the only two fresh-water forms of the family Janiridæ; *Cirolanides texensis* Benedict from an artesian well at San Marcos, Texas; *Cruregens fontanus* Chilton, the only known species of *Anthuridæ* that is not marine, being found in an old well at Eryeton, New Zealand; *Idotea lacustris* Thompson from New Zealand; *Cleantis linearis* Dana from the Rio Negro River, Patagonia; *Alitropus* (?) *typus* (Von Martens) from the Kapaus River at Sintang, in Borneo; *Telotha henselii* (Martens) from the Rio Cadea, in Brazil; *Ichthyoxenos jellinghausi* Herklots from a fish in the river Tjikerang, in Java; *Livoneca daurica* Miers from a river in Dauria (region), Siberia; *Olencira prægustator* (Latrobe) from rivers in the eastern part of North America, especially the Potomac; *Cymothoa amurensis* Gerstæcker from a tributary of the Amur River, Asia; *Nerocila fluvialis* Schiœdte and Meinert from the Rio Plata River, near the city of Montevideo, Uruguay; *Lathræna insidiosa* Schiœdte and Meinert from a river near Santos, Brazil, at its exit into the sea; *Asotana formosa* Schiœdte and Meinert from the river Ica, in Peru; *Ceratothoa laticauda* Milne Edwards from the Continguiba River; *Ichthyoxenus montanus* Schiœdte and Meinert from streams in the Himalayan Mountains; *Artystone trysibia* Schiœdte from the La Plata River, in South America; *Chætilia ovata* Dana from the Rio Plata, Patagonia; *Pseudione* [*Palægyge*] *borrei* (Giard and Bonnier), a parasitic Bopyrid found on a fresh-water species *Palæmon dispar* Von Martens; *Pseudione* [*Palægyge*] *fluviatilis* Max Weber, and some forms belong-

[a] For the preoccupied *Janirella* Sayce.

ing to the genus *Probopyrus* Giard and Bonnier. The list of fresh-water Sphæromidæ is large for a marine family, and includes the following forms belonging to the genera *Sphæroma* Latreille, *Cæcosphæroma* Dollfus, and *Sphæromides* Dollfus: *Sphæroma dugesi* Dollfus from a warm spring in New Mexico; *S. thermophilum* Richardson from a warm spring in New Mexico; *S. destructor* Richardson from St. Johns River, Palatka, Florida; *S. fossarum* Von Martens from a swamp; *S. rugicauda* Leach from brackish waters in Europe; *Sphæromides raymondi* Dollfus from subterranean waters; *Cæcosphæroma virei* Dollfus and *C. burgundum* Dollfus from waters in grottos of the Jura; *C. faucheri* Dollfus from subterranean waters near the village of Sauve; and *Monolistris cæca* Gerstæcker.

With these exceptions all the forms belonging to the Chelifera, the Flabellifera, the Valvifera, the Asellota, and the Epicaridea are marine.

The Ligiidæ, a family of terrestrial Isopoda, are littoral forms, and are found around wharf piles and under rocks and stones along the shore. Prof. A. E. Verrill says of *Ligia baudiniana* Milne Edwards:

> At the Bermudas the *Ligia* occurs in great abundance on the ledges and cliffs along all the shores. It runs with surprising activity and quickly seeks refuge in the cracks and crevices of the ledges, so that it is not easy to capture without injury.

7. FOOD.

Mollusks, Annelids, Crustacea, and fish seem to be the chief food of the marine Isopods. The species *Cirolana concharum* (Stimpson) is known to feed on the blue crab. From a single crab as many as 108 specimens of this form have been taken. It is recorded that the dog-fish *Squalus acanthias* has been reduced to a skeleton by *Conilera cylindracea* (Montagu). The Isopods feed not only on the dead animal, but the living animal is also their prey.

It is supposed that the food of the fresh-water Isopods consists mainly of Infusoria.

The stomachs of certain of the land Isopods have, on examination, been found to contain moss cells, algæ, etc., so that a vegetable diet is in some cases substituted for an animal diet. The Serolidæ are strongly suspected of cannibalism (Stebbing).

8. HABITS.

Very little is known about the habits of the Isopoda, except as they are destructive. It is a well-known fact that the Isopod, *Limnoria lignorum* (Rathke) commonly called the "gribble," attacks wood by boring small holes, causing much damage to bridges, piers, etc. It has also been seen attacking the gutta-percha of submarine telegraph cables.

There are two species of the genus *Sphæroma* which have this same destructive habit. *Sphæroma vastator* S. Bate comes from the Indian Peninsula, where it was procured "from a piece of wood which had formed part of a railway bridge over one of the backwaters of the west coast." The wood is described as being "honeycombed with cylindrical holes, in many of which the animal was rolled up like a ball." *Sphæroma destructor* Richardson was found boring the piers on St. Johns River, at Palatka, Florida. Sections of the wood showed that the diameter had been reduced during a period of eight years from 16 inches to 7½ inches. The whole surface of the wood was bored with holes averaging in size about 5 mm. in diameter, and in an end section the holes were arranged in concentric rings between the rings of annual growth, showing the little animals' preference for the soft pine. Very strong mandibles, projecting beyond the labrum most conspicuously, provide a perfect equipment for this destructive work.

In decided contrast to the above-mentioned habits, Hallez has recently pointed out some of the beneficial work of these little creatures. He has found that *Eurydice pulchra* Leach is the principal agent in maintaining the healthfulness of the coast at Portal, France. Shark fishing is an important industry of the people of Portal, who consume a great many of these fish and export a large number of them to Paris. The heads of the fish are thrown on the beach, but they are instantly surrounded by the little crustacea which leave only the cartilaginous skeleton.

Hallez believes that each locality has a species especially adapted to the conditions of the place for carrying on this sanitary work along the coast.

9. MODE OF LIFE.

Many of the Isopods are ectoparasites. The Cymothoidæ and Ægidæ are found attached to the fins and gills and in the mouths of fishes. Some of the Cirolanidæ are also parasitic on fish. Dr. Goode said of *Olencira prægustator* that these forms are not parasites in the true sense of the word, drawing nourishment from the fish to which they attach themselves; they are commensal rather, stealing shelter and transportation, but not subsistence. When the fish to which they are attached die, they change their quarters and seek a new host. *Olencira prægustator* (Latrobe) is a very abundant parasite, infesting a large per cent of the menhaden from the Potomac.

Ægathoa loliginea Harger was obtained from the mouth of a squid. Other specimens, however, have been found parasitic on young mullet, showing that the species is not parasitic solely on the squid.

Parasitism is the mode of life chiefly with the Epicaridea. The family Bopyridæ infest the shrimps and crabs, and are found either attached to the abdomen of the host or within the branchial cavity, beneath the carapace. A crab or shrimp thus infested is readily detected by the large swelling or protuberance at one side of the body. A new genus of Bopyridæ is described in the following pages, which occupies a position in the visceral chamber of a species of *Munida*, this position with reference to the host never having been heretofore recorded of a parasite of this family. The Entoniscidæ, parasitic on the Brachyura, always occupy the visceral cavity of the body of the host, entering through the branchial cavity.

The Dajidæ are found attached to Schizopoda, and usually occupy a position on the back of the host, but they may also attach themselves on the ventral side to the branchiæ of the gill chamber or to the abdomen on the dorsal side. The Cryptoniscidæ are parasitic on Amphipods, other Isopods, Ostracoda, Cirripedia (usually the parasitic Cirripedia known as the Rhizocephalia), and are sometimes found in the incubatory pouch of deep-water Mysidæ.

One host may carry as many as four parasites. Dr. Fraisse found a *Peltogaster*, a *Cryptoniscus*, an *Athelges*, and a *Pseudione* on one Pagurid. One branchial and one abdominal parasite, or two branchial parasites, one on either side of the body, is not uncommon.

Other abiding places for shelter and protection are found by other Isopods. The Anthurid *Eisothistos vermiformis* Haswell occupies the tube of a *Vermilia*, and in the elongated shape of the body and the smallness of the limbs resembles the original occupant. The posterior part of the body, with its expanded appendages, serves well to imitate the branchiæ of the head region of the *Serpula*, which issues from the free end of the tube, the Anthurid entering the tube in the reverse direction from its former occupant, with head foremost.

Æga spongiophila Semper lives in a silicious sponge. Species belonging to the genus *Titanethes* Schiœdte are found in caverns; species of *Platyarthrus* Brandt are myrmicophile forms, dwelling in ants' nests, and *Leptaspidia brevipes* Bate and Westwood was first found in the fibrous nest of a mollusk.

The species belonging to the genus *Cleantis* Dana are supposed to be tube dwellers.

Ichthyoxenus jellinghausii Herklots bores a hole in the body of the fish, *Puntius maculatus* Bleeker, just behind the fins, where it lives with its mate (Stebbing).

Many Isopods are confined to caves, and lead a subterranean life. *Cæcidotea stygius* Packard was first found in Mammoth Cave; it has been recorded from Wyandotte Cave also (it is not confined to caves); *Cæcidotea richardsonæ* Hay comes from Nickajack Cave, as well as *Cæcidotea nickajackensis* Packard; *Brackenridgia cavernum* Ulrich comes from Ezell's cave and Beaver Cave near San Marcos, Texas; species of the genus *Cæcosphæroma* Dollfus seem to be confined to grottos, being found in subterranean waters; *Sphæromides raymondi* Dollfus comes from subterranean waters in a Cevennes grotto; *Tricho-*

niscus cavernicola Budde-Lund from grottos in the Pyrenees; *Asellus cavaticus* Schiœdte from subterranean waters in Central Europe; *Trichoniscus stygius* Nemec from a Gabroviza grotto near Trieste (probably identical with *Typhloniscus stygius* Joseph, according to Nemec, who, however, considers the species a true *Trichoniscus*), and *Stenasellus virei* Dollfus from subterranean waters (wells) near Cevennes, at a depth of 150 meters.

10. BATHYMETRICAL DISTRIBUTION.

Many of the marine forms are found floating on algæ or swimming freely near the surface of the water. Below the surface they have been taken from depths ranging from 1 to 2,040 fathoms. Among the deep-sea forms, the species *Apseudes gracilis* Norman and Stebbing may be mentioned; it comes from a depth of 1,450 to 1,785 fathoms, and is confined to the deep waters of the North Atlantic. The families which are known to descend below 1,000 fathoms in the North Atlantic are—[a]

Apseudidæ	Genera *Apseudes*, *Sphyrapus*.
Tanaidæ	Many genera.
Anthuridæ	Many genera.
Gnathiidæ	Genus *Gnathia* (*Anceus*).
Cirolanidæ	Genus *Cirolana*.
Idoteidæ	Genus *Chiridotea*.
Asellidæ	Genus *Nannoniscus*.
Arcturidæ	Genus *Astacilla*.
Munnidæ	Genera *Ischnosoma*, *Macrostylis*.
Munnopsidæ	Genera *Munnopsis*, *Ilyarachna*, and *Eurycope*.

In the Southern Sea the Serolidæ have been found distributed over a wide area in very deep waters, descending to 2,040 fathoms.

Æga maxima Hansen, from Cocos Island, comes from a depth of 1,175 fathoms; *Astacilla cæca* Benedict, from off Maryland, was taken at a depth of 1,825 fathoms, and *Pseudione tuberculata* Richardson, from Port Ortway, Patagonia, comes from a depth of 1,050 fathoms.

One of the characteristic features of the deep-sea forms, or "Bassalian animals," is their distribution over wide areas.

11. GEOGRAPHICAL DISTRIBUTION.

The influence of temperature has been considered of paramount importance in the distribution of life in the seas.

According to Prof. James D. Dana, the preponderance of species is in the Temperate Zone, or Pararctalian and Notalian Realms.[b] Species outside of the Tropical Zone or Tropicalian Realm[b] are of the highest rank and usually the largest of the order, the giant forms, such as

[a] For above list refer to Stebbing, Trans. Zool. Soc. London, XII, Pt. 4, 1886, p. 1.

[b] The above nomenclature was suggested by Dr. Theodore Gill for the primary marine regions or realms in place of the zones used by Dana. Proc. Biol. Soc. Washington, II, 1885, pp. 1–66.

Chiridotea sabina (Krøyer), *Chiridotea entomon* (Linnæus), and *Glyptonotus antarticus* Eights[a] being found in the Frigid Zone or Arctalian Realm.[b]

The Sphæromidæ are nearly all cold-water species, though not reaching into the Arctalian Realm. *Sphæroma thermophilum* Richardson, from a warm spring in New Mexico, and *S. dugesi* Dollfus, also from a warm spring in New Mexico, are exceptions.

The Idoteidæ are the most decidedly cold-water forms, the Cymothoidæ and the Corallanidæ the least so.

The following genera extend into the Arctalian Realm: *Idotea*, *Glyptonotus*, *Jæra*, *Janira*, *Munna*, *Æga*, *Serolis*, *Gnathia*, *Arcturus*, *Tanais*, *Liriopsis*, *Phryxus*, *Dajus*, *Chiridotea*, *Cryptocope*, *Leptognathia*, *Sphyrapus*, *Synidotea*, *Astacilla*, *Munnopsis*, *Eurycope*, *Calathura*, and *Bopyroides*.

In the Pararctalian and Notalian realms there is a commingling of forms from the Arctalian, Antarctalian, and Tropicalian realms.

Some of the terrestrial Isopods are very widely distributed, such well-known species as *Armadillidium vulgare* (Latreille), *Porcellio lævis* (Latreille), *Porcellio scaber* (Latreille), *Oniscus asellus* Latreille, and *Metoponorthus pruinosus* (Brandt) being cosmopolitan and found all over the world.

Many of the marine forms from the coast of Norway, England, and the Atlantic coast of Europe, and from the Mediterranean are carried by the Gulf Stream along the Atlantic coast of North America and are found on the coast as far south as the West Indies and the Bermudas. Among the number on record from European waters found on the Atlantic coast of North America may be mentioned: *Idotea metallica* Bosc, *Rocinela maculata* Schiœdte and Meinert, *Æga ventrosa* M. Sars, *Æga arctica* Lütken, *Sphyrapus malleolus* Norman and Stebbing, *Æga webbii* (Guérin), *Synidotea bicuspida* (Owen), *Calathura branchiata* (Stimpson), *Cyathura carinata* (Krøyer), *Æga psora* (Linnæus), *Cirolana concharum* (Stimpson), *Idotea marina* (Linnæus), *Jæra marina* (Fabricius), *Arcturus baffini* (Sabine), *Cirolana borealis* Lilljeborg, *Gnathia elongata* (Krøyer), *Astacilla granulata* (Sars), *Æga crenulata* Lütken, *Cryptocope arctica* Hansen, *Leptognathia longiremis* (Lilljeborg), *Conilera cylindricea* (Montagu), *Leptochelia savignyi* (Krøyer), *Eurycope cornuta* (Sars), *Munnopsis typica* M. Sars, *Janira maculosa* Leach, *Munna fabricii* Krøyer, *Munna kroyeri* Goodsir, *Limnoria lignorum* (Rathke), *Tanais cavolinii* Milne Edwards, *Leptochelia dubia* (Krøyer), *Jæra albifrons* Leach, *Æga incisa* Schiœdte and Meinert,

[a] *Bathynomus giganteus* Milne Edwards coming from the Caribbean Sea is not an exception, because it is found at great depths, where the temperature of the water is very low.

[b] The above nomenclature was suggested by Dr. Theodore Gill for the primary marine regions or realms in place of the zones used by Dana. Proc. Biol. Soc. Washington, II, 1855, pp. 1–66.

Syscenus infelix Harger, *Rocinela dumerili* (Lucas), and *Dajus mysidis* Krøyer.

Chiridotea sabini (Krøyer) is a circumpolar species, having been recorded from the Pacific coast of North America, Greenland, the Siberian Polar Sea, the Kara Sea, and Franz-Josef Land (Sars). *Synidotea nodulosa* (Krøyer) is also circumpolar and occurs along the west and east coasts of North America.

Some of the Bopyridæ have a wide distribution. *Phryxus abdominalis* (Krøyer) has been recorded from the coast of Norway, from Greenland, and from the Atlantic and Pacific coasts of North America, the various species of host which it infests being circumpolar. *Bopyroides hippolytes* (Krøyer) is found also on both coasts of North America, the form from the west coast having been described by Stimpson under the name *acutimarginata*.

It is interesting to note the similarity between several of the species found on the Atlantic coast of North America and those of the Pacific coast, the differences separating them being very slight. Hansen has pointed out the close resemblance of his two species *Æga maxima*, from Cocos Island, and *Æga acuminata*, from the Galapagos Islands, to *Æga psora* (Linnæus) from the Atlantic coast; of his species *Æga plebeia* from Cocos Island and the Galapagos Islands, to *Æga ventrosa* Sars from the coast of Greenland; of his species *Rocinela modesta*, from the Gulf of Panama to *Rocinela maculata* Schiœdte and Meinert, from Greenland, and of his species *Rocinela laticauda* from the coast of Mexico to *Rocinela australis* Schiœdte and Meinert from the Straits of Magellan. *Rocinela affinis* Richardson from Japan also presents striking resemblances to *Rocinela oculata* Harger from the Atlantic coast of North America. *Cilicæa caudata gilliana* Richardson and *Dynamene tuberculosa* Richardson from the Pacific coast are quite similar to forms from the Atlantic coast, *Cilicæa caudata* (Say) and *Dynamene bermudensis* (Ives) from the Gulf of Mexico, Yucatan, and the Bermudas.

A rather remarkable instance of a shallow-water organism coming from two very remote localities is that of *Leptochelia minuta* Dana. The type species of this form was obtained from the Fijis, at the island of Ovalau, from among seaweed and small corals. A few years ago this species was again recorded by Stebbing, but this time from the West Indies, at Long Island, where it was found in shallow water covered with algæ.

In the present paper record is made of a species *Æga deshaysiana* (Milne Edwards) known to West Indian waters, being obtained by the U. S. Fish Commission steamer *Albatross* at the Hawaiian Islands.

In explanation of these facts Dr. Gill has said:

> The inference is irresistible that such types have migrated from common ground, and may have originally developed either in the deep sea and thence dispersed in opposite directions, or at one of the extremes, and wandered thence over the bottom to their final resting places.

12. SECONDARY SEXUAL CHARACTERS.

In many cases the males and females are alike in general characters, although there may be slight differences in size and proportions. In some instances, however, differences occur of the following nature: the antennæ in the males may be longer than in the females; this is true of the Ligiidæ for example. The males of *Ligia baudiniana* Edwards also have a fringe of bristles or stiff hairs along the carpus and the merus of the first pair of legs, which character is entirely wanting in the females. *Ligia exotica* Roux is provided with a process extending from the propodus of the first pair of legs in the males, this process being absent in the females. The males of *Corallana tricornis* Hansen, *Corallana quadricornis* Hansen, and *Corallana sexicornis* Richardson have in the first species named three spines on the dorsal surface of the head, in the second species four spines on the head, and in the third species four spines on the head and two on the basal joints of the antennulæ, the head of the female in all these species being entirely unarmed.

Among the Tanaidæ and the Apseudidæ the first pair of legs of the males are much more robust and very much larger than those of the females, although they are usually similar in structure. The males of several species of the genus *Leptochelia* Dana have greatly elongated first gnathopods and antennæ while the same appendages in the females are greatly reduced.

The genera of the Janiridæ, in which the first pair of legs of the males is different in structure from the other pairs, show a similarity in structure in all seven pairs with the females. *Carpias bermudensis* Richardson, which presents this tendency in the extreme, being remarkable for the great size and peculiar structure of the first pair of legs, exhibits no peculiarities of this kind in the female. The legs of the first pair in the species, *Stenetrium stebbingi* Richardson, differ in form from those of the female, both, however, being chelate in character.

In the Sphæromidæ the genus *Cilicæa* Leach has the first abdominal segment in the male produced in a long spine or process, which, according to Haswell, is sometimes wanting in the female. The males of the genus *Isocladus* Miers have the seventh thoracic segment produced in a long spine, which is not developed in the female. *Cycloidura* Stebbing, an Australian genus of the Sphæromidæ, has the seventh segment of the thorax produced into a large dorsal spine, at least in the male. *Ceratocephalus* Woodward, also a Sphæromid genus, has the head of the male drawn out into three large processes, of which the middle one is much the longest; in the female faintly marked projections take the place of these processes. The sixth segment of the thorax in *Campecopea* Leach is produced in a long tooth in the male, but not in the female.

In this order, with the exception of the Epicaridea, perhaps there is no greater distinction between the males and the females than in the family Gnathiidæ. Owing to these differences, at one time the young and the females were included in a separate family from that to which the males were assigned. The relationship between the two forms was definitely established by Mr. Eugene Hesse, although suggestions were made by Leach as early as 1814 pointing to this conclusion. The adult males have powerful mandibles projecting in front of the large quadrangularly shaped head. In the female the mandibles are absent and the head is small and triangular. The first gnathopods in the male are two-jointed opercular appendages. In the female the first pair of legs lie in a membranous plate supposed to be marsupial in character (Stebbing).

With the Epicaridea not only is sexual dimorphism most marked, but the males also differ from the females in the shape of the body, which is elongate and always bilaterally symmetrical, while the body of the female is usually more or less asymmetrical, and has a tendency to be circular in outline, and in the fact that the segments of the abdomen may be distinct or fused irrespective of this condition in the female.

13. ALTERATION OF SEX AND HERMAPHRODITISM.

The peculiar phenomenon of the alteration of sex occurs among some of the Cymothoidæ. The young male at one period is protandrous, being provided with rudimentary female reproductive organs within the male reproductive organs. When the integument is shed the female reproductive organs develop at the expense of the male organs, the incubatory lamellæ arise at the base of the thoracic legs, and the copulatory organs are thrown off.

This alteration of sex and temporary hermaphroditism of the protandrous type has been observed in *Cymothoa*, *Nerocila*, *Anilocra*, and *Icthyoxenos*.

The Cryptoniscian larvæ (males) of the Epicaridea develop into adult males and females, the larvæ which are to become females having at one period both male and female reproductive organs. In the family Cryptoniscidæ the males not transformed into females do not pass beyond the form of the Cryptoniscian larvæ. With the family Entoniscidæ certain males undergo, while retaining their sex, a metamorphosis less complete than that of the female, but sufficiently great to give a very different appearance to this second form. Thus the Entoniscidæ have larval males (complementary males) as well as degraded adult males, both fertile. It may be possible as Girard and Bonnier suggest, that, if the adult degraded male should disappear, one of these complementary males may take its place and continue its transformation into the adult form. The Cryptoniscidæ have only larval males. The Bopyridæ have only degraded adult males.

I.

ISOPODA COLLECTED IN JAPAN IN THE YEAR 1900 BY THE U. S. FISH COMMISSION STEAMER ALBATROSS, AND IN THE YEAR 1881 BY THE U. S. S. PALOS.

The collections made in Japan by the U. S. Fish Commission steamer *Albatross* and the U. S. S. *Palos* contained material that was interesting and, for the most part, new to science. In the present paper two new genera and several new species are added to the list of those already known.

LIST OF REFERENCES.

Dana, James D. Crustacea U. S. Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U. S. N. Philadelphia, 1852. XIII, Pt. 1, p. 804; Atlas, pl. liii, fig. 7.

Hansen, H. J. Cirolanidæ et familiæ nonnullæ propinquæ Musei Hauniensis. Vidensk. Selsk. Skr., 6te Række, naturvidenskabelig og mathematisk Afd. Kjøbenhavn, 5te Bd. 3, 1890, pp. 326–327, pl. i, figs. 2–29.

——— Report on the Dredging Operations of the West Coast of Central America to the Galapagos, to the West Coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U. S. Fish Commission steamer *Albatross* during 1891, Lieut. Commander Z. L. Tanner, U. S. N., commanding. Cambridge, 1897. XXII, The Isopoda. Bull. Mus. Comp. Zool., Harvard College, XXXI, No. 5, p. 108, pl. iii, figs. 2, 3.

Harger, Oscar. Reports on the Results of Dredging, under the Supervision of Alexander Agassiz, on the East Coast of the United States, during the Summer of 1880, by the U. S. Coast Survey steamer *Blake*, Commander J. R. Bartlett, U. S. N., commanding. Cambridge, 1883. XXIII. Report on the Isopoda. Bull. Mus. Comp. Zool., Harvard College, XI, No. 4, pp. 97, 98, pl. iii, figs. 2–2a; pl. iv, fig. 1.

Haswell, William A. On Some New Australian Marine Isopoda. Pt. 1. Proc. Linn. Soc. N. S. Wales, V, 1880, pp. 470–481, pls. xvi–xix.

Miers, E. J. Catalogue of the Stalk and Sessile-eyed Crustacea of New Zealand. London, 1876, p. 109, pl. iii, fig. 3.

——— Crustacea. Zoological Collections of H. M. S. *Alert*. London, 1884, pp. 302–304, pl. xxxiii, fig. a, and pl. xxxiii, fig. b.

Richardson, Harriet. Description of Four New Species of *Rocinela*, with a Synopsis of the Genus. Proc. Amer. Philos. Soc., Philadelphia, 1898, XXXVII, pp. 14–15, figs. 5, 6.

——— Key to the Isopods of the Pacific Coast of North America, with Descriptions of Twenty-two New Species. Proc. U. S. Nat. Museum, Washington, 1899, XXI, pp. 828 and 868.

Schiœdte, J. C., and Meinert, Fr. Symbolæ ad monographiam Cymothoarum, Crustaceorum Isopodum Familiæ. (Continuato) Additamenta. Index systematicus. Index alphabeticus. Naturhistorisk Tidsskrift, Kjøbenhavn, 1884, (3) XIV, 1883–84, pp. 360–362, pl. xv, figs. 1–2.

Stebbing, T. R. R. Arctic Crustacea: Bruce Collection. London. Ann. Mag. Nat. Hist., (7) V, p. 14, 1900.

Stimpson, William. Crustacea and Echinodermata of the Pacific Shores of North America. Journ. Bost. Soc. Nat. Hist., Cambridge, 1857, VI, 1857, p. 71.

FLABELLIFERA or CYMOTHOIDEA.

Family ÆGIDÆ.

ROCINELA ANGUSTATA, new species.

Rocinela laticauda Richardson (not Hansen), Proc. Am. Philos. Soc., XXXVII, 1898, No. 157, pp. 14–15, figs. 5–6; Proc. U. S. Nat. Museum, XXI, 1899, p. 828.

Locality.—Manazura, Japan. (Collected by the U. S. Fish Commission steamer *Albatross.*)

This species formerly identified by the author with *R. laticauda* Hansen[a] from Acapulco, Mexico, is now given a new specific name. It can be differentiated from *R. laticauda* Hansen by the difference in the width of the abdomen compared with the thorax, the abdomen being much broader in *R. laticauda* Hansen than in *R. angustata* Richardson; in having but four spines on the propodus of the prehensile legs, while in *R. laticauda* Hansen there are six; in having six spines (five are wrongly given in the earlier description) on the merus of the prehensile legs, while in *R. laticauda* Hansen there are four, and in the shorter antennæ. Four specimens of this species were obtained by the U. S. Fish Commission steamer *Albatross*, one from off San Luis Obispo Bay, California, another off Esteros Bay, California, a third at Puget Sound, and a fourth from Unimak Island, Alaska. All four specimens are alike in character; two are males, and two females. The specimen from Japan, a male, agrees with the specimens referred to *R. angustata* Richardson with this exception: There are four spines instead of six on the merus of the prehensile legs. It has the narrow abdomen, the shorter antennæ, and the four spines on the propodus of the prehensile legs, as stated in the description of *R.* (*laticauda*) *angustata* Richardson.

ROCINELA AFFINIS, new species.

Body ovate; color uniformly yellow.

Head large, triangular, and produced over the basal joints of the antennæ in a truncate process. Eyes large, occupying the greater portion of the head and contiguous along the median line. The ocular lobes do not project posteriorly. The ocelli are arranged in ten rows along the long axis of the eye. The first pair of antennæ extend to the end of the peduncle of the second pair of antennæ; the first joint of the peduncle is very short and is almost concealed by the frontal process; the flagellum consists of five joints. The second pair of antennæ extend but a short distance beyond the first thoracic segment;

[a] Bull. Mus. Comp. Zool., Harvard College, 1897, XXXI, No. 5, p. 108, pl. III, figs. 2, 3.

the first joint of the peduncle is entirely concealed by the frontal process; the flagellum consists of fourteen joints.

The first and second segments of the thorax are equal in length. The third is longer and the fourth the longest. The fifth segment is short and equal in length to the first or second segment. The sixth segment is very short in the median dorsal line, being about one-third the length of the preceding segment. The seventh segment is extremely short, being half as long in the median line as the sixth segment. The epimera of the second and third segments are not so acutely produced as in the following segments. Those of the fourth, fifth, and sixth segments are narrow and have acute posterior extremities. The epimera of the seventh segment are broad, but also acutely produced.

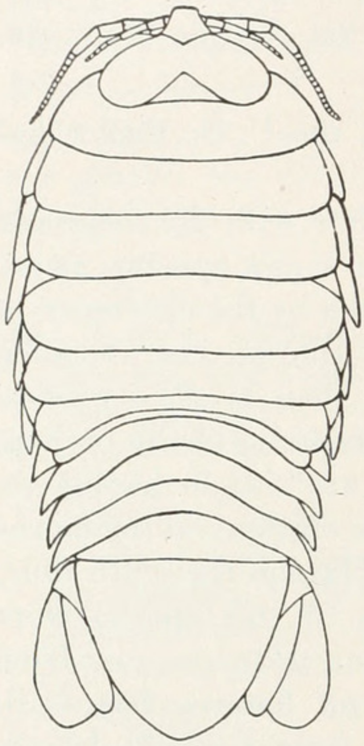

Fig. 1.—Rocinela affinis, new species. × 4.

The first abdominal segment is not evident in a dorsal view, being entirely concealed by the last thoracic segment. The second, third, and fourth segments are produced laterally in acute processes. The fifth segment is narrow, not as wide as the terminal segment, but is longer than the preceding segments in the median line. The terminal segment is roundly triangulate, with margins fringed with a few hairs. The outer branch of the uropoda is broadly expanded, rounded posteriorly, and is about twice as wide as the inner branch. The outer margin is crenulate, and beset with ten spines. The inner branch is narrow, and rounded posteriorly, and is equal in length to the outer branch.

The first three pairs of legs have long curved dactyli. The propodus of the first pair is armed with four spines, the carpus with one, and the merus with two. The second and third pairs have the propodus armed with only three spines. The other legs are long, slender, and somewhat spinulose.

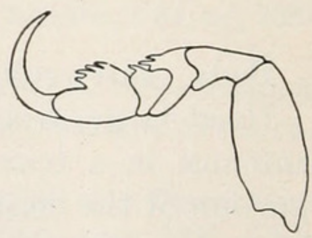

Fig. 2.—Leg of first pair of Rocinela affinis. × 10.

Only one specimen was taken by the U. S. Fish Commission steamer *Albatross*, at the entrance of Port Heda, Japan, at a depth of 167 fathoms.

Type.—Cat. No. 29083, U.S.N.M.

This species is very closely related to *R. oculata* Harger,[a] to which it bears a very striking resemblance. It differs from that species in the following points:

[a] Bull. Mus. Comp. Zool., Harvard College, XI, No. 4, 1883, pp. 97–98; pl. III, figs. 2–2a; pl. IV, fig. 1.

(1) In the entire concealment of the first abdominal segment on the dorsal side by the last thoracic segment; (2) in the much larger epimera of the seventh thoracic segment, which are quite as prominent as those of the sixth segment, and are somewhat broader, the posterior extremities not being on a level with those of the sixth segment, as is true of *R. oculata*, but extending some little distance behind; (3) in having the propodus of the legs of the first pair armed with only four stout spines, while in *R. oculata* there are eight, and in having two stout spines, also, on the merus, while in *R. oculata* there are none; the legs of the second and third pairs have three spines on the propodus, while in *R. oculata* they have six spines; and (4) in not having the eyes produced posteriorly into lobes as in *R. oculata*.

Family CIROLANIDÆ.

CIROLANA JAPONENSIS, new species.

Body about three times as long as wide, rather convex.

Head transverse. Eyes very small, round, and situated at the antero-lateral corners of the head. Color of eyes light brown. Frontal margin of head with small median point, on either side of which is a depression for the reception of the antennæ. First pair of antennæ very short, reaching only to the end of the fourth joint of the peduncle of the second pair of antennæ; flagellum with joints very short and difficult to distinguish; they number about ten. Second pair of antennæ extend a little beyond the posterior margin of the third thoracic segment; the flagellum contains about twenty-four joints. Frontal lamina or interantennal plate is narrow and elongate, this and the clypeus being unarmed and perfectly flat.

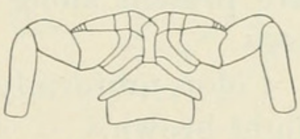

Fig. 3.—Antennæ, frontal lamina, clypeus, and labrum of Cirolana japonensis, new species. × 10.

The first segment of the thorax is not greatly longer than the second, although it is a little longer. The fourth, fifth, and sixth segments are equal in length to each other and to the first, being slightly longer than the second, third, and seventh. The epimera of the second and third segments are not produced posteriorly. Those of the following four segments are produced posteriorly, a gradual increase in this feature being noticeable. The posterior extremity of the epimera of the seventh segment reaches the posterior margin of the second abdominal segment. All the epimera are broad and smooth, with only a faint trace of arched carinæ.

The first four segments of the abdomen are of equal width and of nearly equal length. The third and fourth have the post-lateral extremities produced. The fifth segment is covered at the sides by the post-lateral prolongations of the fourth segment. The sixth segment is triangulate, with apex obtuse, the sides converging more rapidly to the posterior third portion of the segment. This posterior part of the last segment is crenulate, and armed with about ten spines and numerous hairs. The inner branch of the uropoda is about twice as broad as the outer. Both branches are equal in length, crenulate on both margins, and armed with spines and hairs.

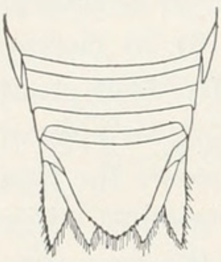

FIG. 4.—ABDOMEN OF CIROLANA JAPONENSIS. ×10.

The legs of the first pair have the ischium and merus distally produced, the process of the merus extending half the length of the propodus. The carpus is very small, almost inconspicuous. There are a few spines on the inferior margin of the merus, carpus, and propodus. In the second and third pairs of legs the carpus is larger, and the process of the merus extends to the end of this joint. The fourth and fifth pairs of legs are similar, with the exception that the basis in the fifth pair is more dilated and less slender than in the fourth pair. The sixth and seventh pairs have the basis much dilated, forming a high carina. All the legs are furnished with long, plumose hairs. Spines also are present along the margins of the legs.

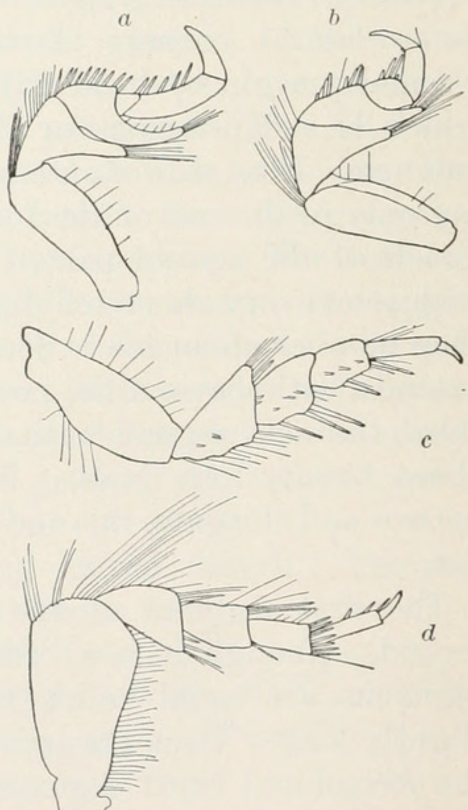

FIG. 5.—LEGS OF CIROLANA JAPONENSIS. *a*, OF FIRST PAIR; *b*, OF SECOND PAIR; *c*, OF FIFTH PAIR; *d*, OF SEVENTH PAIR. ×10.

Color, uniformly light yellow; eyes, light brown.

Only one specimen was taken by the U. S. Fish Commission steamer *Albatross*, at Yokkaichi Light, Japan.

Type.—Cat. No. 29085, U.S.N.M.

This species is closely related to *C. hirtipes* Milne Edwards,[a] but the following characters may serve to distinguish it from that species: Clypeus somewhat wider than labrum, being produced at the lateral angles; antennæ longer than in *C. hirtipes*, reaching the posterior margin of the third thoracic segment; eyes smaller than in *C. hirtipes* and round; epimera of thoracic segments not ornamented with arcuate carinæ ("furca"), only faint traces of these being evident; the legs of the first three pairs are not provided with a spine at the apex of the ischium and merus, as is true of *C. hirtipes;* the other four pairs of legs are provided with spines along the margins and a few spines on

[a] H. J. Hansen. Cirolanidæ, etc., Vidensk. Selsk. Skr., 6te R. Naturvidenskabelig og Mathematisk Afd. 5te Bd. 3, p. 326.

some of the joints, while in *C. hirtipes* the spines are more numerous on the margins and grouped together in rows on the ischium, merus, and carpus; and the posterior margin of the terminal segment of the abdomen is armed with ten rather than sixteen spines.

This species differs from *C. schiödtei* Miers[a] in the form of the frontal lamina (interantennal plate), which in the latter species bears a strong tooth at its anterior extremity.

It differs from *C. tenuistylis* Miers in not having the first thoracic segment greatly longer than the other segments.

From *C. rossii* Miers[b] it differs in the form of the eyes, which in that species are narrow-oblong, and extend "along the sides of the head from the front margin of the first segment of the body nearly to the bases of the antennæ."

Family CYMOTHOIDÆ.

LIVONECA PROPINQUA, new species.

Body broad, with sides subparallel, twisted either to right or left. Abdomen not narrower than thorax. Color, dark yellow.

Head small, triangular; front produced in an obtuse point; posterior margin straight. Eyes moderately large, oval, and situated at the lateral angles of the head. First pair of antennæ extend nearly to the antero-lateral angles of the first thoracic segment; each consists of seven joints. Second pair of antennæ reach the posterior margin of the head; each is composed of thirteen joints.

First thoracic segment considerably longer than any of the others. The antero-lateral angles of this segment extend up around the head on either side; the posterior angles are widely rounded. The other thoracic segments are about equal in length, the seventh segment being somewhat shorter.

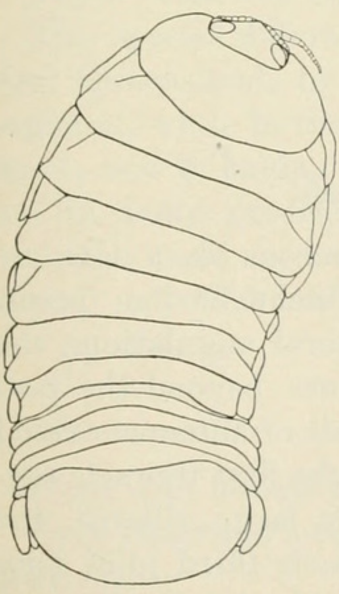

FIG. 6.—LIVONECA PROPINQUA, NEW SPECIES. ×3.

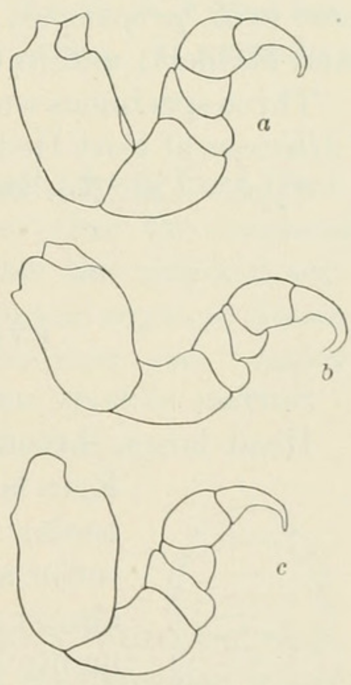

FIG. 7.—LIVONECA PROPINQUA. *a*, LEG OF FIFTH PAIR; *b*, LEG OF SIXTH PAIR; *c*, LEG OF SEVENTH PAIR. ×10.

[a] Zoological Collections of H. M. S. *Alert*, 1884, pp. 302–304, pl. XXXIII, fig. A, and pl. XXXIII, fig. B.

[b] Catalogue of the Stalk and Sessile-eyed Crustacea of New Zealand, 1876, p. 109, pl. III, fig. 3.

The epimera of the second and third segments are long and narrow, and extend the whole length of the lateral margin of the segments. The epimera of the fourth and fifth segments are short and pointed posteriorly, and extend only half the length of their respective segments. The epimera of the sixth segment are pointed posteriorly and extend three-fourths the length of the segment; those of the seventh segment are rounded posteriorly and extend fully to the posterior margin of the seventh segment.

The abdominal segments are short but fully as wide as the thoracic segments. The terminal segment is transverse, about twice as wide as long, with the posterior margin widely rounded.

The uropoda are narrow oar-like appendages, somewhat tapering toward the extremity, which is rounded. The outer branch is a little longer than the inner branch and extends almost to the posterior margin of the terminal abdominal segment.

The legs are all similar, with the exception that the carina of the basis is very high on the four posterior pairs.

This species differs from *L. caudata* Schiœdte and Meinert[a] from Japan in the fact that the carina of the basis is much higher than in that species; in the longer uropoda, the outer branch being the longer one in *L. propinqua*, while the reverse is true in *L. caudata* Schiœdte and Meinert; and in the transverse terminal segment.

Three specimens were obtained by the U. S. Fish Commission steamer *Albatross* at Port Heda, Japan.

Type.—Cat. No. 29086, U.S.N.M.

Family SPHÆROMIDÆ.

CYMODOCEA ACUTA, new species.

Surface of body smooth; color white with numerous black dots.

Head large, broader than long, with prominent median point. Eyes large, situated in the post-lateral angulations, the ocular lobes extending some distance beyond the posterior margin of the head. First pair of antennæ extend almost to the posterior margin of the first thoracic segment; first two joints of peduncle large, dilated, the first one long, the second very short; third joint long and slender; flagellum composed of about seventeen joints. Second pair of antennæ reach the posterior margin of the second thoracic segment; flagellum composed of about twenty joints.

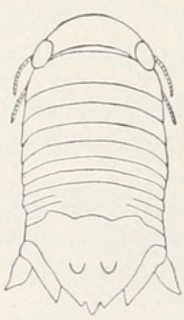

Fig. 8.—Cymodocea acuta, new species. × 3.

First segment of thorax is twice as long as any of the others. The following six segments are subequal in length. The lateral parts of all the segments are produced in narrow, acute angulations. The epimera are indicated by faint suture marks.

[a] Naturhistorisk Tidsskrift, (3) XIV, 1883–84, pp. 360–362, pl. xv, figs. 1–2.

The first segment of the abdomen is twice as long as the last thoracic segment. There are three suture lines on either side, the first pair being entirely concealed except in a lateral view. This segment is posteriorly produced in two small points, one on either side of the median line, and in two larger points, one on either side a little within the line of the epimeral sutures of the thoracic segments. The terminal abdominal segment has a large triangular lobe within the notch at the posterior extremity. The lobes on either side of the median lobe are smaller and shorter. About the middle of the segment are two elevations, one on either side of the median line, transversely situated. The uropoda are equal in length, and are shorter than the terminal segment. Both are pointed posteriorly. The outer one is more tapering than the inner one, which is equal in width throughout its length.

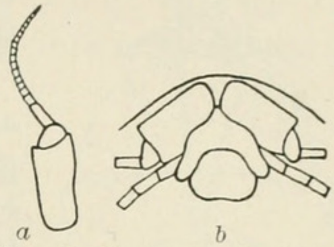

FIG. 9.—CYMODOCEA ACUTA. *a*, ANTENNÆ OF THE FIRST PAIR; *b*, LABRUM.

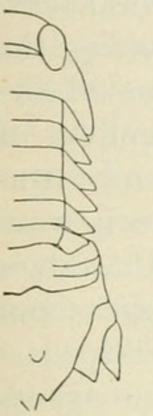

FIG. 10.—LATERAL VIEW OF BODY OF CYMODOCEA ACUTA. ×5.

The legs are all similar in shape and size and terminate in biunguiculate dactyli. They are ambulatory in character.

Only one specimen was collected by the U. S. Fish Commission steamer *Albatross* at Yeno-Ura, Japan. It was taken on the surface.

Type.—Cat. No. 29084, U.S.N.M.

This species differs from *C. mammifera* Haswell,[a] from Port Denison, Queensland, in having the uropoda shorter than the terminal segment, while in that species they are longer than the terminal segment; and in having the lateral angles of the thoracic segment drawn out in acute processes, while in *C. mammifera* they are "rather blunt."

VALVIFERA or IDOTEOIDEA.

Family IDOTEIDÆ.

SYMMIUS, new genus.

Head with lateral parts expanded; lateral margins entire, not cleft. Eyes small and situated on the posterior part of the expanded lateral portions.

First pair of antennæ elongate, consisting of four joints, the last joint being clavate. Second pair of antennæ very short, not longer than the first pair, and consisting of six joints, five being peduncular, the sixth joint being the flagellar joint. Maxillipeds with a three-jointed palp.

Epimera present and developed on only the last three segments of the thorax, as in *Glyptonotus* Eights, the epimera of the three ante-

[a] Proc. Linn. Soc. New South Wales, V, 1880, pp. 474, 475.

rior segments being perfectly united with the segments and with no trace of suture lines.

The abdomen is composed of three segments, two short basal segments and one long, narrow terminal segment.

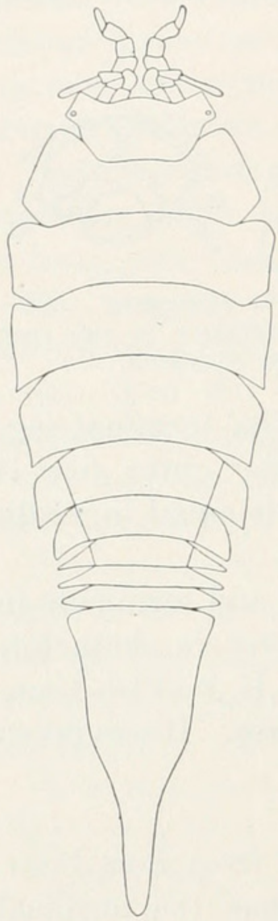

FIG. 11.—SYMMIUS CAUDATUS, NEW SPECIES. × 7.

The opercular valves consist of a single piece each, the basal and terminal plates not being distinct or separated by even a suture line.

This genus differs from both *Glyptonotus* Eights and *Chiridotea* Harger in having the lateral margins of the head entire and not cleft; in having the eyes situated on these lateral expansions of the head; in having all the joints of the flagellum of the second pair of antennæ consolidated and forming a single piece; in having the abdomen composed of only three segments; in having the valves of the operculum consisting of a single piece, and in having a three-jointed palp to the maxillipeds.

It differs also from *Chiridotea* Harger but agrees with *Glyptonotus* Eights in having the epimera distinct only on the last three segments of the thorax.

SYMMIUS CAUDATUS, new species.

Body elongate, broadest at second and third thoracic segment.

Head broader than long, with the anterior part expanded laterally. The margins of these lateral expansions are entire. The eyes are very small and situated in the posterior angles of the lateral lobes. There is no notch in the middle of the anterior margin, the margin being very slightly produced in a widely rounded lobe.

The first pair of antennæ consist of four joints and are somewhat elongate. The last joint is long and clavate. The second pair of antennæ consist of six joints and do not exceed in length the antennæ of the first pair. The joints of the flagellum are all consolidated into a single piece, the terminal or flagellar joint.

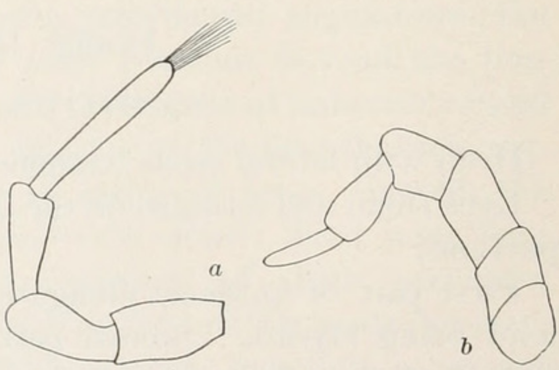

FIG. 12.—SYMMIUS CAUDATUS; *a*, ANTENNA OF FIRST PAIR; *b*, ANTENNA OF SECOND PAIR. *a* × 10; *b* × 7.

The first four segments of the thorax are about equal in length. The fifth, sixth, and seventh segments become successively shorter. The body is broadest at the second and thoracic third segments, the sides converging beyond that point to the narrow apex of the terminal abdominal segment. The epimera of the four anterior thoracic segments are consolidated and perfectly united with the segments. Those of the fifth, sixth, and seventh segments are distinct and evident in a dorsal view.

The abdomen is composed of three distinct segments—two short segments preceding the long and narrow terminal segment. The lateral parts of the first two abdominal segments, as well as of the seventh thoracic segments, are produced into acute points. The terminal segment is entire, with no suture lines at the base. It is produced in a long and narrow extremity, rounded at the apex. About the middle of the segment there is a slight lateral expansion on either side. The opercular valves consist each of a single piece and are produced in a long and narrow extremity.

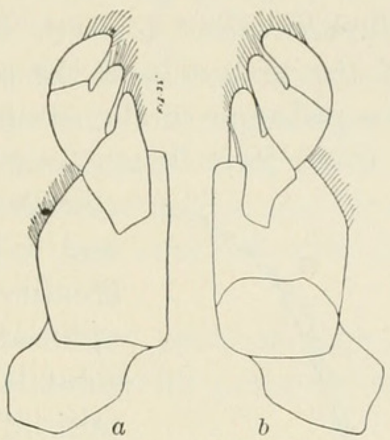

FIG. 13.—MAXILLIPED OF SYMMIUS CAUDATUS; *a*, ANTERIOR SIDE; *b*, POSTERIOR SIDE. × 10.


FIG. 14.—OPERCULAR VALVE OF SYMMIUS CAUDATUS. × 10.

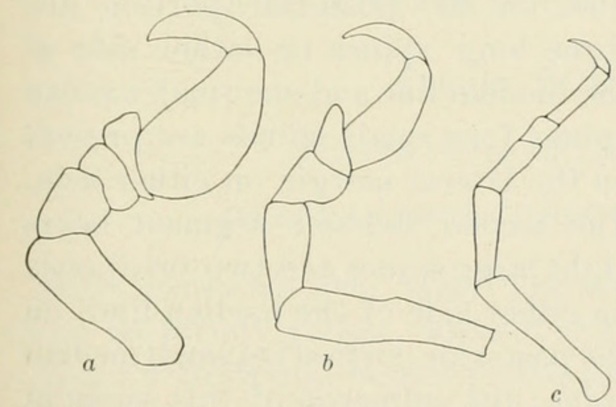

FIG. 15.—LEGS OF SYMMIUS CAUDATUS; *a*, FIRST PAIR; *b*, SECOND PAIR; *c*, SEVENTH PAIR. × 15.

The legs of the first pair are stouter and more robust than the others. Those of the last pair are very feeble and much smaller than the preceding pairs.

Color white, with markings of grayish brown.

Nine specimens were collected by the U. S. Fish Commission steamer *Albatross* at Ose Zaki, Japan, at a depth of 60 to 70 fathoms.

Type.—Cat. No. 29081, U.S.N.M.

Family ARCTURIDÆ.

ARCTURUS HIRSUTUS, new species.

Body densely covered and beset with spines, each of which at its distal end has a circle of fine hairs radiating from it in all directions in a plane at right angles to the axis of the spine, giving a very characteristic and unusually beautiful appearance to the body.

The head has a median excavation on the frontal margin. Between the eyes on the anterior portion are two long spines, the longest of any on the body except the two at the posterior extremity of the terminal segment of the abdomen. On the posterior portion of the head in the space between the eyes are four spines of equal length, two on either side of the median line. On the antero-lateral portion of the head is a single small spine; on the post-lateral portion are two groups of small spines, having two or three spines in each group. The basal joints of the first pair of antennæ bear each a single long spine; the flagellum extends a short distance beyond the middle of the third joint of the peduncle of the second pair of antennæ. The second joint of the peduncle of the second pair of antennæ bears three long spines; the third joint bears four long spines in a longitudinal row about the middle of the segment, and a long spine at the distal extremity; the fourth joint bears a long spine at the distal extremity; the fifth joint is unarmed; the flagellum contains fifteen joints. The joints of the antennæ are thickly fringed with long hairs.

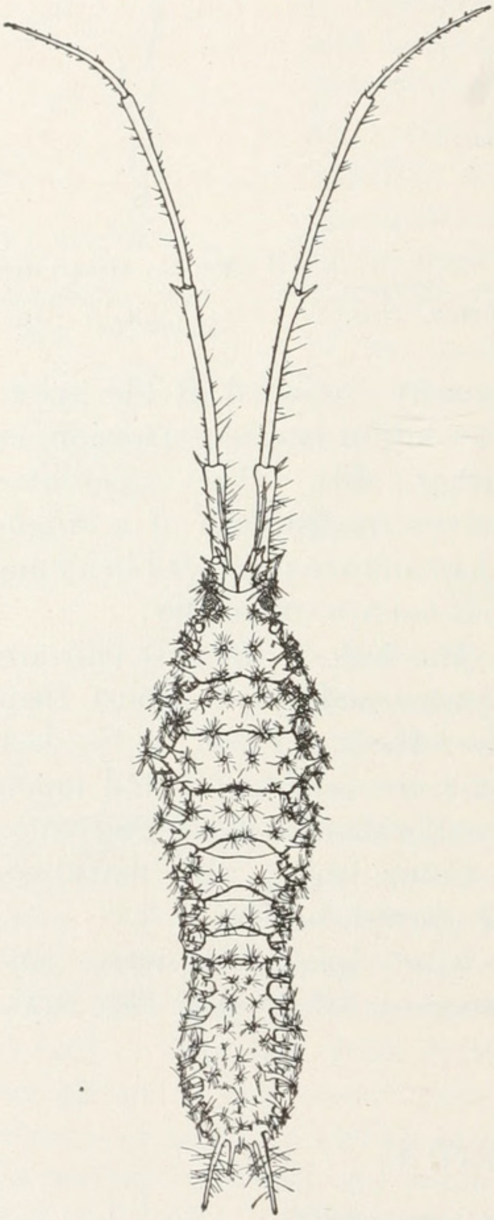

FIG. 16.—ARCTURUS HIRSUTUS, NEW SPECIES. ×2.

The first segment of the thorax has on the anterior portion two long spines on either side of the median line; on the posterior portion are three long spines on either side of the median line and one small median spine; four small spines are present on the lateral margin on either side. The second thoracic segment bears eight large spines and two small ones on either side of the median line; on the posterior portion is a small median spine; the epimeron of this segment is beset with four small spines. The third segment bears seven long spines and three small ones on either side of the median line, and one long spine on the posterior portion in the median line; the epimeron is beset with four small spines. The fourth segment bears eight long spines and two small ones on either side of the median line, and on the posterior portion in the median line two small spines close together; the epimeron is beset with two spines. The fifth and sixth segments bear each five long spines on either side of the median line; the epimeron of each segment is beset with three spines. The seventh segment bears three spines on either side of the median line; the epimeron is beset with three spines.

The first and second abdominal segments have each four spines on either side of the median line. The third segment has three spines on either side of the median line. These segments are not separated from the terminal segment, but are coalesced with it. The terminal segment is rounded posteriorly. Bordering the lateral margins is a row of seven or eight spines on either side of the median line. The dorsal surface is irregularly covered with numerous long and short spines. At the posterior extremity of the terminal segment are two very long spines—the longest on the body—directed backward. Between them and a little back of them are two smaller spines, also directed backward.

The valves of the operculum are covered with numerous small spines.

Both the anterior and the posterior pairs of legs are armed with many long and short spines. The anterior pairs are also fringed with hairs.

Three specimens of this species were collected by the U. S. Fish Commission steamer *Albatross* at Rat Islands, the Aleutian Chain, at a depth of 270 fathoms.

Type.—Cat. No. 29082, U.S.N.M.

EPICARIDEA or BOPYROIDEA.

Family BOPYRIDÆ.

PARAPENÆON, new genus.

PARAPENÆON CONSOLIDATA, new species.

Body somewhat oval, about one and a half times longer than broad. Color uniformly yellow, without any markings.

Head with frontal border produced in a large quadrangular process, directed upward; posterior portion triangulate in shape. Eyes absent. The first pair of antennæ are composed of three joints, the terminal joint being minute. The second pair of antennæ consist of four joints.

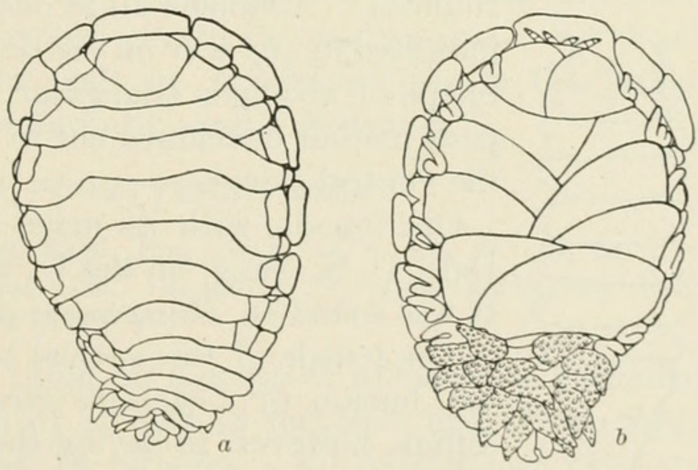

FIG. 17.—PARAPENÆON CONSOLIDATA, NEW SPECIES. *a*, DORSAL VIEW OF FEMALE. *b*, VENTRAL VIEW OF SAME. × 8.

The first two segments of the thorax have the anterior portion of the pleural plates ("lames pleurales") very large and conspicuous, and, although developed from the anterior part of the segment, they extend some little distance in front of the segments. The posterior parts of these segments have each a small lobe constricted off, which may be regarded as the posterior portion of the pleural plates of the segments. (Hansen so considers the posterior lobes of the corresponding thoracic segments in his genus *Cryptione.*)[a] In the two following segments the pleural plates are of this character, except that on one side of the body the anterior portion is greatly reduced and almost inconspicuous. The pleural plates in the three following segments are not divided by a furrow into anterior and posterior portions, but extend entire along the whole of the lateral margin of the segments. The ovarian bosses are prominent and well developed on the first four segments.

FIG. 18.—FIRST LAMELLA OF MARSUPIUM OF PARAPENÆON CONSOLIDATA. × 10.

The segments of the abdomen are all distinct, with the lateral portions of the first five produced into plates, the first two of which on one side are turned upward. These plates are not distinctly separated from the segments. The sixth or terminal segment is minute and rounded and without pleural plates. The uropoda are a pair of small single-branched lamellæ attached to the terminal abdominal segment. The pleopoda consists of five pairs of double-branched lamellæ (ten on either side), the surfaces of which are closely and densely covered with small rounded knobs, supposed to indicate rudimentary ramification.

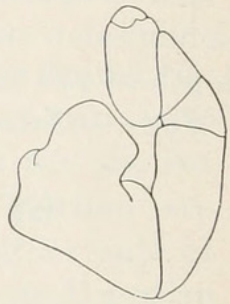

FIG. 19.—LEG OF SIXTH PAIR OF ADULT FEMALE OF PARAPENÆON CONSOLIDATA. × 39.

The marsupium consists of five pairs of large smooth plates, over-lapping in the ventral median line.

The basis of all the legs is furnished with a high carina.

Description of male.—Body elongate. Head large, rounded. Eyes absent. Seven thoracic segments distinct, with lateral margins rounded. Abdomen all in one piece, the six segments not indicated in any way on the dorsal side or lateral margins. Shape of abdomen triangular, with apex rounded. Pleopods neither developed nor in a rudimentary condition on the ventral side.

One female, with its male, was collected by Dr. F. C. Dale, U. S. Navy, on the U. S. S. *Palos*, at Mogi, Japan. It was found on *Parapenæus dalei* Rathbun.

The female of this species bears a great resemblance to the female of *Cryptione elongata* Hansen. The male differs, however, in having the segments of the abdomen all consolidated and forming a single piece, the male of Hansen's type species of the genus *Cryptione* having the abdomen distinctly segmented, each segment bearing a pair of rudimentary pleopoda, and the terminal segment provided with uropoda.

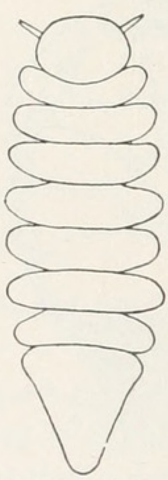

FIG. 20.—MALE OF PARAPENÆON CONSOLIDATA. × 41.

Type.—Cat. No. 29087, U.S.N.M.

[a] Bull. Mus. Comp. Zool. at Harvard College, XXXI, No. 5, Pt. 22, 1897, p. 113.

Young female of Phryxus sp.?—Body asymmetrical. Segments of thorax defined only on the one side; other side greatly swollen. All the legs of both sides present.

Segments of abdomen distinct. Terminal segment entire and produced in a long narrow process. Four pairs of double-branched pleopoda present. The outer lamellæ have the proximal portion greatly dilated, being constricted about the middle on one side and terminating in a narrow elongated process; the inner lamellæ are small, tapering processes directed toward the median line of the body.

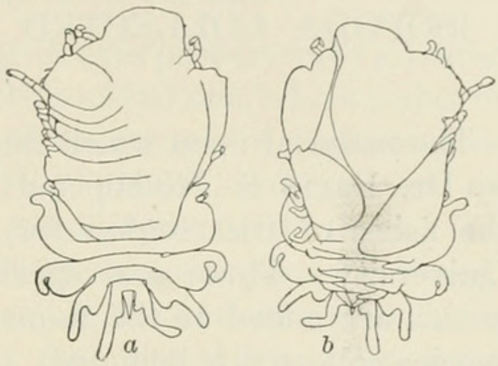

FIG. 21.—YOUNG FEMALE OF PHRYXUS, SPECIES.? *a*, DORSAL VIEW; *b*, VENTRAL VIEW. × 10.

The marsupium consists of four pairs of plates, four of these being large and conspicuous, the other four small and partly concealed by one of the larger plates.

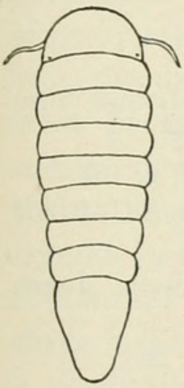

FIG. 22.—MALE OF PHRYXUS, SPECIES.? × 61.

Male.—Head large, broadly rounded in front; eyes very small, and situated at extreme post-lateral angulations; antennæ long. Segments of thorax distinct; those of the abdomen fused into one segment, whose extremity is broadly rounded.

Only one specimen, unattached, was obtained by the U. S. Fish Commission steamer *Albatross* at Omai Zaki Light, at a depth of 36 to 48 fathoms.

The young female described differs from the young female of *Phryxus abdominalis* (Krøyer)[a] in the shape of the terminal segment of the body, in the shape of the outer lamellæ of the pleopoda, and in having the inner branches of the pleopoda directed toward the median line.

The male differs from the male of *P. abdominalis* in the larger head, longer antennæ, and differently shaped abdomen.

ARGEIA PUGETTENSIS Dana.

Argeia pugettensis DANA, U. S. Expl. Exp. Crust., II, p. 804, pl. LIII, fig. 7.—STIMPSON, Bost. Journ. Nat. Hist., VI, 1857, p. 71.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 868.

Locality.—Tsuragi Saki Light, at a depth of 259 and 110 fathoms; Yokkaichi Light, at a depth of 13 and 16 fathoms; and Oboro Saki, Japan, at a depth of 14 and 18 fathoms. All parasitic on *Crangon propinquus* Stimpson, except those from the locality first named, which are parasitic on *Crangon* sp.

Another specimen was collected at Mogi, Japan, by Dr. F. C. Dale (U. S. S. *Palos*), which was parasitic also on *Crangon propinquus*.

[a] Sars, Crustacea of Norway, II, 1899, pp. 214–217, pls. XC–XCI.

II.

ISOPODA COLLECTED IN JAPAN BY JORDAN AND SNYDER.

The material upon which this paper is based was collected in Japan by Dr. David S. Jordan and Mr. J. O. Snyder while investigating the fishes of that region for the Hopkins Laboratory of Stanford University. Three new species, one of which is the type of a new genus, are added to the fauna of that country. A list of the other species collected is included.

LIST OF REFERENCES.

Bate, Spence. On Some New Australian Species of Crustacea. Proc. Zool. Soc. London, 1863, p. 504, pl. xli, fig. 7.

Budde-Lund, G. Crustacea Isopoda Terrestria, pp. 266–268, Hauniæ, 1885.

Dana, J. D. United States Exploring Expedition during the years 1838–1842 under the command of Charles Wilkes, U. S. N., Philadelphia, 1853, XIV, Crustacea, Pt. 2, p. 741, pl. xlix, figs. 6a–h.

De Haan, Willem. Fauna Japon., Crust., L, p. 227, fig. 7a–b.

Dollfus, Adrien. Les Idoteides des Cotes de France. Feuilles des Jeunes Naturalistes, Paris, XXIV–XXV, 1893–1895, pp. 1–5, 17–18, 38–40, 53–56.

Edwards, H. Milne. Hist. Nat. des Crustacés, Paris, 1840, III, p. 272, p. 157.

Leach, W. E. Cymothoadées, Dict. des Sci. Nat., Strasbourg and Paris, XII, p. 353, 1818.

Miers, E. J. A Revision of the Idoteidæ, a Family of Sessile-eyed Crustacea. Journ. Linn. Soc., London, XVI, 1883, pp. 58–65.

Nicolet, Hercule. In Gay, Claudio. Hist. Chile, Paris, III, 1849, p. 265.

Richardson, Harriet. Description of a new species of *Idotea* from Hakodate Bay, Japan. Proc. U. S. Nat. Museum, Washington, 1900, XXII, pp. 131–134.

Roux, P. Crustacés de la Mediterranée et de son littoral, Paris, 1828, p. 3, pl. xiii, fig. 9.

Schiœdte, J. C., and Meinert, Fr. Symbolæ ad Monographiam Cymothoarum, Crustaceorum Isopodum Familiæ, IV, Cymoithoidæ, Tri. 1, Ceratothoinæ. Naturhistorisk Tidsskrift, Copenhagen, 1883, XIII, pp. 358–364, pl. xvi, figs. 1–7.

Stebbing, T. R. R. A History of Crustacea, New York, 1893, p. 354.

——— South African Crustacea, Pt. 2, Cape of Good Hope, Dept. of Agriculture, Marine Investigations in South Africa, Cape Town, 1902, No. 12, 1901, pp. 50–59.

FLABELLIFERA or CYMOTHOIDEA.

Family CYMOTHOIDÆ.

MEJNERTIA TRIGONOCEPHALA (Leach).

Cymothoa trigonocephala Leach, Dict. Sc. Nat., XII, 1818, p. 353.—Milne Edwards, Hist. Nat. Crust., III, p. 272.—De Haan, Faun. Japon., L, p. 227, fig. 7a–b.

Ceratothoa trigonocephala Schiœdte and Meinert, Naturhist. Tidsskrift, (3) XIII, 1883, pp. 358–364, pl. xvi, figs. 1–7.

Meinertia trigonocephala Stebbing, Hist. Crust., 1893, p. 354.

Locality.—Nagasaki, Hizen, Misaki, Sagami, Japan. (Collected by Jordan and Snyder.)

Family SPHÆROMIDÆ.

SPHÆROMA RETROLÆVIS, new species.

Body somewhat convex. Head large with eyes post-laterally situated. Segments of thorax subequal with exception of last one, which is shorter than any of the others. The epimera are drawn out into narrow processes at the sides of the segments. The epimera, however, are not distinct from the segments, but are consolidated with them. The last two segments of the thorax are provided on the posterior margin with four low tubercles in a transverse row, the two on either side of the median line being more prominent than the others. The whole surface of the abdomen is rugose. The first segment has a transverse row of four tubercles. The terminal segment is posteriorly truncate; the posterior portion is rather flat on the dorsal surface and is unarmed; the more convex anterior portion is provided with two longitudinal rows of three low tubercles on either side of the median line, the middle tubercle in each row being the most prominent; on either side of these two median rows of tubercles are two small tubercles also in longitudinal series. The uropoda do not extend beyond the extremity of the terminal abdominal segment. The inner branch is smooth on both margins; in shape it is long and narrow, and pointed posteriorly. The outer branch is similar in size and shape to the inner branch, but is denticulate on the exterior margin, being armed with four teeth. The legs are in two series. The first three pairs are very slender and feeble and are directed forward. The last four are more robust. Only one specimen was found at Nagasaki, Hizen, Japan, collected by Jordan and Snyder.

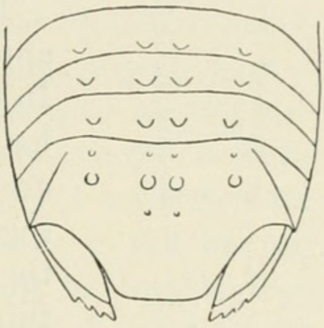

Fig. 23.—Abdomen and last two thoracic segments of Sphæroma retrolævis, new species. × 8.

Type.—Cat. No. 28965, U.S.N.M.

VALVIFERA or IDOTEOIDEA.

Family IDOTEIDÆ.

IDOTEA JAPONICA Richardson.

Idotea japonica Richardson, Proc. U. S. Nat. Museum, XXII, 1900, pp. 131–134.

Locality.—Tokyo, Japan; Mororan, Hokkaida, Japan. Hakodate, Hokkaido, Japan. (Collected by Jordan and Snyder.)

PENTIAS, new genus.

PENTIAS HAYI, new species.

Body narrow elongate, four and a half times longer than wide; surface smooth; color in alcohol almost white.

Head twice as wide as long, slightly emarginate in front, with a small median point. Eyes situated at the extreme lateral margin, about the middle. First pair of antennæ have the basal joints greatly dilated, the three following joints slender and not reaching beyond the second peduncular joint of the second pair of antennæ. The second pair of antennæ are extremely short, reaching, when retracted, only to the posterior margin of the first thoracic segment; the first joint of the peduncle is short, the second about twice as long, the last three equal in length and not much longer than the third joint; the flagellum consists of six short joints. Maxilliped with a five-jointed palp.

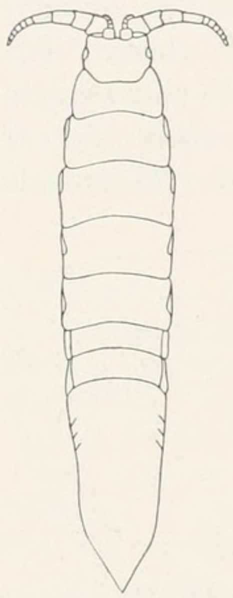

FIG. 24.—PENTIAS HAYI, NEW SPECIES. ×2.

The first thoracic segment is deeply excavate, the antero-lateral parts being produced on either side. In the median dorsal line the first segment is half as long as the second. The third and fourth segments are equal in length and are the longest. The last three segments are subequal and are about half as long as the two preceding ones. The epimera of the second, third, and fourth segments extend half the length of the segment, occupying only the anterior half of the lateral margin; those of the fifth segment extend two-thirds the length of the segment; the epimera of the last two segments occupy the whole of the lateral margin.

The abdomen consists of a single segment, very long, equal in length to the last five thoracic segments and with three suture lines on either side, near the base. The sides of the segment gradually converge to a point near the apex, where they form broadly rounded angles and meet some distance below in a long acute point.

The legs are very small and slender and terminate in bi-unguiculate dactyli; the two unguli are of equal length, and the character very distinctly marked.

One specimen, a female, was collected by Jordan and Snyder at Misaki, Sagami, Japan.

Type.—Cat. No. 28963, U.S.N.M.

FIG. 25.—MAXILLIPED OF PENTIAS HAYI.

This species differs from *Crabyzos* Spence Bate in having the head well separated and distinct from the first thoracic segment, while in Spence Bate's genus the head and first thoracic segment are fused and in having the epimera distinct. It differs from the type species *C. longicaudatus* in having the eyes placed in the middle of the lateral margin instead of at the antero-lateral angles; in having the basal joints of the first pair of antennæ dilated; in the much shorter first pair of antennæ; in the fewer number of joints in the flagellum of the second pair of antennæ (Miers writes[a] that there are from twelve to fourteen joints in the flagellum of the second pair of antennæ in *C.* (*Idotea*) *longicaudatus*); in the much shorter second pair of antennæ; in having the body evenly convex, while in *C. longicaudatus* "the dorsal surface of the thoracic segments is nearly flat, while the margins with the epimera stand nearly perpendicular to them;" in having the first thoracic segment much shorter than the four following segments, which are about equal in length, while in *C. longicaudatus* the first segment is equal in length to the two following segments; in having the head broader than long, while the reverse is true of *C. longicaudatus*, and in the more tapering terminal abdominal segment, the sides being more nearly parallel from the base to about the middle of the segment in *C. longicaudatus*.

This genus differs from all the other known genera of Idoteidæ except *Glyptidotea* Stebbing[b] and *Crabyzos* in having the maxillipeds with a five-jointed palp. It is in agreement with *Glyptidotea* in having the epimera of all the thoracic segments, from the second to the seventh inclusive, distinct from the segments, and in having a uniarticulate abdomen. It differs, however, from Stebbing's genus in not having sculptured joints to both pairs of antennæ, and in not having the legs more or less subchelate in character. The abdomen of *Glyptidotea* has not the lateral rudiments of several coalesced segments.

The genus *Crabyzos* was formerly included in *Idotea* by Miers in his subdivision of the genus corresponding to *Stenosoma* Leach. The maxillipeds of *Stenosoma* have, however, four-jointed palps as in *Idotea* Fabricius,[c] while in *Crabyzos* they have five-jointed palps (Stebbing).

ONISCOIDEA.

Family LIGIIDÆ.

LIGIA EXOTICA Roux.

Ligia exotica Roux, Crust. Medit., 1828, p. 3, pl. XIII, fig. 9.

Ligia gaudichaudii Milne Edwards, Hist. Nat. des Crust., III, p. 157.—Dana, Expl. Exp., p. 741, pl. XLIX, figs. 6a-h.—Nicolet in Gay, Hist. Chile, III 1849, p. 265.

Ligia exotica Budde-Lund, Crust. Isop. Terrestria, 1885, pp. 266–268.

Locality.—Tokyo, Japan. (Collected by Jordan and Snyder.)
Misaki, Sagami, Japan. (Collected by Jordan and Snyder.)

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[a] Journ. Linn. Soc. London, XVI, 1883, p. 63.

[b] Cape of Good Hope, Dept. of Agriculture: Marine Investigations in South Africa, No. 12, 1901, pp. 50–59.

[c] The information in regard to the number of joints to the palp of the maxillipeds in *Stenosoma* was kindly furnished me by Rev. T. R. R. Stebbing.

EPICARIDEA or BOPYROIDEA.

Family BOPYRIDÆ.

DIPLOPHRYXUS, new genus.

Body of female very asymmetrical, one side being much more swollen than the other side. All seven legs present on the smaller side. The first leg, only, present on the swollen side. Segments of thorax defined only on smaller side.

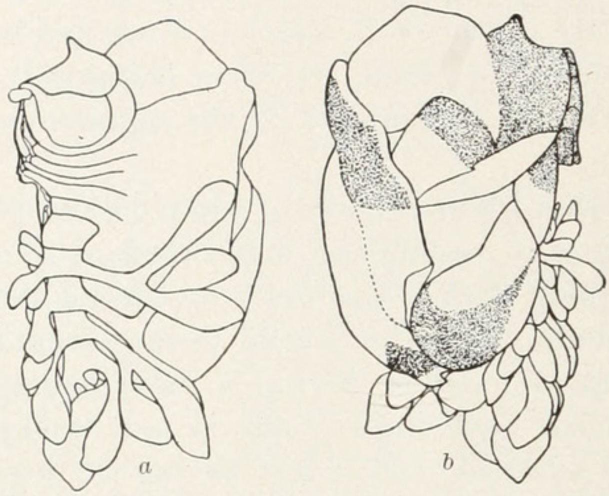

Fig. 26.—Female of Diplophryxus jordani, new species. *a*, dorsal view; *b*, ventral view. × 8.

Abdomen composed of only five segments, the first four carrying each two pairs of double-branched appendages, a pair on either side. The incubatory lamellæ consist of four pairs of plates, those of the smaller side being greatly reduced and crowded together, the lamellæ of the swollen side sufficing to cover the marsupial pouch and extending as large plates over the whole ventral area.

This genus differs chiefly from *Phryxus* Rathke, in having the two pairs of pleopoda, one pair on either side of the body for each segment, double-branched instead of single-branched.

DIPLOPHRYXUS JORDANI, new species.

Body of female very asymmetrical, one side being very much more swollen than the other. Outline very irregular.

Head deeply sunk in thorax, and surrounded by first segment of the thorax; frontal margin covered by the projecting lobe of the first lamella of the incubatory pouch which folds over on the dorsal side. Antennæ small. Oral area wholly concealed on the ventral side.

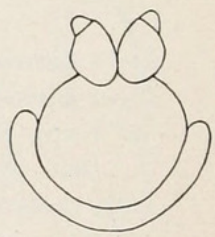

Fig. 27.—Head and first pair of antennæ of Diplophryxus jordani. × 14.

Segments of thorax defined on one side only, the smaller side. The first five are small and closely crowded together, the sixth somewhat longer, the seventh the longest. All seven legs are present on the smaller side, all, except the first one, being small and feeble. Only one leg is present on the other, the swollen side, this one belonging to the first thoracic segment.

Abdomen narrow, elongate, and composed of five well-defined segments, the last segment being small, rounded posteriorly, and without appendages. The four anterior segments are provided each with two pairs of double-branched appendages, a pair on either side, the outer appendages of the swollen side being much more developed and elongate than those of the smaller side, and extending as long leaf-like lamellæ over the incubatory pouch; the separation of each appendage into two branches occurs some distance from the segments.

Incubatory pouch extremely large, occupying the whole ventral side of the thorax and extending laterally on one side a considerable distance beyond the ill-defined outline of the body. The lamellæ of the narrow side of the body are small, and crowded together as four small plates. Those of the other side are developed and suffice to form the marsupium. Only four plates are present on this side also, the first lamella extending anteriorly over the dorsal surface of the head, concealing the antennæ of the first pair which are composed of two very much flattened joints.

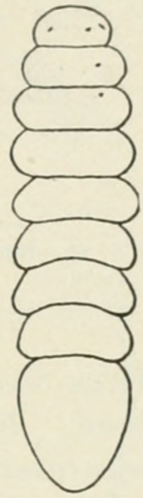

Fig. 28.—Male of Diplophryxus jordani. × 61.

Color of female white, with large areas of dark reddish brown on the marsupium and thorax.

Male.—Body narrow, elongate. Segments of thorax distinct. Abdomen composed of a single piece, with no trace of segmentation; outline rounded, or ovate. No rudiments of appendages. Eyes wanting.

Three specimens were found on the abdomen of *Palæmon serrifer* (Stimpson). They were collected by Jordan and Snyder at Misaki, Sagami, Japan, in 1900.

Type.—Cat. No. 28964, U.S.N.M.

III.

TWO NEW CYMOTHOIDS FROM THE WEST COAST OF CENTRAL AMERICA.

The two species new to science, herein described, were collected by Dr. C. H. Gilbert on the west coast of Central America from Panama and Mazatlan. Both were found in the mouth of *Mugil hospes*.

LIST OF REFERENCES.

Edwards, Milne. Hist. Nat. Crust., III, p. 271.

Schiœdte, J. C., and Meinert, F. Symbolæ ad monographiam Cymothoarum, Crustaceorum Isopodum Familiæ.—IV. Cymothoidæ, Trib. II. Cymothoinæ. Trib. III. Livonecinæ. Naturhistorisk Tidsskrift (3), XIV, 1883–84, pp. 334–336, pl. xiii, figs. 7–8.

——— ———. Symbolæ ad Monographiam Cymothoarum, Crustaceorum Isopodum Familiæ.—III. Saophridæ. IV. Cymothoidæ, Trib. I. Ceratothoinæ. Naturhistorisk Tidsskrift (3), XIII, 1881–83, pp. 335–340, pl. xiii, figs. 11–15; pl. xiv, figs. 1–4, 5.

FLABELLIFERA, or CYMOTHOIDEA.

Family CYMOTHOIDÆ.

INDUSA[a] CARINATA, new species.

Body very convex, having a decidedly hunched appearance. Thorax large, rounded, almost as wide as long, the last two segments rapidly converging to the narrow abdomen. Abdomen nearly three times narrower than greatest width of thorax, with all the segments of equal width.

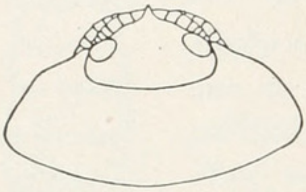

FIG. 29.—HEAD AND FIRST THORACIC SEGMENT OF INDUSA CARINATA. × 5.

Head about two and a half times narrower than first thoracic segment and four times narrower than fourth segment; front triangular in shape and produced into an acute point projecting between the basal joints of the antennæ. Eyes distinct and situated at the sides and about the middle of the head. First pair of antennæ, which are almost contiguous being separated only by the very acute median point, reach to the eyes; flagellum seven jointed. Second pair of antennæ extend to the posterior margin of the head; flagellum nine jointed.

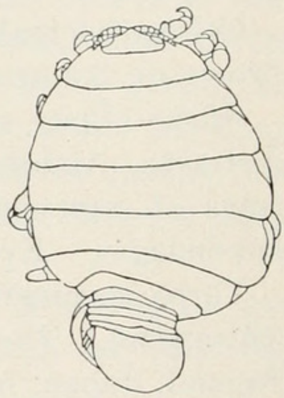

FIG. 30.—INDUSA CARINATA, NEW SPECIES. × $2\frac{2}{3}$.

First thoracic segment rounded anteriorly and posteriorly, the sides of the segment surrounding the head, the lateral angles extending to the eyes. The first four segments gradually increase in width. The fourth and fifth are about equally wide. The sixth and seventh rapidly decrease in width, converging to the narrow abdomen. The epimera are well developed on all the segments with the exception of the first; they are narrow and elongate, rounded posteriorly and not reaching the posterior margin of their respective segments.

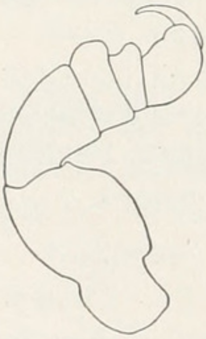

FIG. 31.—LEG OF SEVENTH PAIR OF INDUSA CARINATA. × 7.

The abdomen is likewise very convex and is nearly three times narrower than the thorax at its greatest width. The segments are of equal width. The terminal segment is rounded posteriorly or slightly triangular. The uropoda are very short, less than half the length of the terminal segment; the branches are equal in length.

There is a high carina on the four posterior pairs of legs, and a small one on the three anterior pairs. Color reddish brown.

Two specimens, a male and a female, were collected by Mr. C. H. Gilbert from the west coast of Panama. They were found in the mouth of *Mugil hospes*.

Type.—Cat. No. 28961, U.S.N.M.

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[a] Schiœdte and Meinert.—Naturhistorisk Tidsskrift (3), XIV, pp. 334–335.

MEINERTIA GILBERTI, new species.

Head set in first segment of thorax, whose antero-lateral prolongations extend forward to about the middle of the eye. Shape of the head somewhat triangular; posterior margin straight; anterior margin produced somewhat at the middle, but quite rounded. Eyes very large, far apart, and situated at the sides of the head. First pair of antennæ consist of seven joints and extend to the middle of the eye; second pair contain eight joints and reach the posterior margin of the head.

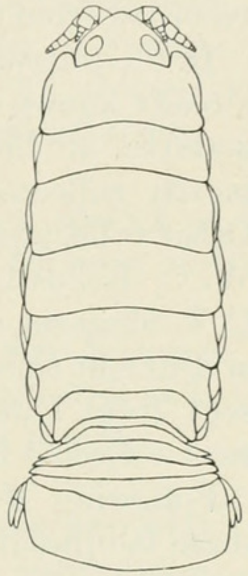

FIG. 32.—MEINERTIA GILBERTI, NEW SPECIES. × 2⅗.

The first four segments of the thorax are about equal in length, the second being somewhat shorter. The last three segments decrease gradually in length. The epimera are narrow pieces at the sides of the segments; in the first five segments they do not reach the posterior margin of the segments, although the fifth pair more nearly reach the posterior margin than the others; the epimera of the last two segments reach quite to the posterior margin.

The first segment of the abdomen is as wide as the last thoracic. The others are wider, increasing in width gradually to the terminal segment. The last segment is about three times as broad as long, and quadrangular in shape. The uropoda are short, reaching only a little beyond half the length of the abdomen; both branches are alike and of equal length.

The legs all terminate in long recurved unguli. There is no high carina developed on the basis of any of the legs.

Color reddish brown.

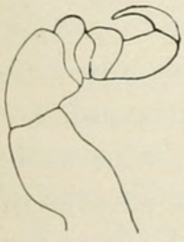

FIG. 33.—LEG OF SEVENTH PAIR OF MEINERTIA GILBERTI. × 7.

Three specimens, two males and one female, were collected by C. H. Gilbert at Mazatlan. They were found in the mouth of *Mugil hospes*.

Type.—Cat. No. 29080, U.S.N.M.

This species differs chiefly from *M. gaudichaudii* (Milne Edwards)[a] from near locality, in the absence of high carinæ, which in *M. gaudichaudii* are strongly developed on the last four pairs of legs; in the much shorter uropoda, which in *M. gaudichaudii* extend beyond the terminal segment, both branches of which are narrowly pointed at their extremities; in the much larger eyes, and in the smaller size of the species, the adult female being only half the size of the adult female of *M. gaudichaudii*.

[a] Naturhistorisk Tidsskrift, XIV, pp. 335–340, pl. XIII, figs. 11–15.

IV.

AMERICAN EPICARIDEA.

American Epicaridea are represented in the following four families: Bopyridæ, Dajidæ, Cryptoniscidæ, and Entoniscidæ. At the present time no representatives of the Entoniscidæ are known to the North American fauna, and no representatives of the Dajidæ have been recorded from South American waters.

In the following pages the forms added to the list given of those already known are all representatives of the family Bopyridæ. The material studied belongs to the U. S. National Museum and was mostly collected by the U. S. Fish Commission steamer *Albatross*. Other collectors are Mr. Henry Hemphill, Mr. George M. Gray, Mr. W. C. Kendall, Dr. C. W. Richmond, Mr. J. B. Henderson, jr., Mr. C. T. Simpson, and Dr. G. Brown Goode. These collections were made at different times and in various localities. Some specimens were also sent from Union University to the U. S. National Museum; they were collected by Prof. H. E. Webster.

Following the classification of G. O. Sars,[a] who combines the three families of Giard and Bonnier, Cyproniscidæ, Cabiropsidæ, and Cryptoniscidæ, into one family, Cryptoniscidæ, the form *Clypeoniscus meinerti* Giard and Bonnier has been assigned to the family Cryptoniscidæ. Sars also cancels the family Microniscidæ, for he considers *Microniscus*, the only known genus, to represent not an adult condition, but only a transitory larval stage in different Epicaridea. The Microniscus stage Sars found to be intermediate between the two larval stages previously known, the larva of the first stage and the Cryptoniscus stage, and the Microniscus larvæ of two different Epicarid families was proved to be always parasitic on Copepoda. Giard and Bonnier do not accept Sars's conclusions, but assign to *Microniscus* the rank of a separate family, Microniscidæ, which they believe represents the ancestral form from which the other Epicaridea have descended.

Contrary, also, to the hypothesis of Giard and Bonnier, who write that one species of parasite can not be found on different species of host, Sars[b] has pointed out that for *Phryxus abdominalis* Krøyer ten different species of host have been recorded, representatives of two different genera, *Spirontocaris* and *Pandalus;* for *Bopyroides hippolytes* (Krøyer), three different species of *Spirontocaris;* for *Bopyrus squillarum* Latreille, three different species of *Leander;* for *Pseudione affinis* G. O. Sars, two different species of *Pandalus;* for *Pseudione hyndmanni* (Spence Bate and Westwood), two different species of *Eupagurus;* for *Pseudione crenulata* G. O. Sars, two species of

[a] Crustacea of Norway, II, 1899, pp. 193–195.

[b] Idem, pp. 198, 199.

Munida; for *Dajus mysidis* Krøyer, two different species of *Mysis;* for *Aspidophryxus peltatus* G. O. Sars, four different species of *Erythrops*, one species of *Parerythrops*, and also a species of *Mysidopsis;* for *Munnoniscus marsupialis* Sars, two different species of host belonging to the Isopod genera, *Eurycope* and *Ilyarachna*.

In the present paper, ten species of host are added to Sars's list of those on which *Phryxus abdominalis* is found to be parasitic. The list now includes the following additional species: *Pandalus leptocerus*, *Spirontocaris grœnlandica*, *S. arcuata*, *S. townsendi*, *S. tridens*, *S. macrophthalma*, *S. suckleyi*, *S. gaimardii belcheri*, *S. fabricii*, and *S. biunguis*. Spence Bate also records it from *Plesionika semilævis*.

Argeia puggettensis Dana is found parasitic on fifteen species of host representing two different genera of Crangonidæ, *Crangon* and *Nectocrangon*.

The list of hosts for *Bopyroides hippolytes* (Krøyer) is also enlarged and now includes the following additional species: *Spirontocaris suckleyi*, *S. bispinosa*, *S. arcuata*, *S. brevirostris*, *Pandalus borealis*, *P. montagui*, and *Pandalopsis dispar*.

Pseudione galacanthæ Hansen, is herein recorded from two additional species of host, *Munida subrugosa* and *Munida quadrispina*. A new species of *Probopyrus* described in the following pages, *P. bithynis*, is found on two different species of *Bithynis*, *B. ohionis*, and *B. acanthurus*.

LIST OF REFERENCES.

Bate, Spence. Characters of New Species of Crustaceans discovered by J. K. Lord on the coast of Vancouver Island. Proc. Zool. Soc. London. 1864, p. 668.

Bate, C. Spence, and Westwood, John Obadiah. A history of the British sessile-eyed Crustacea. London, 1868, II.

Bate, C. Spence. In Lord's Naturalist in British Columbia. London, 1866, II, p. 282.

——— Report on the Crustacea Macrura collected by H. M. S. *Challenger* during the years 1873–1876. Challenger report, London, 1888, XXIV, Pt. 52, p. 574; also pp. 645–646.

Buchholz, Reinhold. Zweite deutsche Nordpolfahrt in den Jahren 1869 und 1870, unter Führung des Kapitäns Koldewey. Leipzig, 1874, II, Pt. 8, Crustaceen, pp. 286–288, pl. II, fig. 2.

Calman, W. T. On a collection of Crustacea from Puget Sound. Ann. N. Y. Acad. Sci., New York, 1898, XI, pp. 274–284, pl. XXXIV, fig. 5.

Cornalia, Emilio, and Panceri, Paolo. Osservazioni zoologiche ed anatomiche sopra un nuovo genere di Isopodi sedentari (*Gyge branchialis*). Mem. R. Accad. Sci., Torino, 1861(2), XIX, p. 114.

Dana, James D. Crustacea. U. S. Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U. S. N., Philadelphia, 1853, XIV, Pt. 2, 1853. Atlas.

Edwards, Henri Milne. Histoire naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux. Paris, 1840, III, p. 283.

Giard, Alfred, and Bonnier, Jules. Contributions à l'étude des Bopyriens. Travaux de l'Institut zoologique de Lille et du Laboratoire de zoologie maritime de Wimereux, Lille, 1887, V, pp. 68, 70, 232–237, 239–240.

——— ———. Contributions à l'étude des Épicarides. XX. Sur les Épicarides, parasites des Arthrostacés, et sur quelques Copépodes symbiotes de ces Épicarides. Bull. scientifique de la France et de la Belgique. Paris, 1893(4), XXV, 1893, pp. 421–436, 444.

——— ———. Sur le genre Entione. Kossmann Comptes Rendes de l'Académie des Sciences, Paris, 11 Octobre, 1886.

Gissler, Carl F. A singular Parasitic Isopod Crustacean and Some of its Developmental Stages. Boston, 1882. The American Naturalist, XVI, 1882, pp. 6–12.

———. Bopyroides latreuticola, a new species of Isopod Crustacean parasitic on a Gulf-Weed Shrimp. Boston, 1882. The American Naturalist, XVI, 1882, pp. 591–594.

———. The Common Prawn and its Parasite. Scientific American, New York, XLV, Sept. 3, 1881, p. 151.

Hansen, H. J. Reports on the Dredging Operations off the West Coast of Central America to the Galapagos, to the West Coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U. S. Fish Commission steamer *Albatross*, during 1891, Lieut. Commander Z. L. Tanner, U. S. Navy, commanding. Bull. Mus. Comp. Zool. at Harvard College, Cambridge, 1897, XXXI, No. 5, Pt. 22, The Isopoda, 1897, pp. 111–124, pls. III–VI.

Harger, Oscar. Report on the Marine Isopoda of New England and adjacent Waters. Report of the U. S. Fish Comm., Washington, 1880. Pt. VI.

Harger, Oscar; Smith, Sidney I.; Verrill, Addison Emory. Catalogue of the Marine Invertebrate animals of the Southern Coast of New England and adjacent Waters. Report U. S. Fish Comm., Washington, 1874. Pt. 1, p. 573 (279).

Kossmann, Robby. Studien über Bopyriden. III. *Ione thoracica* und *Cepon Portuni*. Mittheilungen aus der Zoologischen Station zu Neapel, Leipzig. III, 1881, pp. 170–182, pl. XI.

———. Zoologische Ergebnisse einer Reise in die Küstengebiete des Rothen Meeres, III, Malacostraca, Leipzig. pp. 119–124, pl. IX, figs. 1–7, 1880.

Krøyer, Henrik. Bopyrus abdominalis. Nat. Tiddsskr. R. 1, Copenhagen, 1841. III, 1840–41, pp. 102–289.

——— Grönlands Amfipoder. Kongelige Danske Videnskabenes Selskabs naturvidenskabelige og mathematiske Afhandlinger, Copenhagen, 1838. VII, p. 306 (78), pl. IV, fig. 22.

——— Monografisk Fremstilling af Slægten Hippolytes nordiske Arter. Kongelige Danske Videnskabenes Selskabs naturviden-skabelige og mathematiske Afhandlinger, Copenhagen, 1842, IX, pp. 262–263.

——— Voyage en Scandinavie, en Laponie, au Spitzberg et aux Feröe, Zoologie, Crustacés, Paris, 1849. (Published under the direction of M. Paul Gaimard.) 1849, pls. XXVIII, figs. 1–2; XXIX, fig. 1.

Leidy, Joseph. Contributions toward a knowledge of the marine invertebrate fauna of the coasts of Rhode Island and New Jersey. Philadelphia, 1855. Journ. Acad. Nat. Sci., (2), III, p. 150, pl. XI, figs. 26–32.

——— Notices of some animals on the coast of New Jersey. Proc. Acad. Nat. Sci. Philadelphia, 1879, Pt. 2, p. 198.

Lilljeborg Wilhelm. Hafs-Crustaceer vid Kullaberg. Œfversigt af Kongl. Vetenskaps-Akademiens Forhandlinger, Stockholm, 1852, IX, p. 11.

Lockington, William N. Description of a New Genus and Species of Decapod Crustacean. Proc. Cal. Acad. Sci., VII, 1876, p. 57, San Francisco, 1876; Ann. Mag. Nat. Hist., 1878, pp. 299–300.

Lütken, Christian Friedrich. The Crustacea of Greenland. Manual of the natural history, geology, and physics of Greenland and the neighboring regions; prepared for the use of the Arctic expedition of 1875 by T. Rupert Jones, London, 1875, p. 150.
Metzger, Adolf. Nordseefahrt der Pommerania. Zoologishe Ergebnisse der Nordseefahrt, X. Crustaceen aus den Ordnungen Edriophthalmata u Podophthalmata. Aus Jahrsbericht der Commission zu wiss. Untersuchung des deutsches Meer, im Kiel, Jahre 1872–1873, Berlin, 1875, p. 286.
Miers, Edward John. Report on the Crustacea collected by the naturalists of the Arctic Expedition in 1875–1876, London, 1877, Ann. Mag. Nat. Hist., (4), XX, pp. 64 (14), 65 (15).
Montagu, George. Description of several Marine Animals found on the South Coast of Devonshire. Trans. Linn. Soc. London, IX, 1808, pp. 103–104.
Müller, Fritz. Bruchstücke zur naturgeschichte der Bopyriden Jen. Zeitschrifte Nat., Leipzig, 1871, VI, 1870, pp. 51–73, pls. III and IV.
——— *Entoniscus porcellanæ*, eine neue Schmarotzerassel. Archiv für Naturg., Jahrg. XXVIII, Berlin. Pt. 1, 1862, pp. 10–17, pl. II.
——— Für Darwin. Leipzig, 1864. Translated by F. Debray in Bulletin Scientifique du Nord, 1882–83, figs. 16, 41, 42, pp. 422–449.
Norman, Alfred Merle. Crustacea, Tunicata, Polyzoa, Echinodermata, Actinozoa, Foraminifera, Polycistina, and Spongida in "Preliminary Report of the Biological Results of a Cruise in H. M. S. *Valorous* to Davis Straits in 1875. London, 1876. B. J. Gwyn Jeffreys. Proc. Royal Soc., XXV, p. 209.
——— Last report on dredging among the Shetland Isles, Pt. II, Crustacea, etc. Report of the British Association for the Advancement of Science for 1868, Reports on the State of Science. London, 1869, p. 288.
Ohlin, Axel. Bidrag till Kannedomen om Malakostrakfaunan i Baffin Bay och Smith Sound. Akad. Afhdlg. Lund. Lund, 1895. XXII, pp. 18, 19.
Packard, Alpheus S. Observations on the glacial phenomena of Labrador and Maine, with a view of the recent invertebrate fauna of Labrador. Memoirs of the Boston Society of Natural History. Boston, 1867, I, p. 295, pl. VIII. fig. 3.
——— Zoology for High Schools and Colleges. New York, 1881.
Rathke, Heinrich. Beitrage zur Fauna Norwegens. Nova Acta Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Breslau and Bonn, 1843, XX, p. 40, pl. 11, figs. 1–10.
Richardson, Harriet. Key to the Isopods of the Atlantic Coast of North America with Descriptions of New and Little known Species. Proc. U. S. Nat. Museum. Washington, 1901, XXIII, pp. 576–579.
——— Key to the Isopods of the Pacific Coast of North America with Descriptions of Twenty-two New Species. Proc. U. S. Nat. Museum, Washington, XXI, 1899, pp. 867–869.
——— Results of the Branner-Agassiz Expedition to Brazil. Pt. 2, The Isopod Crustacea. Proc. Wash. Acad. Sci., II, 1900, pp. 157–159.
Sars, G. O. Crustacea of Norway. Bergen, 1898, II, Pts. 11, 12, pp. 199–200, 223–225, pl. LXXXIV, fig. 2; pl. XXVIII, fig. 1.
——— Prodromus descriptionis Crustaceorum et Pycnogonidarum, quæ in expeditione Norvegica anno 1876, observavit G. O. Sars. Archiv for Mathematik og Naturvidenskab, Christiania, 1877. II, p. 354 (254).
Smith, Sidney I., in Harger, Oscar. Notes on New England Isopoda. Proc. U. S. Nat. Mus., II, 1879, pp. 157–158.
Stebbing, T. R. R. A History of Crustacea, Recent Malacostraca, New York, 1893, pp. 392–419.
Steenstrup, Japetus, and Lütken, Christian Friedrich. Mindre Meddelelser fra Kjöbenhavns Universitets zoologiske Museum.—2. Forelöbig Notits om danske Hav-Krebsdyr. Videnskabelige Meddelelser fra den Naturhistoriske Forening i Kjöbenhavn, Copenhagen, 1862. 1861, II, Vol. III, p. 275 (9).

Stimpson, William. Crustacea and Echinodermata of the Pacific Shores of North America. Journ. Bost. Soc. Nat. Hist., 1857, VI, pp. 71–73.

——— Synopsis of the marine Invertebrata collected by the late Arctic Expedition under Dr. I. I. Hayes. Proc. Acad. Nat. Science Philadelphia, 1863. XV, 1863, p. 140.

Thompson, M. T. A New Isopod parasitic on the Hermit Crab. Bull. U. S. Fish Commission, 1901, pp. 53–56, pls. ix and x.

Walz, Rudolf. Ueber die Familien der Bopyriden mit besonderer Berucksichtigung der Fauna der Adrias. Arbeiten aus d. Zoologischen Institute der Univers. Wien, 1882, IV, p. 59.

Wilson, H. V. Marine Biology at Beaufort. The American Naturalist, 1900. XXXIV, p. 353.

NORTH AMERICAN EPICARIDEA.

EPICARIDEA or BOPYROIDEA.

Family BOPYRIDÆ.

PHRYXUS ABDOMINALIS (Krøyer).

Bopyrus abdominalis Krøyer, Nat. Tidsskrift, R. 1, III, 1840, pp. 102–289, pls. i, ii; Monog. Fremst. Slægten Hippolytes nordiske Arter, 1842, p. 263; Voy. en Scand., Crust., 1849, pl. xxix, fig. 1.

Phryxus hippolytes Rathke, Fauna Norwegens, 1843, p. 40, pl. ii, figs. 1–10.

Phryxus abdominalis Lilljeborg, Œfvers. Kongl. Vet. Akad. Forh., IX, 1852, p. 11.—Steenstrup and Lütken, Vidensk. Meddelelser, 1861, p. 275 (9).—Bate and Westwood, Brit. Sessil-eyed Crust., II, 1868, p. 234.—Norman, Rep. Brit. Assoc., 1869, p. 288; Proc. Royal Soc. Lond., XXV, 1876, p. 209.—Buchholz, Zweite deutsche Nordpolfahrt, 1874, p. 287.—Metzger, Nordseefahrt der Pomm., 1875, p. 286.—Miers, Ann. Mag. Nat. Hist. (4), XX, 1877, p. 65 (15).—Smith in Harger, Proc. U. S. Nat. Mus., II, 1879, p. 158.—Harger, Rep. U. S. Fish Comm., 1880, Pt. 6.—Axel Ohlin, Bidrag till Kannedomen on Malakostrakfaunan i Baffin Bay, och Smith Sound, 1895, pp. 18–19.—Richardson, Proc. U. S. Nat. Mus., XXIII, 1901, p. 577.

Locality.—Circumpolar in distribution.

Atlantic coast localities: Massachusetts Bay on *Pandalus borealis*, *Spirontocaris spinus*, *S. securifrons*, and *Pandalus montagui;* Cashes Ledge, Gulf of Maine, on *Pandalus borealis* and *S. pusiola;* Georges Bank on *Pandalus leptocerus;* Halifax, Nova Scotia, on *S. pusiola*, *S. spinus*, and *S. securifrons;* northeastern part Grand Bank on *S. gaimardii*, and *S. gibba;* Cape Cod on *P. montagui*, *P. leptocerus*, *S. securifrons*, *S. pusiola*, and *S. polaris;* Grinnell Land, Discovery Bay, Greenland, Cape Dudley Digges on *S. phippsii* and *S. polaris;* Inglefield Gulf on *S. polaris;* 73° 48′ N. lat., 80° 30′ W. long., on *S. polaris;* 64° 56′ N. lat., 66° 18′ W. long., on *S. phippsii;* off Marthas Vineyard, on *Pandalus leptocerus* and *S. securifrons;* Casco Bay, Maine, on *P. borealis.*

Pacific coast localities: Admiralty Inlet, Puget Sound, Washington, on *Spirontocaris grœnlandica;* off N. Head, Akutan Island, Alaska, on *S. arcuata;* Straits of Fuca, between Washington and Vancouver Island, on *S. townsendi;* Admiralty Inlet, Puget Sound, Washington, on *S. tridens;* Washington Sound, Straits of Fuca, Washington, on *S. tridens;* off Queen Charlotte Sound, British Columbia, on *S. macrophthalma;* off Yahwhit Head, Washington, on *S. macrophthalma;* Ilinlink Harbor, Unalaska, on *S. suckleyi;* Arctic Ocean on *S. gaimardii belcheri* (Bell); Plover Bay, East Siberia, on *S. polaris* (Sabine); Alaska on *S. polaris* (Sabine); off Cape Strogonoff, Alaska, on *S. fabricii* (Krøyer); off Shumagin Bank, Alaska, on *S. biunguis* Rathbun; off Point Arena, California, on *S. macrophthalma;* Straits of Fuca on *S. townsendi* Rathbun; Philippine Islands on *Plesionika semilævis* (according to Spence Bate).[a] Also recorded from British Isles; Scandinavian coast; Spitzbergen; Kara Sea; coast of Norway; depth, 5 to 204 fathoms.

STEGOPHRYXUS HYPTIUS Thompson.

Stegophryxus hyptius Thompson, Report U. S. Fish Comm., 1901, pp. 53–56, pls. IX, X.

Locality.—Great Harbor, Woods Hole; Hadley Harbor, Nashon; Edgartown and Warwick, Rhode Island, on *Pagurus longicarpus.*

STEGIAS, new genus.

STEGIAS CLIBANARII, new species.

Head deeply set in thorax, broader posteriorly than anteriorly, longer than broad, and with straight frontal margin. First pair of antennæ visible on dorsal surface, just anterior to front, as two small lobes, each antenna terminating in a minute joint. Second pair of antennæ also visible on dorsal surface, lying on either side of first pair of antennæ, each antenna terminating in a flagellum composed of several minute joints.

Thorax divided into seven distinct segments. The first three surround the head and are closely crowded together. The other four are very much longer and are of nearly equal length, the fifth being much longer at the sides than the others. The first five segments at the sides are directed forward,

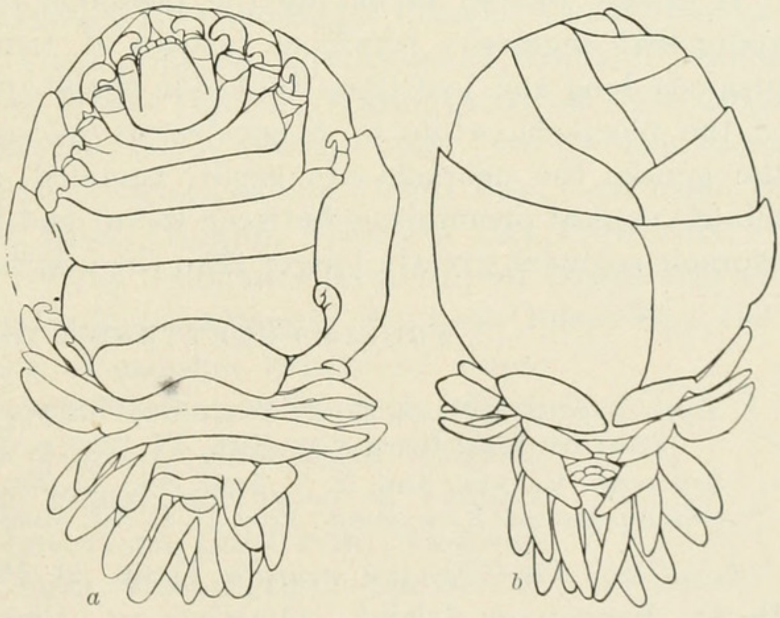

FIG. 34.—STEGIAS CLIBANARII. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF FEMALE. × 8.

[a]Challenger Report, 1888: Crustacea Macrura, XXIV, pp. 645–646.

the five pairs of legs all extending in an anterior direction. A considerable space separates the fifth pair of legs from the sixth pair. The sixth pair of legs, as well as the seventh pair, are placed at the posterior extremity of the sixth and seventh segments, respectively. The epimera of the first four segments are distinct as narrow ridges on the lateral margins of each segment. The ovarian bosses are also present on these segments.

The abdomen is composed of six distinct segments, the first three of which are provided with a pair of triramous pleopods, two dorsal branches and one ventral branch to each pleopod; the next two segments, the fourth and fifth, are each provided with a pair of biramous pleopods, both branches of each pleopod being dorsal, the ventral branch, corresponding to that of the first three segments, not being represented; the sixth segment of the abdomen is furnished with a pair of simple, elongated uropoda, equaling in length the dorsal branches of the pleopoda of the other abdominal segments.

The marsupium is composed of five pairs of lamellæ, the lamellæ of the fifth pair being very large and occupying almost half of the ventral side of the thorax.

Male unknown.

Only one specimen was collected by Dr. G. Brown Goode at the Bermudas in 1876–77. The parasite was found attached to *Clibanarius tricolor*.

Type in the Peabody Museum, Yale University.

This genus differs chiefly from *Stegophryxus* Thompson, to which it is closely related in having the pleopoda of the fourth and fifth abdominal segments biramous instead of triramous; in having the uropoda long and leaf-like, similar in shape and size to the branches of the pleopoda, while in *Stegophryxus hyptius*, the type species of the genus, the uropoda are small, rounded, and knob-like, with a minute conical prominence between them; and in not having the sixth thoracic segment greatly longer than the others.

ARGEIA PUGETTENSIS Dana.

Argeia pugettensis Dana, U. S. Expl. Exp. Crust., II, p. 804, pl. LIII, fig. 7.—Stimpson, Bost. Journ. Nat. Hist., VI, 1857, p. 71.
Argeia sp.? Calman, Ann. N. Y. Acad. Sci., XI, No. 13, 1898, p. 281.
Argeia pugettensis Richardson, Proc. U. S. Nat. Museum, XXI, 1899, p. 868.

Locality.—On *Crangon munita* Dana, at Puget Sound; off Cape Beale, Vancouver Island. On *Crangon alascensis* Lockington, off Cape Seniavin, Alaska; at Davidson Bank, Alaska; east of Amak Island, Alaska; off Cape Strogonoff, Alaska; northwest of Unimak Island, Alaska; Kouloulak Bay, Alaska; off Columbia River, Oregon; Gulf of Georgia, British Columbia. On *Crangon dalli* Rathbun, South of Amak Island, Alaska. On *Crangon alascensis elongata* Rathbun, off

Columbia River, Oregon. On *Nectocrangon ovifer* Rathbun, off North Head, Akutan Island, Alaska; west of Pribilof Islands, Alaska. On *Crangon franciscorum angustimana* Rathbun, Straits of Fuca; Gulf of Georgia, British Columbia. On *Nectocrangon nigricauda* Stimpson, off Port Ano Nuevo, California. On *Nectocrangon crassa* Rathbun, off Cape Seniavin, Alaska; off Cape Newenham, Alaska; north of Bird Island, Shumagins, Alaska; Bering Sea, off the Pribilof Islands; Semidi Islands. On *Nectocrangon lar* (Owen), off Rakovaya Bay; Avatcha Bay; off Cape Strogonoff; off Kouloulak Bay and off Bristol Bay, Alaska; off Cape Menchikoff, Alaska; off Khoudoubine Islands, Alaska; off mouth of Yukon River. On *Nectocrangon alascensis* Kingsley, southwest of Hagemeister Island, Alaska; south and northwest of Unimak Island, Alaska; off Moorovskoy Bay, Alaska; Davidson Bank, Alaska; off North Head, Akutan Island, Alaska; south of San Diego Bay, California; off Rootook Island, Alaska; Petropautski, Kamchatka; off Kouloulak Bay, Alaska; between Bird and Nagai Islands, Alaska; Unimak Pass; off Cape Johnson; southwest of Sannakh Islands, Alaska; off Grays Harbor, Washington; off Destruction Island; Bering Sea, off Akutan Pass. On *Crangon nigromaculata* Lockington, at San Diego Bay, California; off Tillamook Rock, Oregon; Monterey Bay, California; off Cape Johnson. On *Crangon communis* Rathbun, off Grays Harbor, Washington; off Columbia River, Oregon; San Luis Obispo Bay, California; Ilinlink Harbor, Unalaska; Straits of Fuca; south of San Diego Bay, California; off Rootook Island, Alaska; off Falmouth Harbor, Shumagins, Alaska; Bering Sea, off Akutan Island; northwest of Unimak Island, Alaska; off Point Arena, California; Washington Sound, Straits of Fuca, Washington. On *Nectocrangon dentata* Rathbun, at Kyska Harbor; Unalaska; Mazan Bay, Atka; Port Etches, Alaska; Port Levasheff, Unalaska; Ilinlink Harbor, Unalaska; off Round Island, Coal Harbor, Unga Island; off Sitkalidak Island, Alaska. On *Crangon alba* Holmes, south of San Diego Bay, California.

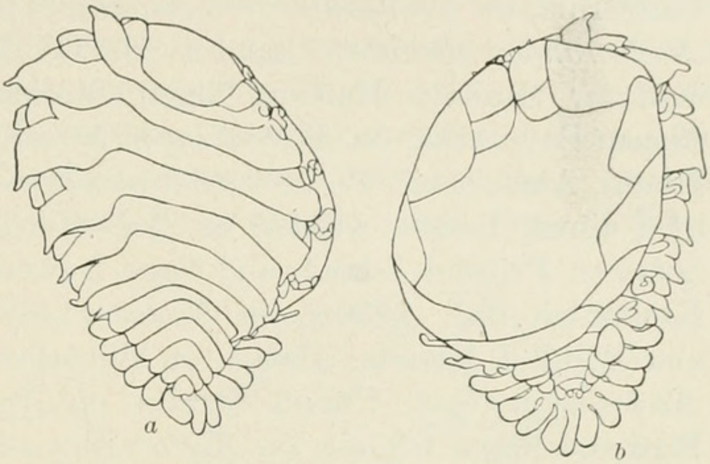

Fig. 35.—Argeia pugettensis. *a*, dorsal view of adult female; *b*, ventral view of adult female. × 14½.

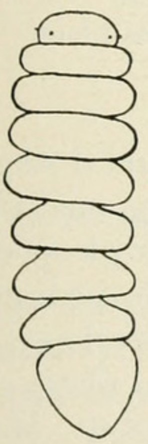

Fig. 36.—Argeia pugettensis, male. × 22.

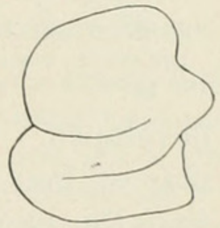

Fig. 37.—Argeia pugettensis, first lamella of marsupium. × 14½.

Immature specimens were found off Seal Islands, Alaska, on *Nectocrangon alascensis;* off Rootook Island, Alaska, on *Crangon communis;* north of Bird Islands, Shumagins, Alaska; Gulf of the Farallones, California, on *Crangon nigromaculata;* Coal Harbor, Unga Island, on *Nectocrangon dentata;* Captains Harbor, Unalaska, on *Nectocrangon dentata;* Sanborn Harbor, Nagai, Shumagins on *Nectocrangon lar;* Mazan Bay, Atka, on *Nectocrangon crassa;* southwest of Hagemeister Island, Alaska, on *Nectocrangon alascensis;* northwest and northeast of Unimak Island, Alaska, on *Nectocrangon alascensis;* Bering Sea, between Pribilof Islands and Cape Newenham, on *Nectocrangon lar;* Kouloulak Bay, Alaska, on *Nectocrangon lar;* between Bristol Bay and Pribilof Islands, Alaska, on *Nectocrangon lar;* Arctic Ocean, on *Nectocrangon lar;* Popoff Straits, on *Nectocrangon crassa;* between Bird and Nagai Islands, on *Nectocrangon alascensis.*

List of Crangonidæ on which *Argeia pugettensis* is found parasitic:

Nectocrangon ovifer Rathbun.
Nectocrangon lar (Owen).
Nectocrangon alascensis Kingsley.
Nectocrangon crassa Rathbun.
Nectocrangon dentata Rathbun.
Crangon nigromaculata Lockington.
Crangon franciscorum angustimana Rathbun.
Crangon dalli Rathbun.
Crangon communis Rathbun.
Crangon propinqua Stimpson.
Crangon nigricauda Stimpson.
Crangon alascensis Lockington.
Crangon alascensis elongata Rathbun.
Crangon alba Holmes.
Crangon munita Dana.

Immature forms.—A female (probably in the first post-larval stage) has the thoracic processes well developed, sometimes only on one side. Inner pleopoda of the first pair usually present; all the outer pleopoda, the other four inner pleopoda and the uropoda are not developed at this stage. Marsupial plates are small and just developing. Male is similar to male found on adult female.

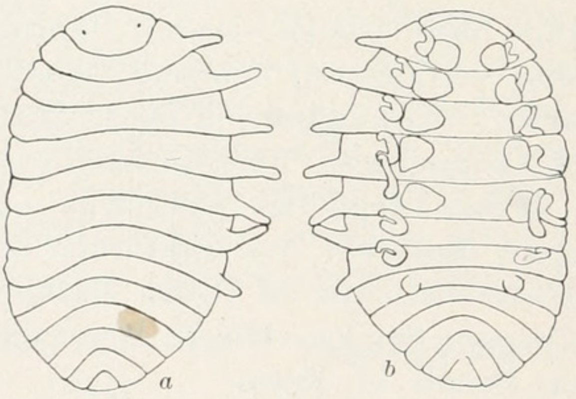

Fig. 38.—Argeia pugettensis. *a*, dorsal view of immature female; *b*, ventral view of same. × 10.

Immature female of a more advanced stage has thoracic processes well developed, although perhaps not quite as long as in the preceding stage. Outer pleopoda and uropoda small, but all developed. The first two inner pleopoda are present; the other three may or may not be present. When present they are usually smaller than the first two, decreasing in size to the fifth pair, and sometimes difficult to discern. The marsupial plates are larger than in the preceding stage, but not fully developed. The incubatory pouch never carries eggs in either of these stages. The male is similar to the male of the adult female.

Specimens of both immature stages were found on the same species and genera of host as the adult females.

A male in the cryptoniscan stage was found on one immature female (in first post-larval stage).

Thoracic processes of adult female.—In the adult female the thoracic processes may be quite reduced. In some specimens these processes are well developed, though never in all the specimens examined were they found as long as in the very young female or as in the figure given by Dana of the adult female. In other specimens these processes are very small, and yet in many they were not even present. Not only is this variation found in specimens taken from different

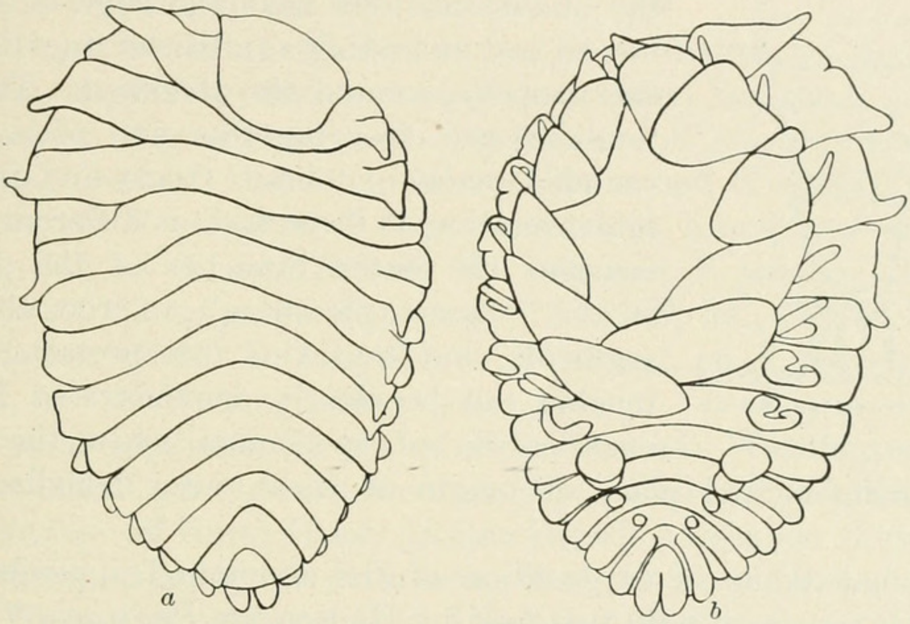

FIG. 39.—ARGEIA PUGETTENSIS. *a*, DORSAL VIEW OF IMMATURE FEMALE; *b*, VENTRAL VIEW OF SAME. $\times 14\frac{1}{2}$.

species and genera of host, but it was also true of those found on the same species and genus of host. As a result of this observation on a large number of these forms, the conclusion must be maintained that these thoracic processes, well developed in the young female, of varying size and shape and sometimes so reduced as to be practically absent in the adult female, have no specific value whatever. Giard and Bonnier[a] have described their function as organs of fixation, which seems a reasonable conclusion and one capable of explaining why so much variation occurs in this respect with each individual parasite.

The following paragraph is taken from the above quoted authors:

The "lames épimériènnes (nos lames pleurales)" have, as we have already said, but a very slight morphological importance. They are organs of fixation developed to assure the position of the parasite in the branchial cavity of the host and to protect it against the gill sweepers. Their form, their number, their dimensions are therefore only in accord with the peculiarities which the branchial cavity presents, and one knows nothing more variable in the decapod Crustacea than the organization of the branchiæ * * * the presence of pleural lamellæ in these animals is evidently simply a fact of adaptive convergence.

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[a] Contributions à l'étude des Bopyriens. Travaux de l'Institut zoologique de Lille et du Laboratoire de Zoologie maritime de Wimereux, V, 1887, p. 61.

The thoracic processes are not, however, in *Argeia* of epimeral origin. They arise from the posterior portion of the segments, while the epimera are placed above on the anterior division of the segments. It is, therefore, incorrect to speak of them as "lames pleurales."

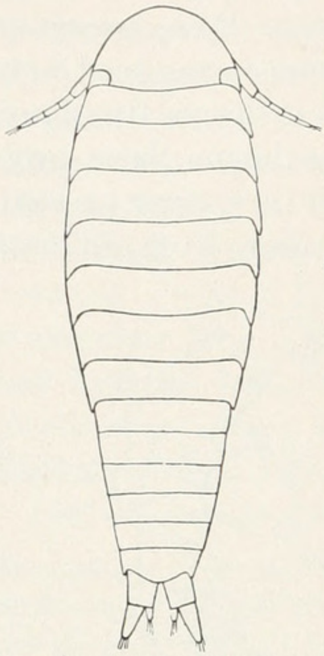

FIG. 40.—ARGEIA PUGETTENSIS, CRYPTONISCAN MALE. × 77½.

In the adult, the pleopoda consist of five pairs of double-branched appendages, the outer branches being elongate, lamellar, attached on the under side very near the edge of the segments, and extending as a border, together with the uropoda, around the abdomen. The inner branches are close together and more or less rounded plates or lobes. Giard and Bonnier's interpretation of these facts is different. They consider the outer branches of the pleopoda as the "lames pleurales" of the abdominal segments, but that this interpretation is untenable can be clearly demonstrated from an examination of specimens, when the manner of attachment and place of origin of these outer lamellæ can be seen.

The view taken in explanation of the abdominal appendages for *Argeia* is in accord with that held by Hansen for *Parargeia*.[a]

ARGEIA DEPAUPERATA Stimpson.

Argeia depauperata STIMPSON, Bost. Journ. Nat. Hist., VI, 1857, p. 71.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 868.

Locality.—San Francisco Bay, on *Crangon franciscorum.*

PARARGEIA ORNATA Hansen.

Parargeia ornata HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 120–122, pl. VI, figs. 1, 2.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 869.

Locality.—Off Acapulco, Mexico, in the branchial cavity of *Sclerocrangon procax* Faxon.

BOPYROIDES HIPPOLYTES (Krøyer).

Bopyrus hippolytes KRØYER, Grønlands Amfipoder, 1838, p. 306 (78), pl. IV, fig. 22; Monog. Fremst. Slægten Hippolytes Nordeske Arter, 1842, p. 262; Voy. en Scand., Crust., 1849, pl. XXVIII, fig. 2.—EDWARDS, Hist. Nat. des Crust., III, 1840, p. 283.—STIMPSON, Proc. Acad. Nat. Sci. Phila., 1863, p. 140.
Bopyroides acutimarginatus STIMPSON, Proc. Acad. Nat. Sci. Phila., 1864, p. 156.

[a] Bull. Mus. Comp. Zool. Harvard College, XXXI, No. 5, Pt. 22. The Isopoda, 1897, p. 121.

Gyge hippolytes BATE and WESTWOOD, Brit. Sess. Crust., II, 1868, p. 230.—BUCHHOLZ, Zweite Deutsche Nordpolfahrt, 1874, p. 286.—METZGER, Nordseefahrt der Pomm., 1875, p. 286.—MIERS, Ann. Mag. Nat. Hist., (4), XX, 1877, p. 64 (14).—SMITH in Harger, Proc. U. S. Nat. Mus., II, 1879, p. 157.—HARGER, Rep. U. S. Fish Comm., 1880, Pt. 6, p. 311.—AXEL OHLIN, Bidrag till Kannedomen om Malakostrak-faunan in Baffln Bay och Smith Sound, 1895, p. 19.

Bopyroides hippolytes G. O. SARS, Crust. of Norway, II, Pts. 11, 12, 1898, pp. 199, 200, pl. LXXXIV, fig. 2.—RICHARDSON Proc. U. S. Nat. Mus., XXIII, 1901, p. 578.

Locality.—Circumpolar in distribution.

Atlantic coast localities: Massachusetts, Bay of Salem, on *Spirontocaris spinus*, *S. fabricii*, and *S. securifrons;* Casco Bay on *S. polaris* and *S. pusiola;* Bay of Fundy, on *S. spinus* and *S. pusiola;* Halifax, Nova Scotia; Gulf of Maine, on *S. securifrons* and *S. spinus;* Eastport, Maine, on *S. spinus;* off Cape Cod, on *S. securifrons* and *S. liljeborgii;* 73° 48′ N. lat., 80° 30′ W. long., on *S. polaris;* 72° 33′ N. lat., 71° 30′ W. long., on *S. polaris;* 71° 42′ N. lat., 73° W. long., on *S. polaris;* 66° 33′ N. lat., 61° 50′ W. long., on *S. polaris;* 64° 56′ N. lat., 66° 18′ W. long., on *S. polaris*.

Pacific coast localities: Straits of Fuca, between Washington and Vancouver Island, on *Spirontocaris suckleyi;* Heceta Bank, Oregon, on *S. bispinosa;* off North Head, Akutan Island, Alaska, on *S. spinus;* Bay of Islands, Adakh, on *S. spinus;* Port Etches, Alaska, on *S. arcuata;* West of Amaknak Island, Unalaska, on *S. arcuata;* Bering Sea, north of Umnak Island, on *Pandalus borealis* Krøyer; off south entrance to Akutan Pass, Alaska, on *Pandalus montagui* Leach; between Bird and Nagai Islands, Shumagins, Alaska, on *P. montagui;* Bering Sea, south of Pribilof Islands, on *P. borealis* Krøyer; Straits of Fuca, on *Pandalopsis dispar* Rathbun; Unalaska, and Lituya Bay, Alaska, on *Spirontocaris brevirostris* (Dana); Puget Sound on *S. brevirostris;* Bering Sea, west of Pribilof Islands, on *S. polaris* (Sabine); Straits of Fuca, on *S. suckleyi;* Lituya Bay, Alaska, on *S. suckleyi*.

Also recorded from Greenland, Barents Sea, British Isles, coast of Norway; depth, 5 to 116 fathoms.

B. acutimarginatus Stimpson is undoubtedly identical with *B. hippolytes* (Krøyer), which is circumpolar in distribution, and infests the species and genera quoted above common to both coasts of North America.

BOPYROIDES LATREUTICOLA Gissler.

Bopyroides latreuticola GISSLER, Am. Nat., XVI, 1882, pp. 591–594.

Bopyrus latreutes SPENCE BATE, Challenger Report, XXIV, 1888, p. 584.

Bopyroides latreuticola RICHARDSON, Proc. U. S. Nat. Mus., XXIII, 1901, p. 579.

Locality.—Beaufort, North Carolina, on *Latreutes ensiferus* (Milne Edwards); lat. 28° 17′ 7″ N., long. 66° 17′ 37″ W.; lat. 31° 15′ 42″ N., long. 67° 39′ 10″ W., on *L. ensiferus;* lat. 31° 16′ N., long. 71° 50′ W., on *L. ensiferus;* 27° 38′ N. lat., 76° 23′ 24″ W. long., on *L. ensiferus;* Bahamas, between Nassau and Andros, on *L. ensiferus;* off South Carolina, on *L. ensiferus;* Bermuda, on *L. ensiferus.*

PROBOPYRUS PALÆMONETICOLA (Packard).

Bopyrus (?) LEIDY, Proc. Acad. Nat. Sci. Philad., 1879, Pt. 2, p. 198.—HARGER, Report U. S. Fish Comm., 1880, Pt. 6, p. 312.
Bopyrus palæmoneticola PACKARD, Zool. for High Schools and Colleges, 1881, p. 289.
Bopyrus manhattensis GISSLER, Scientific American, XLV, Sept. 3, 1881, p. 151.
Bopyrus palæmoneticola GISSLER, Am. Nat., XVI, 1882, pp. 6–12.
Probopyrus palæmoneticola STEBBING, Hist. Crust., 1893, p. 416.
Bopyrus palæmoneticola RICHARDSON, Proc. U. S. Nat. Mus., XXIII, 1901, p. 578.

Locality.—Atlantic City (Leidy), on *Palæmonetes vulgaris* (Say);

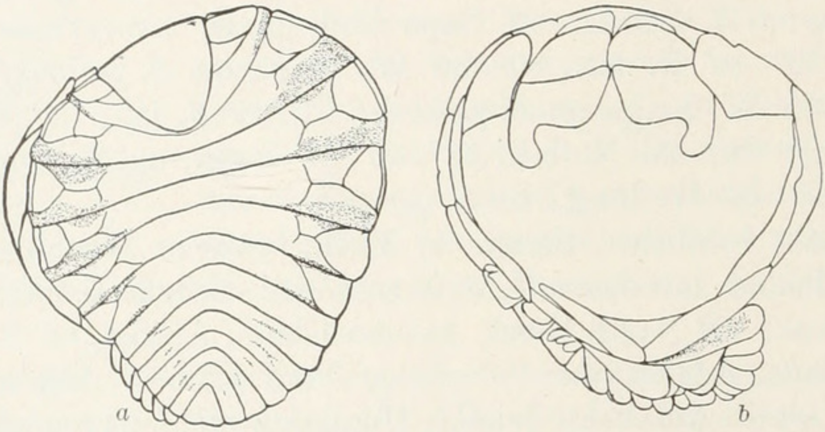

FIG. 41.—PROBOPYRUS PALÆMONETICOLA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 4.

from New Hampshire to Florida (Carl Gissler), on *P. vulgaris;* East Providence, Rhode Island, on *P. vulgaris;* Acushnet River, Massachusetts, on *P. vulgaris;* Baldwin Lodge, Mississippi, on *Palæmonetes* sp.; Lantana, Florida, on *Palæmonetes.*

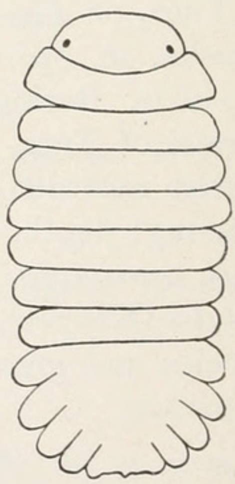

FIG. 43.—PROBOPYRUS PALÆMONETICOLA, MALE. × 41.

Description.—Color of body white, with patches of black on the lateral margins of all the thoracic segments on both sides of the body. Head and abdomen also with a few scattered black markings. Legs of both sides white; patches of black on the ventral side of the lateral margins of both sides of the thorax. Incubatory lamellæ with patches of black on all the plates of both sides.

FIG. 42.—PROBOPYRUS PALÆMONETICOLA, LEG OF SIXTH PAIR OF ADULT FEMALE. × 39.

Head deeply set in thorax; anterior margin straight; posterior margin rounded. Eyes wanting. Ovarian bosses present on the first four segments of the thorax at the anterior part of the sublateral margin; epimera evident as narrow plates lateral to the ovarian bosses. The epimera occupy the entire lateral margins on the last three segments. The segments of the abdomen are distinct. The terminal segment is broad, more or less bilobed. The pleopoda consist of five pairs of double-branched lamellar appendages, closely crowded together on the ventral side of the abdomen.

The five pairs of incubatory lamellæ surround a large open area normally filled with eggs. The first pair have the terminal lobe of the distal segment large, well defined, and incurved.

All the legs have a high quadrangularly shaped expansion or carina on the basis.

Male with all the segments of the thorax distinct, and with the lateral margins contiguous. First four segments of the abdomen well defined at the sides, but fused in the middle of the dorsal surface. The last two segments form a single large piece, the fused terminal segment being indicated only by a small median point on the posterior margin. The body is a little more than twice as long as wide. Eyes are present. The rudimentary pleopoda are pairs of small oval processes one pair on each abdominal segment. The abdomen is about one and a half times as broad as long.

PROBOPYRUS ALPHEI (Richardson).

Bopyrus sp. ? FRITZ MÜLLER, Jenaische Zeitschrift, VI, 1871, p. 68.
Bopyrus alphei RICHARDSON, Proc. Wash. Acad. Sci., II, 1900, pp. 158–159.
Gype sp. ? H. V. WILSON, American Naturalist, XXXIV, 1900, p. 353.
Bopyrus alphei RICHARDSON, Proc. U. S. Nat. Museum, XXIII, 1901, p. 578.

Locality.—Beaufort, North Carolina, on *Alpheus heterochælis;* mangroves, Rio Parahyba do Norte, Brazil, on *Alpheus heterochælis.*

As previously said,[a] this species is probably identical with the *Bopyrus* mentioned by Fritz Müller as being found on a species of *Alpheus* on the coast of Brazil. Giard and Bonnier have referred their species *Grapsicepon fritzii* from the branchial cavity of a *Grapsus* (*Leptograpsus rugulosus*) to Fritz Müller's *Bopyrus* recorded from a species of *Alpheus.* A difference, not only in the species, but even in the genus of host, makes this conclusion rather inconsistent with a certain hypothesis which these authors maintain, namely, that one and the same species of parasite can not infest different species of Crustacea. The genus *Grapsicepon* Giard and Bonnier is characterized by the fact that there are four pairs of triramous appendages elongated and fringed to the first four segments of the abdomen, those of the fifth segment being biramous. It does not seem

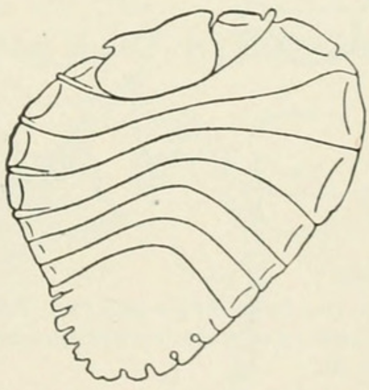

FIG. 45.—PROBOPYRUS ALPHEI DORSAL VIEW OF FEMALE.

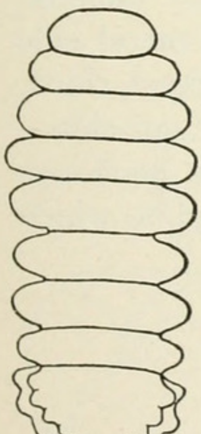

FIG. 44.—PROBOPYRUS ALPHEI, MALE.

[a] Proc. Wash. Acad. Sci., II, 1900, p. 158.

probable that Fritz Müller could have referred his species to the genus *Bopyrus* had there been any such appendages to the pleon.

PROBOPYRUS BITHYNIS, new species.

Body of female with dorsal surface perfectly white, having only three small patches of black on one side at the post-lateral parts of the

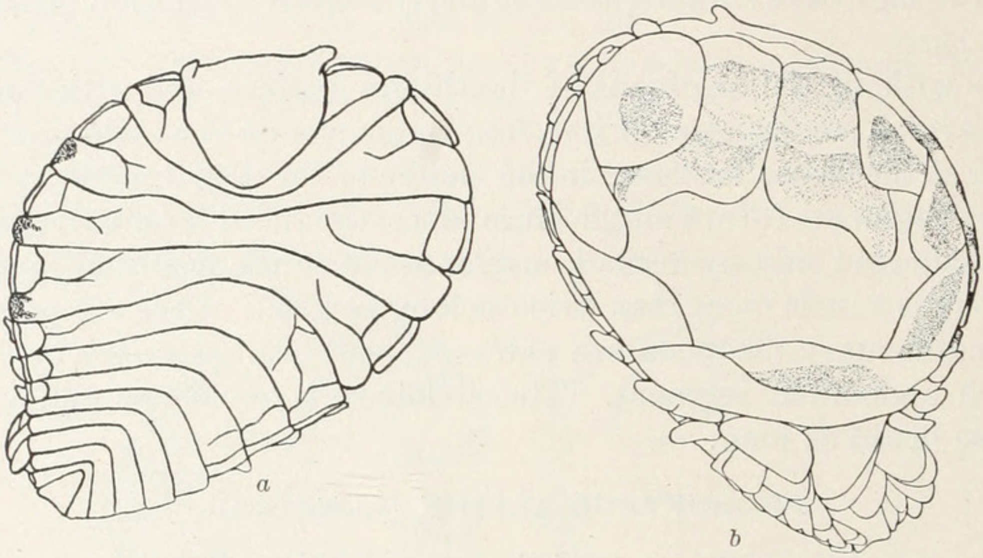

FIG. 46.—PROBOPYRUS BITHYNIS. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. + 16.

second, third, and fourth thoracic segments. Ventral side of the body with the first pair of incubatory lamellæ almost entirely covered with patches of black, and with all the other lamellæ of one side having patches of black, those of the other side being without these patches, with the exception in some specimens of the second lamella. Patches of black also on the ventral side of the lateral margins of the second, third, and fourth thoracic segments of one side—the same side on which these markings occur on the dorsal surface and to which the incubatory lamellæ, likewise marked with patches, are attached. Legs of both sides white and without any markings.

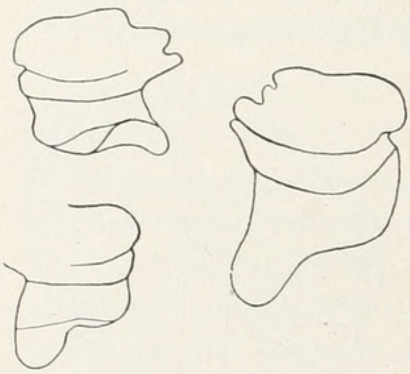

FIG. 47.—PROBOPYRIS BITHYNIS, FIRST LAMELLA OF MARSUPIUM, RIGHT SIDE. + 10.

Head with antero-lateral corners produced into prominent processes; anterior margin between these processes straight; posterior margin narrowly rounded. Length of head about equal to breadth. Eyes wanting.

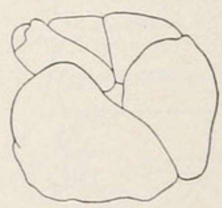

FIG. 48.—PROBOPYRIS BITHYNIS, LEG OF SIXTH PAIR OF ADULT FEMALE. + 39.

The thoracic segments are distinctly defined. Ovarian bosses are present on all the segments, occupying only the anterior portion of the sublateral margin of the first four segments. The epimera are evident as narrow pieces lateral to the ovarian bosses on all the segments.

The segments of the abdomen are distinct on the dorsal side. The lateral margins of the first five segments are straight. The sixth or terminal segment is narrow, elongate, and has a slight emargination in the middle of the posterior margin.

The pleopoda are five pairs of double-branched appendages, the inner branches of the first pair being the largest and overlapping in the middle ventral line. The uropoda are wanting.

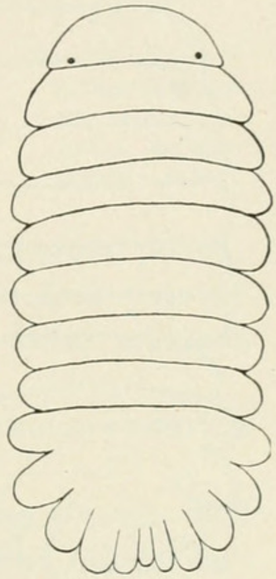

FIG. 49.—PROBOPYRUS BITHYNIS, MALE. × 41.

The first pair of incubatory lamellæ are large and extend about half the length of the ventral side of the thorax. In fact all the lamellæ are quite large, and encompass the marsupium, leaving only a comparatively small opening into the pouch.

All the legs have an extremely high expansion or carina on the basis.

The male has the thorax distinctly segmented, the segments not being widely separated at the sides. Body of male short and thickset, being only twice as long as wide.

The abdomen is a little more than one and a half times broader than long. The segments of the abdomen are only indicated at the sides, being fused in the middle of the dorsal surface; they gradually decrease in size to the sixth or last, which is a narrow piece situated between the two lobes of the fifth segment and which does not reach to the extremity of those lobes. Eyes present. Body with markings of brown.

Six specimens of this species were taken by the U. S. Fish Commission steamer *Albatross* from the Mississippi River near the Exposition Grounds in New Orleans, Louisiana. Parasitic on *Bithynis ohionis* (Smith).

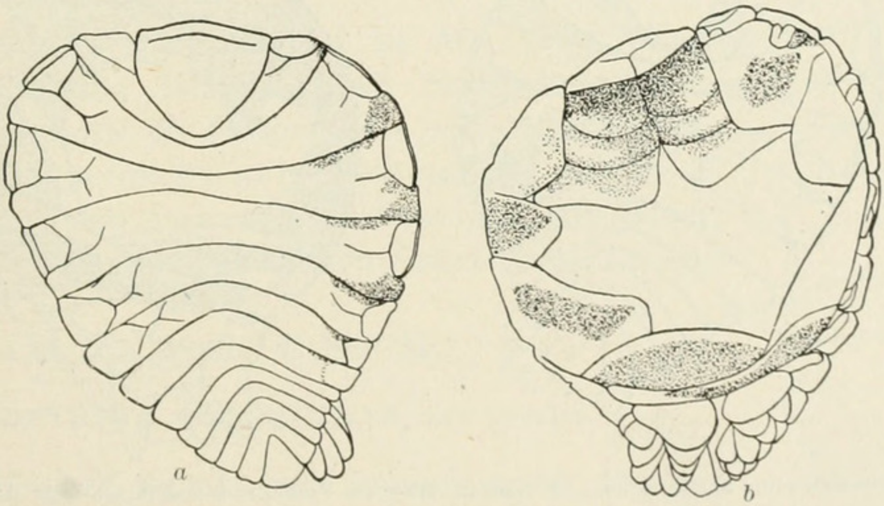

FIG. 50.—PROBOPYRUS BITHYNIS. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 8.

Type.—Cat. No. 29089, U.S.N.M.

About 6 specimens which should probably be referred to this species were found in Escondido River, Nicaragua, 50 miles from Bluefields, by C. W. Richmond; they are parasitic in the branchial cavity of *Bithynis acanthurus* (Wiegmann).

They differ from the type as above described in having no antero-lateral processes to the head of the female; in having patches of black on the lateral margins of all the segments of the thorax on one side of the body; and in having sometimes the third and also the fourth lamellæ of the incubatory pouch with patches of black.

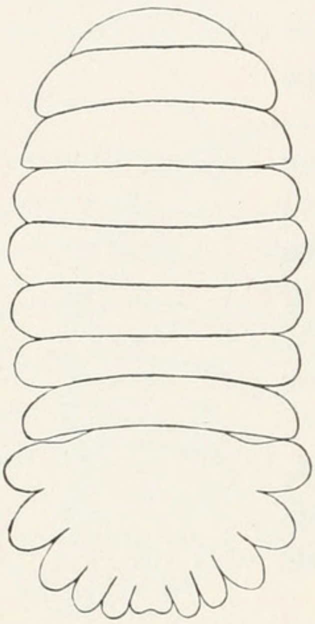

Fig. 51.—Probopyrus bithynis, male. ×41.

In the male the terminal segment has in some specimens a tendency to be bilobed.

PROBOPYRUS FLORIDENSIS, new species.

Body of female light brown, with head, abdomen, ovarian bosses, and epimera light yellow, almost white. Markings of black are present all over thorax and a few black lines are present on the abdomen. The incubatory lamellæ are almost entirely covered with black markings, so that the color is uniformly dark. The lateral parts of the thorax on the ventral side have markings of black, those of one side being in patches with yellow areas separating them, all the legs of this side being yellow. The legs of the opposite side are dark.

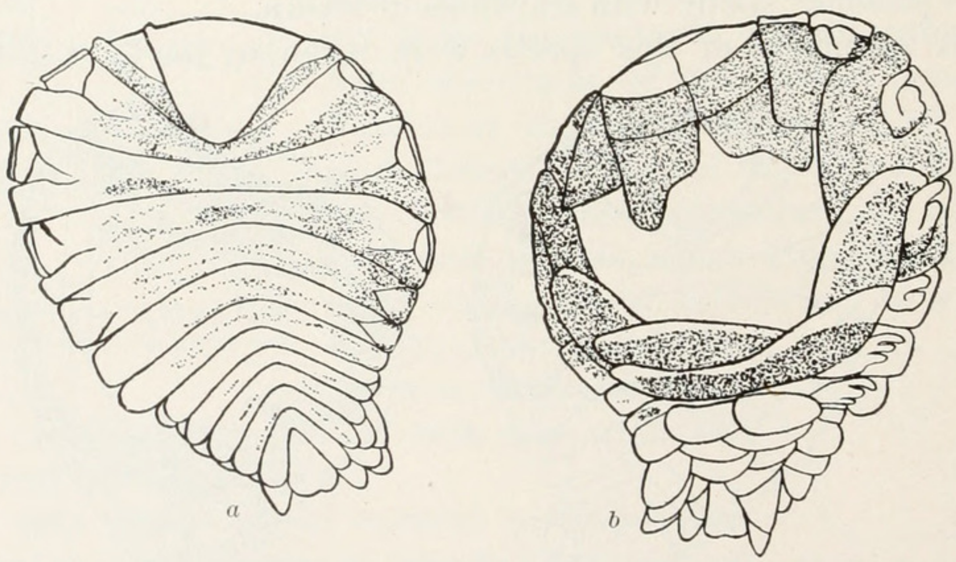

Fig. 52.—Probopyrus floridensis. *a*, dorsal view of female; *b*, ventral view of same. ×12.

Head deeply set in thorax, broad anteriorly with frontal margin nearly straight; posterior margin narrowly rounded; eyes wanted.

The segments of the thorax are distinct. Ovarian bosses are prominent on the anterior portion of the sublateral margin of the first four segments; the epimera are present as narrow plates lateral to the ovarian bosses. On the last three segments the epimera occupy the whole of the lateral margin.

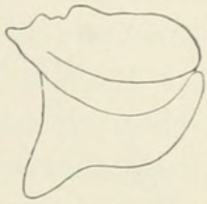

FIG. 53.—PROBOPYRUS FLORIDENSIS, FIRST LAMELLA OF MARSUPIUM. × 10.

The segments of the abdomen are distinctly separated on the dorsal side. The lateral margins are narrowly rounded. The terminal segment of the body is long and narrow, reaching beyond the lateral margins of the fifth segment, is rounded posteriorly, and with or without a minute excavation.

The pleopoda consist of five pairs of double-branched lamellar appendages.

The incubatory lamellæ are large, encircling the incubatory pouch, leaving only a small opening into the interior. The first pair of plates have the terminal lobe of the distal segment straight.

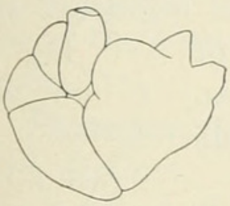

FIG. 54.—PROBOPYRUS FLORIDENSIS, LEG OF SIXTH PAIR OF ADULT FEMALE. × 39.

All the legs have a well rounded expansion or carina about the middle of the basis.

Male with all the segments of the thorax well defined and widely separated at the sides. Body narrow, elongate, nearly three times as long as wide.

The abdomen has all the segments well defined at the sides, but fused in the middle of the dorsal surface. Length almost equal to the breadth. Terminal segment well defined, rounded posteriorly, and extending beyond the lobes of the preceding segment. The lateral margins of all the segments are rounded. Pleopoda are present in the form of pairs of small rounded processes, a pair on each segment of the abdomen. Eyes present.

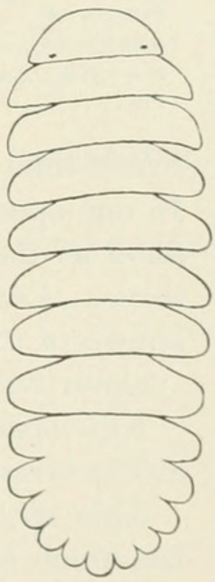

FIG. 55.—PROBOPYRUS FLORIDENSIS, MALE. × 41.

One specimen was collected by Mr. W. C. Kendall at Satsuma Island, above St. Johns River, Florida; parasitic on *Palæmonetes exilipes* Stimpson. Two other specimens were obtained by the U. S. Fish Commission steamer *Albatross* at Little River, Miami, Florida, parasitic also on *Palæmonetes exilipes* Stimpson.

Type.—Cat. No. 29090, U.S.N.M.

BOPYRINA ABBREVIATA, new species.

Body of adult female very asymmetrical, the one side being very much longer than the other. Color entirely white with a few black dots scattered irregularly over the dorsal surface.

Head large, turned to the shorter side; frontal boarder produced in a rounded lobe in the middle. Antero-lateral angles produced in narrow lobes or processes. Eyes small, distinct.

The segments of the thorax are distinctly defined. The epimera are distinct on the first three segments, where they occupy the anterior portion of the lateral margin; they are quite distinct on the longer side of the body, but it is impossible to distinguish them on the shorter side. Ovarian bosses are not present on any of the segments. The epimera of the last four segments are not separated off from the segments; they occupy the entire lateral margin.

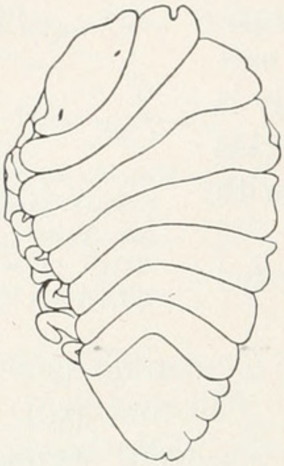

Fig. 56.—Bopyrina abbreviata, dorsal view of female. × 23.

The abdominal segments are completely fused in the middle of the abdomen. On the lateral margin of the shorter side of the body there is no indication whatever of the coalesced segments. The first four abdominal segments are represented on the longer side of the body by four rounded lobes. The last two segments are completely fused, and are not indicated on either side.

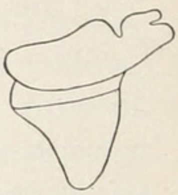

Fig. 57.—Bopyrina abbreviata, first lamella of marsupium. × 27.

The pleopoda, as far as could be made out, consist of four pairs of single branched lamellæ. Three pairs were distinctly seen; the last pair are very indistinct.

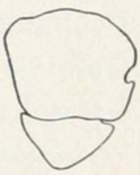

Fig. 58.—Bopyrina abbreviata, maxilliped. × 41.

The first lamella of the marsupium on the shorter side extends about one-third the length of the body; on the longer side, the first lamella extends to the posterior margin of the second thoracic segment.

Male with head large, rounded in front. Eyes large, irregularly shaped. All seven segments of thorax distinct. Abdomen narrower than thorax, and tapering to a narrow extremity. In one specimen all six segments were more or less defined at the sides; in the other specimen only the first three. Length of abdomen about equal to one-third the length of the body.

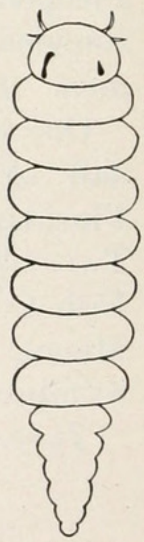

Fig. 59.—Bopyrina abbreviata, male. × 77¼.

Color white with markings of black or brown.

Nine specimens were collected by Mr. Henry Hemphill at Puntarasa, Florida, on *Hippolyte zostericola* (Smith).

This species differs from *Bopyrina virbii* (Waltz),[a] in the much smaller first lamellæ in the female, the lamella of the shorter side of the marsupium extending but one-third the length of the body, while in *B. virbii* it extends nearly to the abdomen, that of the longer side reaching only the posterior margin of the second thoracic segment, while in *B. virbii* it

[a] Kossman, Zeitschrift für Wissenschaftliche Zoologie, XXXV, 1881, p. 666–679, pls. XXXIV–XXXV.

extends to the posterior margin of the fourth segment; in not having any indication of segmentation on the shorter side of the abdomen, while in *B. virbii* there is some indication; and in having the abdomen of the male rounded posteriorly with indications of segmentation at the sides more or less during its entire length, while in *B. virbii* the abdomen is truncate posteriorly, with only the first two segments indicated.

The specific name refers to the abbreviated first lamellæ of the marsupium.

Type.—Cat. No. 29097, U.S.N.M.

BOPYRINA UROCARIDIS, new species.

Body of female twice as long as wide

Head with frontal margin produced in a broadly rounded process. Eyes present about the middle of the head as small black spots.

The segments of the thorax are distinct. The epimera are marked off by faint lines or impressions. The abdomen is composed of six segments, which are distinct at the sides but fused in the middle. The posterior margin of the terminal segment is broad, with a slight median excavation.

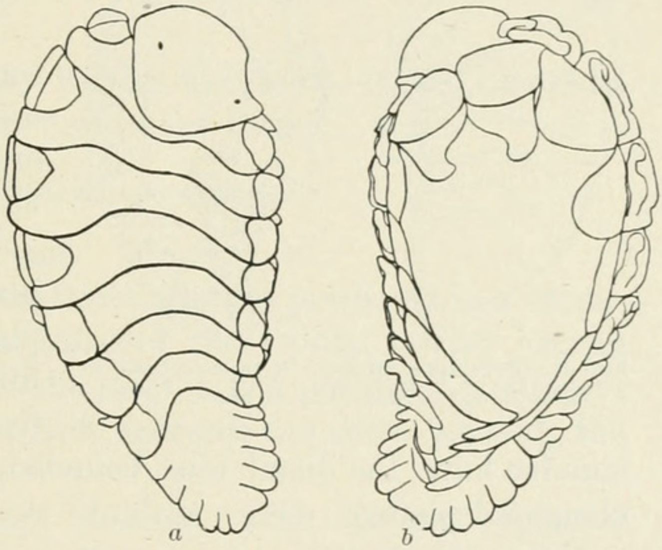

Fig. 60.—Bopyrina urocaridis. *a*, dorsal view of female; *b*, ventral view of same. × 23.

The pleopoda consist of four pairs of single branched plates or lamellæ, each pair directed toward the median line. There are no uropoda.

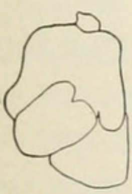

Fig. 61.—Bopyrina urocaridis, maxilliped. × 39.

The incubatory pouch is a large area on the ventral side of the body, which is not closed over by the incubatory lamellæ. These lamellæ consist of five pairs of plates, the first pair of which have the second segment produced distally in a linguiform process.

Color uniformly light yellow with small black dots on the incubatorylamellæ.

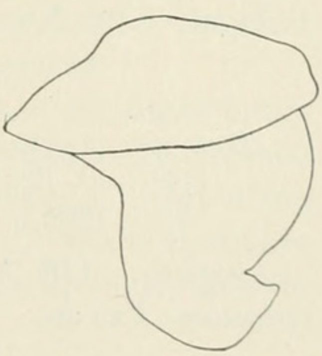

Fig. 62.—Bopyrina urocaridis, first lamella of marsupium, right side. × 52.

Male unknown.

Four specimens were found—three at Puntarasa, Florida, collected by Henry Hemphill, and one from west Florida, collected by Mr. J. B. Henderson and Mr. C. T. Simpson, all parasitic on *Urocaris longicaudata* Stimpson.

Type.—Cat. No. 29088, U.S.N.M.

BOPYRINA THORII, new species.

Body of adult female asymmetrical, turned very much to one side. Color yellow with a few markings of black on one side of the thorax and in the center of the first three segments of the abdomen.

Head large with frontal margin produced in a rounded lobe, which is turned upward in the specimen; the antero-lateral angles are produced into small processes. The eyes are black and distinct.

The segments of the thorax are all distinctly separated from each other. The epimera are distinct on the longer side of the body as long, narrow plates on the anterior portion of the lateral margin of the first four segments. Ovarian bosses are not present on any of the segments.

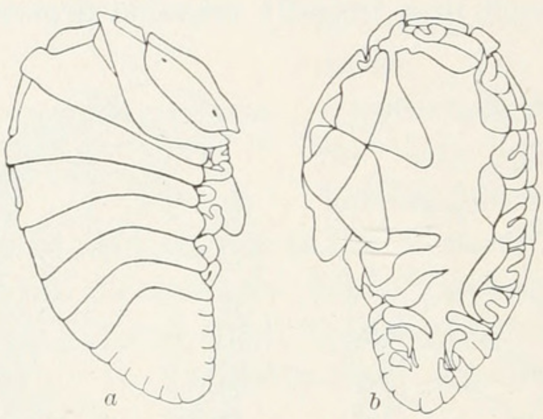

FIG. 63.—BOPYRINA THORII. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 15.

The abdomen is composed of six segments, completely fused in the middle, but indicated on both lateral margins. The terminal segment is rounded posteriorly.

There are four pairs of single branched pleopoda. The marsupium is a large open area, normally filled with eggs, and inclosed by five pairs of lamellæ. The first lamellæ have the distal lobe rounded. The fifth lamellæ are narrow elongated plates.

Male unknown.

Only one specimen was obtained by the U. S. Fish Commission steamer *Albatross* at Key West, Florida. The species is parasitic on *Thor floridanus* Kingsley.

This species differs from the preceding species chiefly in the form of the distal segment of the first lamellæ of the marsupium.

Type.—Cat. No. 29099, U.S.N.M.

BATHYGYGE GRANDIS Hansen.

Bathygyge grandis HANSEN, Bull. Mus. Comp. Zool., Harvard College, XXXI, 1897, pp. 122, 124, pl. VI, figs. 2, 2*e*.—RICHARDSON, Proc. U. S. Nat. Mus. XXI, 1899, p. 869.

Locality.—Off Acapulco, in the branchial cavity of *Glyphocrangon spinulosa* Faxon.

LEIDYA DISTORTA (Leidy).

Cepon distortus LEIDY, Journ. Acad. Nat. Sci., Phila., (2), III, 1855, p. 150, pl. XI, figs. 26–32.

Leidya distorta CORNALIA and PANCERI, Mem. R. Acad. Sci., Torino, (2), XIX, 1861, p. 114.

Cepon distortus HARGER, Rep. U. S. Fish Comm., Pt. 1, 1874, p. 573 (279); Proc. U. S. Nat. Museum, II, 1879, p. 157; Rep. U. S. Fish Comm., 1879, p. 157;

Pt. 6, p. 311.—KOSSMAN, Zool. Ergb. einer Reise in die Küst. des Rothen Meeres, III, Malacostraca, p. 122; Mittheil, aus der Zool. Station zu Neapel, III, 1881, first half, p. 182.

Phryxus distortus WALZ, Arbeit. aus d. Zoolog. Insti. d. Univers. Wien, IV, 1882, p. 59.

Cepon distortus RICHARDSON, Am. Nat., XXXIV, 1900, p. 309.

Leidya distorta RICHARDSON, Proc. U. S. Nat. Museum, XXIII, 1901, p. 579.

Locality.—Atlantic City, New Jersey, in the branchial cavity of *Uca pugilator*.

IONE CORNUTA Spence Bate.

Ione cornuta SPENCE BATE, Proc. Zool. Soc. London, 1864, p. 668; Lord's Naturalist in British Columbia, II, 1866, p. 282.

Ione cornuta BATE and WESTWOOD, Brit. Sessile-eyed Crust., II, p. 253.—GIARD and BONNIER, Travaux de l'Institut zoologique de Lille et du Laboratoire Maritime de Wimereux, V, 1887, p. 77.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 869.

Locality.—Esquimault Harbor, British Columbia, in the branchial cavity of *Callianassa longimana;* Vancouver Island.

IONE THOMPSONI, new species.

Body of female longer than broad.

Head deeply set in thorax, its anterior margin produced in a crenulated border. The antero-lateral lobes of the frontal border extend some distance beyond the sides of the head. The posterior portion of the head is evenly rounded. The first antennæ are three jointed; the second pair are five jointed.

All the thoracic segments are distinct, with distinct epimera ("lames pleurales" of Giard and Bonnier), in the form of large rounded lobes, not elongated. In the first two segments these epimeral lobes occupy the anterior portions of the lateral parts of the segments; in the third segment they are placed about the center of the lateral margin; in the fourth and fifth segments they occupy more of a posterior position; in the sixth and seventh segments they occupy the entire lateral margin. Ovarian bosses are present on the first four segments, along the anterior portion of the segment.

The six segments of the pleon are distinct, and are produced laterally, each in a pair of elongated and jointed appendages, furnished with numerous mammilliform, branching appendages, originating from the posterior margin and extending downward. Thus there are six pairs of appendages corresponding to the "lames epimeriennes du pleon" of Giard and Bonnier.

The pleopoda consist of four pairs of double-branched appendages and one pair of single-branched appendages.[a] The inner branches of

[a] The young female of *Ione thompsoni* has the last pair of pleopoda double-branched, the two branches similar, however. The inner branches of the first four segments are quite different from those of the outer branches, as is true of the adult female, and lie folded over the abdomen as in the adult described.

the first four pairs fold over the ventral side, meeting in the median line. These branches are all large and of nearly equal size and thickly tuberculate, the first two pairs being somewhat larger than the last two pairs. The outer branches of the first four pairs and the fifth pair of pleopoda consist of narrow, elongated appendages crenulated on their outer margins and thickly tuberculate. The appendages of

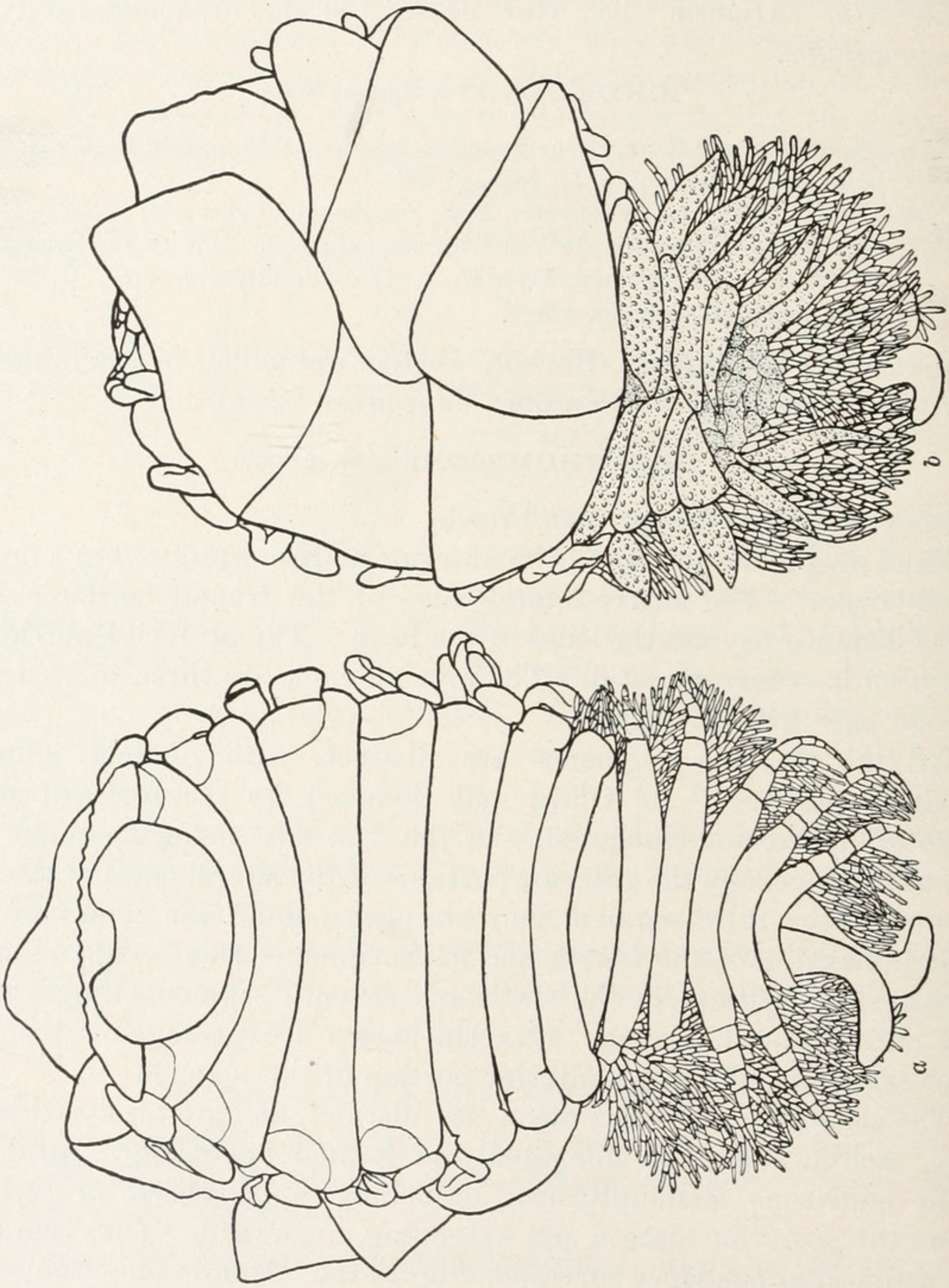

Fig. 64.—Ione thompsoni. *a*, dorsal view of female; *b*, ventral view of same. × 6.

the sixth abdominal segment, the uropoda, are a pair of simple, cylindrical, elongated lobes, recurved at their extremities, and not reaching beyond the mass of epimeral appendages.

The incubatory pouch is formed of five pairs of lamellæ, five issuing from one side and five from the other. The first pair are much smaller than the others, and are entirely concealed by the second pair.

The seven pairs of legs are all similar, and terminate in a prehensile hand. There are two expansions or carinæ on the basis of all the legs, the anterior one being only half as long as the other.

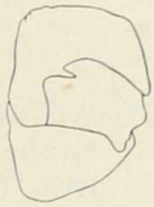

FIG. 65.—IONE THOMPSONI, MAXILLIPED.

Male with all the segments of the thorax distinct. Eyes wanting. Antennæ conspicuous, six jointed. Antennulæ, three jointed. The segments of the abdomen are distinct, all six furnished each with a pair of elongated leaf-like tapering appendages.

Two specimens were collected by Mr. G. M. Gray at North Falmouth, Massachusetts. They were found on *Callianassa stimpsoni*.

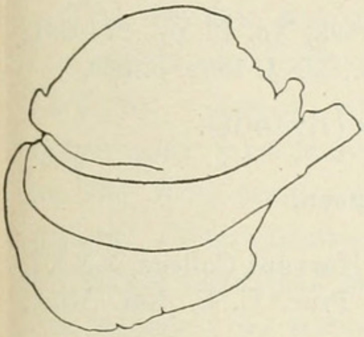

FIG. 66.—IONE THOMPSONI, FIRST LAMELLA OF MARSUPIUM. ×10.

The species is named for Mr. Millett T. Thompson, from whom the specimens were received.

Type.—Cat. No. 29091, U.S.N.M.

This species is apparently very close to *I. cornuta*, Spence Bate, from Vancouver Island. It agrees with *I. cornuta* in the absence of the elongated epimeral lobes (lames pleurales), in which both species differ from *I. thoracica* (Montagu). *Ione thompsoni* and *I. cornuta* are both much larger species than *I. thoracica*. In the description of *I. cornuta*,[a] the author says that the coxæ of the three posterior segments of the thorax are larger than the four anterior, and are produced posteriorly to a point. This is not true of *I. thompsoni*, in which the epimera of the three posterior thoracic segments are smaller than those of the anterior segments, although they occupy the entire lateral margin, and they are rounded posteriorly and not produced to a point. Spence Bate also speaks, in reference to *I. cornuta*, of the antero-lateral "horn-like process of the cephalon[b] curving posteriorly." In *I. thompsoni*, these lateral processes or lobes extend out straight at the sides. Bate and Westwood, in describing *I. cornuta*, state that the last pair of inner saccular branches of the pleopoda are almost obsolete. There are but four pairs of inner branches in *I. thompsoni*. The above quoted authors also describe the inner branches of the pleopoda as

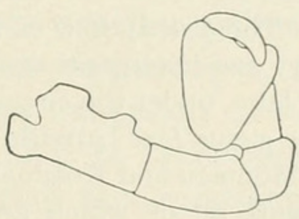

FIG. 67.—IONE THOMPSONI, LEG OF SIXTH PAIR OF ADULT FEMALE. ×11½.

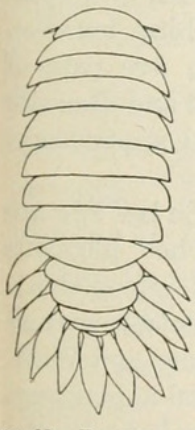

FIG. 68.—IONE THOMPSONI, MALE. ×8.

[a] Proc. Zool. Soc. London, 1864, p. 668.
[b] British Sessile-eyed Crustacea, II, 1867, p. 254.

gradually diminishing in size to the last pair, whereas the outer branches gradually increase in size. This is not true of *I. thompsoni.*[a]

PHYLLODURUS ABDOMINALIS Stimpson.

Phyllodurus abdominalis STIMPSON, Journ. Bost. Soc. Nat. Hist., VI, 1857, p. 71.—LOCKINGTON, Proc. Cal. Acad. Sci., VII, 1877, Pt. 1, p. 57; Ann. Mag. Nat. Hist., 1878, pp. 299, 300.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 868.

Locality.—Puget Sound; Tomales Bay, California, "on *Upogebia pugettensis;*" San Francisco Bay on *Upogebia pugettensis.*

PSEUDIONE GIARDI Calman.

Pseudione giardi CALMAN, Ann. N. Y. Acad. Sci., XI, 1898, No. 13, pp. 274–281, pl. XXXIV, fig. 5.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 869.

Locality.—Puget Sound, on *Pagurus ochotensis* (Brandt).

PSEUDIONE GALACANTHÆ Hansen.

Pseudione galacanthæ HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 118–120, pl. V, fig. 22*i*.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 869.

Locality.—Gulf of California, in the branchial cavity of *Galacantha diomedeæ* var. *parvispina* Faxon; near Flattery Rocks, Washington, parasitic on *Munida quadrispina* Benedict. (Collected by U. S. Fish Commission steamer *Albatross.*)

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[a] The descriptions of the type species, *Ione thoracica* (Montagu), are so unsatisfactory and inadequate and so much at variance when compared that the only action to take, under the circumstances, is to place the form described above tentatively in the genus *Ione* Latreille and to give it a new specific name.

Montagu and Kossman describe the pleon of *Ione thoracica* as composed of six segments, all of which are produced laterally into arborescent, branching lamellæ. Montagu in his figure, however, represents but four segments, with five pairs of branching lamellæ. Milne Edwards, Bate and Westwood, and Giard and Bonnier describe six segments, with only the first five produced into ramified appendages. The appendages of the last segment are described as simple, recurved.

Montagu mentions also six simple, recurved appendages, of which the last two are larger than the rest. Kossman describes six pairs of double-branched pleopods (pleopodoiden) and also a single pair of simple, cylindrical uropoda (pleopoden). Milne Edwards says that the first (appendages of the first five segments?) carry at their base a little "écaille" folded beneath, under the abdomen. Bate and Westwood refer to the pleopoda in the following way: "Several of the basal appendages are, moreover, furnished at the base beneath with a small scale, lying beneath the tail." Finally, Giard and Bonnier, characterize these appendages in this way: "Rames des Pléopodes composés de six articles."

The species herein described as new seems close to *Ione cornuta* Spence Bate. In the original description of *Ione cornuta* the pleopoda are simply described as "long and fringed with arborescent branchiæ." Bate and Westwood mention the jointed character of these appendages (pleural lamellæ), and give a much fuller description of the species.

PSEUDIONE FURCATA, new species.

Body of female longer than broad, more or less ovate.

Head with frontal border; anterior margin nearly straight; posterior portion narrowly rounded. Head small and deeply immersed in thorax. Mouth parts and antennæ concealed by first lamellæ of marsupium. The first antennæ are composed of three, the second of four joints.

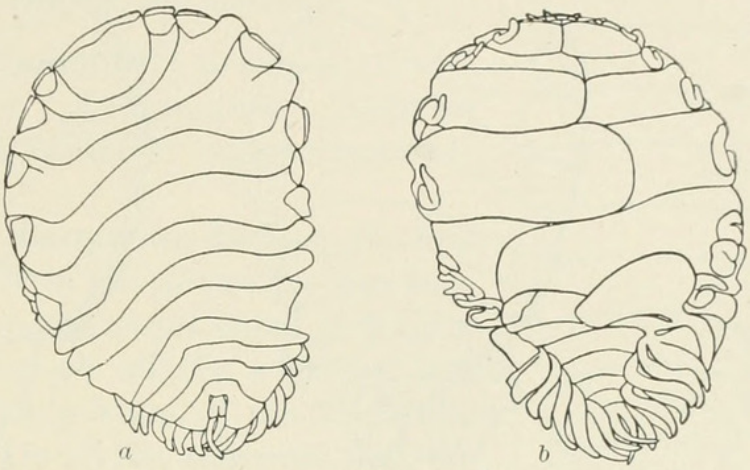

FIG. 69.—PSEUDIONE FURCATA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 4.

The thorax has all the segments distinct. Ovarian bosses are large and prominent on the first four segments. The epimera on these segments are represented by narrow ridges lateral to the ovarian bosses; those of the three last segments occupy all of the lateral margin.

The segments of the abdomen are all distinct with the epimera produced in wide plates on either side of the narrow middle portion of the segment. The sixth or terminal segment is without epimera, and terminates posteriorly in two small, rounded lobes. The pleopoda are five pairs of smooth, narrow, elongated biramous appendages, all similar and equal in size, with the exception of the inner branch of the first pair, which is exceedingly large and is inwardly directed, meeting the corresponding branch of the opposite side in the median ventral line, just below the incubatory pouch. All the remaining branches are directed post-laterally. The surfaces of all the lamellæ are quite smooth. The uropoda consist of a single pair of simple appendages, similar in shape and size to the pleopoda.

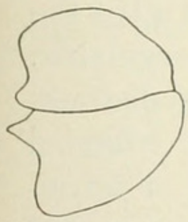

FIG. 70.—PSEUDIONE FURCATA, FIRST LAMELLA OF MARSUPIUM.

The incubatory pouch consists of five pairs of large lamellæ, overlapping in the median line. First pair of plates with the terminal lobe not defined.

There is a high and widely rounded expansion or carina on the basis of all the legs.

Male unknown.

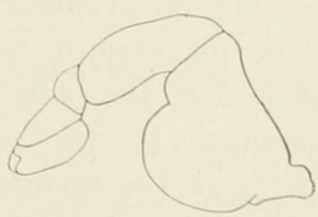

FIG. 71.—PSEUDIONE FURCATA, LEG OF SIXTH PAIR OF ADULT FEMALE. × 20½.

Four specimens were collected on the eastern shore of Virginia by Prof. H. E. Webster. Host unknown. They were sent from Union College to the Smithsonian Institution.

Type.—Cat. No. 29093, U.S.N.M.

PSEUDIONE CURTATA, new species.

Head very large, with wide anterior margin, almost straight; no frontal border. Antero-lateral portion produced in a small process on either side. Posterior portion widely rounded. Eyes wanting.

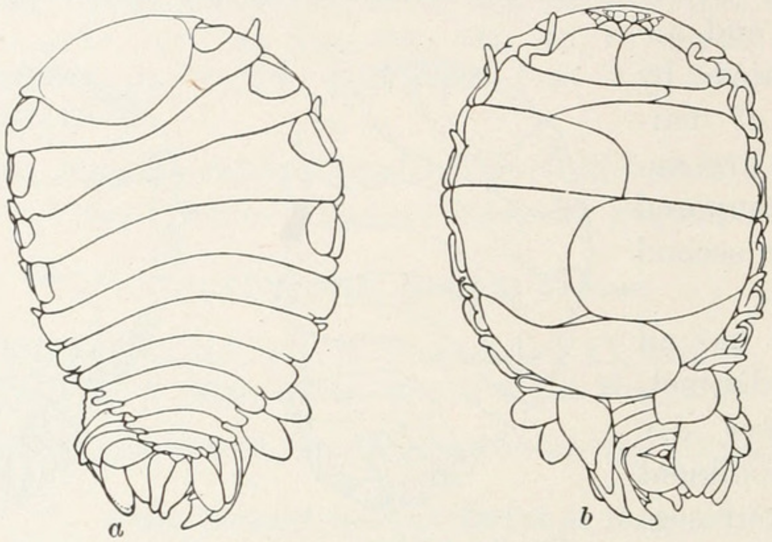

FIG. 72.—PSEUDIONE CURTATA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. ×8.

The segments of the thorax are distinct. The epimera are distinct as narrow plates on the extreme lateral margin of the anterior portion of the first four segments. Ovarian bosses are prominent on the anterior portion of the first four segments. The epimera occupy almost all of the lateral margin of the three posterior segments.

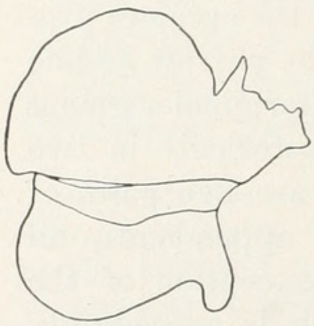

FIG. 73.—PSEUDIONE CURTATA, FIRST LAMELLA OF MARSUPIUM. ×14½.

The abdomen has the six segments distinct. All are produced laterally in small rounded epimera with the exception of the last; or terminal segment which is very small and rounded posteriorly.

The pleopoda are five pairs of large, broad, smooth, leaf-like, double-branched appendages not concealed on the dorsal side by the small epimeral plates of the abdominal segments, from which they project in full view. The uropoda are a pair of single-branched, simple appendages, similar in shape to the branches of the pleopoda.

The marsupium is formed of five pairs of incubatory lamellæ, which overlap so as to completely encompass the ventral surface of the body; the first pair have the terminal lobe of the distal segment small, but well defined.

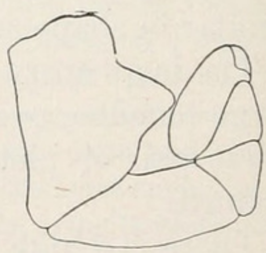

FIG. 74.—PSEUDIONE CURTATA, LEG OF SIXTH PAIR OF ADULT FEMALE. ×39.

There are seven pairs of small legs, all similar in size and structure; a high triangularly shaped expansion or carina is present on the basis.

Color uniformly light yellow.

Male, two and one-third times longer than broad, with all seven segments of the thorax and all six segments of the abdomen distinct.

Eyes present. Abdomen occupies one-fourth of the entire length of the body.

Only one specimen was found at Key West by Henry Hemphill. Parasitic on *Petrolisthes sexspinosus* (Gibbes).

Type.—Cat. No. 29094, U.S.N.M.

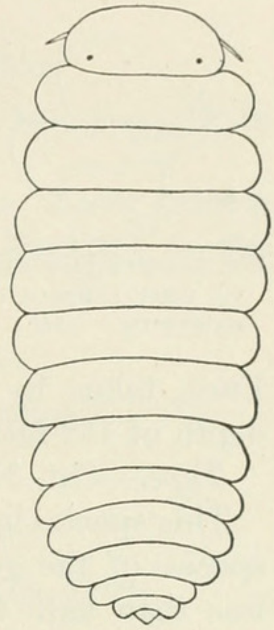

FIG. 75.—PSEUDIONE CURTATA, MALE. ×23.

MUNIDION PARVA, new species.

Head large, broader anteriorly than posteriorly, with wide frontal border. Eyes wanting. Anterior margin nearly straight, posterior margin narrowly rounded.

The segments of the thorax are distinct, the first two of which are short in the dorsal median line. The other five segments are about equal in length. Ovarian bosses present on all the segments and occupying the posterior portion of the sublateral part of the segment. On all the segments they are in the form of petiolated processes. The epimera are large plates which occupy the whole of the lateral margin of the segments. These plates are larger on the posterior segments than on the anterior ones.

The abdominal segments are all distinct. The first five are produced laterally in epimeral lobes, elongated and leaf-shaped, decreasing in size gradually from the first to the fifth segments. These lobes do not cover the dorsal surface of the abdomen, or obscure the small terminal segment, which is visible dorsally as a small rounded petiolated process.

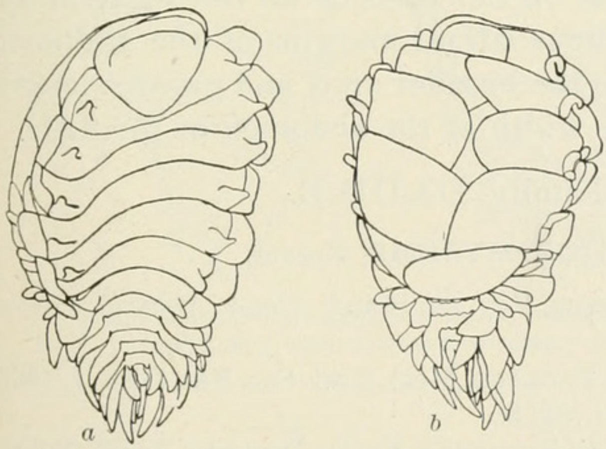

FIG. 76.—MUNIDION PARVA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. ×8.

The pleopoda are five pairs of double-branched elongated leaf-like appendages; the inner branches are smaller than the outer. The uropoda consist of a pair of biramous appendages, each with one large outer and one small inner branch, similar in shape to the branches of the pleopoda.

The ventral side of the abdominal segments is keeled on the posterior margin. The pleopoda and abdominal epimera are somewhat carinated on both surfaces.

The marsupium is bounded by five pairs of incubatory lamellæ, the third pair of which do not overlap in the median ventral line, so that a small opening is left into the incubatory pouch. The terminal lobe of the distal segment of the first pair is very small, but well defined.

The seven pairs of legs are all similar; the basis is furnished with an extremely high expansion, the anterior end of which is twice as high as the other end.

FIG. 77.—MUNIDION PARVA, FIRST LAMELLA OF MARSUPIUM. ×14½.

The male has all the segments of the thorax distinct. The segments of the abdomen are fused into a single piece. There are no indications of the coalesced segments on the lateral margins of the abdomen, these margins being entire. The posterior portion of this segment is narrower than the anterior portion, its apex, however, being widely rounded. Its length is about one and one-half times its greatest breadth. Eyes are present.

Only one specimen comes from the Straits of Fuca, taken by the U. S. Fish Commission steamer *Albatross* at a depth of 152 fathoms. Parasitic on *Munida quadrispina* Benedict.

Type.—Cat. No. 29095, U.S.N.M.

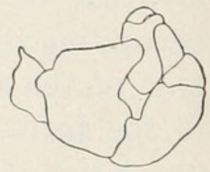

FIG. 78.—MUNIDION PARVA, LEG OF SIXTH PAIR OF ADULT FEMALE. ×20½.

This species is a very much smaller one than the type species of the genus described by Dr. Hansen,[a] being less than half the size of *Munidion princeps*. The present species differs from the type species in its much smaller size; in the relatively larger and differently shaped head; in the larger thoracic epimera (pleural plates); in the differently shaped ovarian bosses; in the smaller and differently shaped abdominal epimera, which do not conceal the abdominal segments dorsally as in that species; in the differently shaped carina on the basis of all the legs; in the absence of the sinuous lateral margins of the abdomen of the male; and in the broader apex and greater length compared with the width of the abdomen of the male.

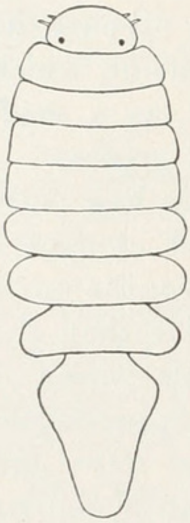

FIG. 79.—MUNIDION PARVA, MALE. ×23.

Family DAJIDÆ.

DAJUS MYSIDIS Krøyer.

Dajus mysidis KRØYER, Voy. en. Scand., Crust., 1849, pl. XXVIII, fig. 1.

Bopyrus mysidium PACKARD, Mem. Bost. Soc. Nat. Hist., I, 1867, p. 295, pl. VIII, fig. 3.

Leptophryxus mysidis BUCHHOLZ, Zweite Deutsche Nordpolfahrt, 1874, p. 288, pl. XI, fig. 2.

Dajus mysidis LÜTKEN, Crustacea of Greenland, 1875, p. 150.—G. O. SARS, Arch., Math. Nat., II, 1877, p. 354 (254).—SMITH in Harger, Proc. U. S. Nat. Museum, II, 1879, p. 158.—HARGER, Rep. U. S. Fish Comm., 1880, Pt. 6, p. 312.—G. O. SARS, Crustacea of Norway, II, Pts. 11, 12, 1898, p. 223–225, pl. XXVIII, fig. 1.—RICHARDSON, Proc. U. S. Nat. Museum, XXIII, 1901, p. 579.

Locality.—Labrador; Greenland; Kingigtok; Duck Island; Murchison Sound; 73° 48′ N. lat., 80° 30′ W. long.; 72° 33′ N. lat., 71° 30′ W. long; 71° 57′ N. lat., 73° 56′ W. long.; 66° 33′ N. lat., 61° 50′ W. long.;

[a] Bull. Mus. Comp. Zool. Harvard College, XXXI, No. 5, Pt. 22, The Isopoda, 1897, pp. 115–117, pl. IV, figs. 2–2*c*; pl. V, figs. 1–1*d*.

64° 56′ N. lat., 66° 18′ W. long.; also recorded from west coast of Norway, Kara Sea, Sabine Island, Spitzberg, Jan Mayen, Murman coast.

Depth.—3 to 20 fathoms.

Family CRYPTONISCIDÆ.

CLYPEONISCUS MEINERTI Giard and Bonnier.

Clypeoniscus meinerti GIARD and BONNIER, Bull. Scientifique de la France et de la Belgique, (4) XXV, 1893, pp. 421–436, 444.

Locality.—Greenland (Godhavn), 8 to 10 fathoms; Nova Zembla (Jugor Schar), 6 fathoms, (Giard and Bonnier). Parasitic in the incubatory pouch of *Synidotea nodulosa* (Krøyer).

SOUTH AMERICAN EPICARIDEA.

EPICARIDEA or BOPYROIDEA.

Family BOPYRIDÆ.

STEGOPHRYXUS RESUPINATUS (Müller).

Bopyrus resupinatus MÜLLER, Jen. Zeitschrift Nat., VI, 1871, pp. 57–60.
Phryxus resupinatus STEBBING, Hist. Crust., 1893, p. 409.
Stegophryxus resupinatus THOMPSON, Report U. S. Fish Comm., 1901, p. 56.

Locality.—Brazil, on a Pagurid.

PSEUDIONE GALACANTHÆ Hansen.[a]

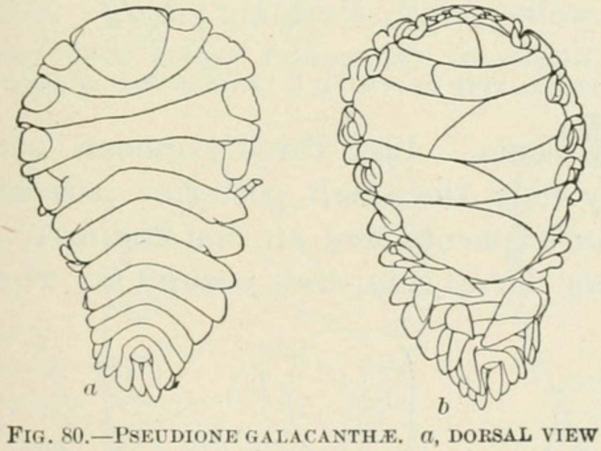

FIG. 80.—PSEUDIONE GALACANTHÆ. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 8.

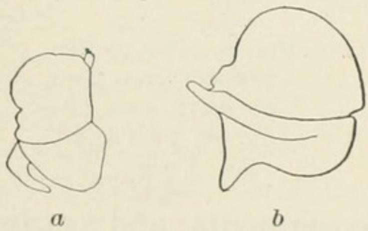

FIG. 81.—PSEUDIONE GALACANTHÆ. *a*, MAXILLIPED. × 11½; *b*, FIRST LAMELLA OF MARSUPIUM, RIGHT SIDE. × 15.

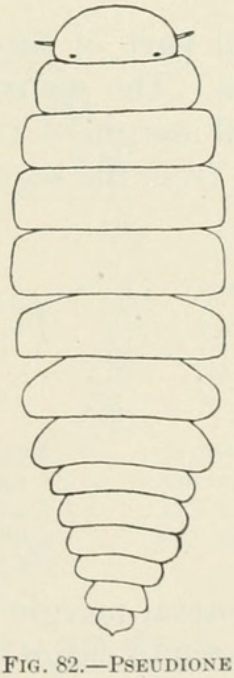

FIG. 82.—PSEUDIONE GALACANTHÆ, MALE. × 23.

Pseudione galacanthæ HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 118–120, pl. v, fig. 22*i*.—RICHARDSON, Proc. U. S. Nat. Mus., XXI, 1899, p. 869.

[a] This species is again figured, for the reason that it is found parasitic on a different species of host, and is from a different locality from that of the type specimen.

Locality.—Off east coast of Patagonia, two specimens parasitic on *Munida subrugosa.* Collected by U. S. Fish Commission steamer *Albatross.*

PSEUDIONE TUBERCULATA, new species.

Head small, with frontal border; anterior margin straight; posterior portion narrowly rounded.

Segments of thorax distinct. Ovarian bosses present on antero-

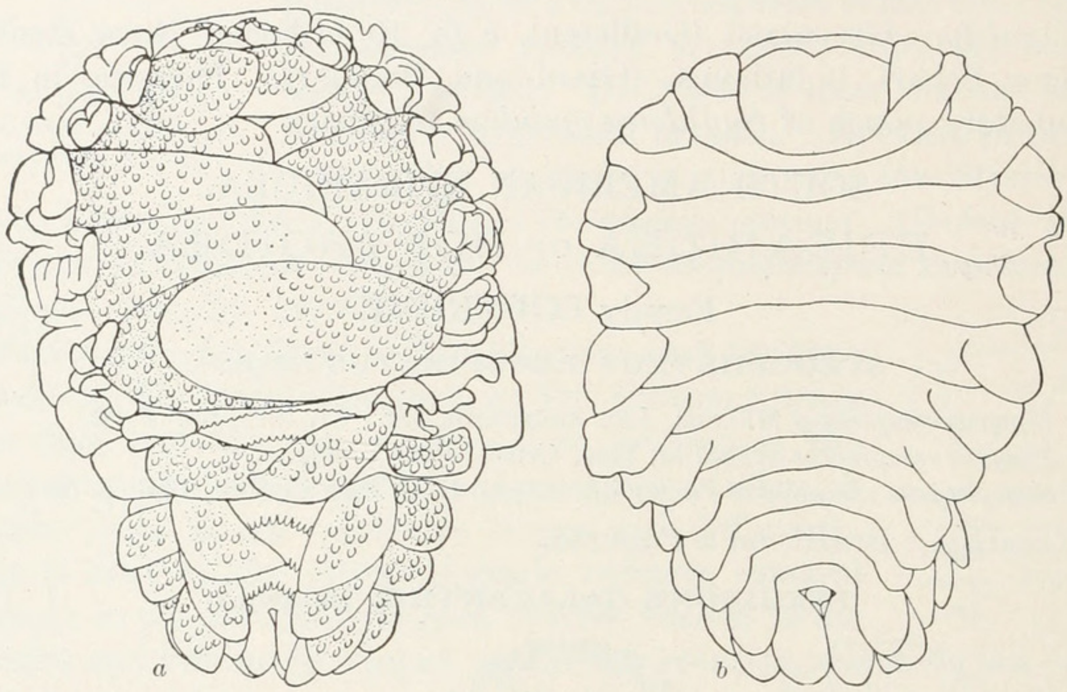

Fig. 83.—Pseudione tuberculata. *a*, dorsal view of female; *b*, ventral view of same. ×4.

lateral part of first four segments. Last three segments without bosses. The epimera occupy only the small posterior part of the lateral margin of the first four segments, and are not distinctly separated from the segments on the dorsal side; they occupy the whole of

Fig. 84.—Pseudione tuberculata, maxilliped. ×5.

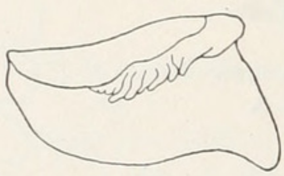

Fig. 85.—Pseudione tuberculata, distal segment of first lamella of marsupium. ×10.

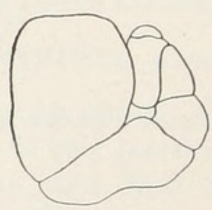

Fig. 86.—Pseudione tuberculata, leg of sixth pair of adult female. ×11½.

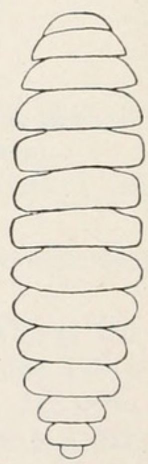

Fig. 87.—Pseudione tuberculata, male. ×8.

the lateral margin of the last three segments, and are in the form of large plates, extending somewhat backward.

The segments of the abdomen are distinct. The epimera of the abdominal segments form large plates on either side of the segments. They are present on all but the last or terminal segment, and are not distinctly separated from the segments. The epimera almost entirely conceal, on the dorsal side, the underlying pleopoda. The terminal segment is bilobate posteriorly, with a small median point. The posterior edge of the ventral side of all the abdominal segments is strongly keeled. The pleopoda are five pairs of double-branched, broad, leaf-like appendages, distinctly tuberculate. The inner branches of the first pair overlap in the median ventral line.

The marsupium is composed of five pairs of strongly tuberculate lamellæ, overlapping in the median ventral line of the thorax, and entirely inclosing the incubatory pouch.

There are seven pairs of legs similar in shape and structure. A wide expansion extends the entire length of the basis.

Color, uniformly light yellow.

Males, three and a half times longer than broad, with all seven segments of thorax and all six of abdomen distinct. Eyes wanting. Abdomen occupies more than one-third of the entire length of the body.

About thirteen specimens were obtained by the U. S. Fish Commission steamer *Albatross*, from off Port Ortway, Patagonia, at a depth of 1,050 fathoms. Parasitic on *Lithodes diomedeæ* Benedict.

Type.—Cat. No. 29092, U.S.N.M.

PSEUDIONE PAUCISECTA, new species

Body of female ovate, twice as long as wide, twisted somewhat to one side. Color, uniformly light yellow.

Head very large, triangular in shape, with frontal margin widely

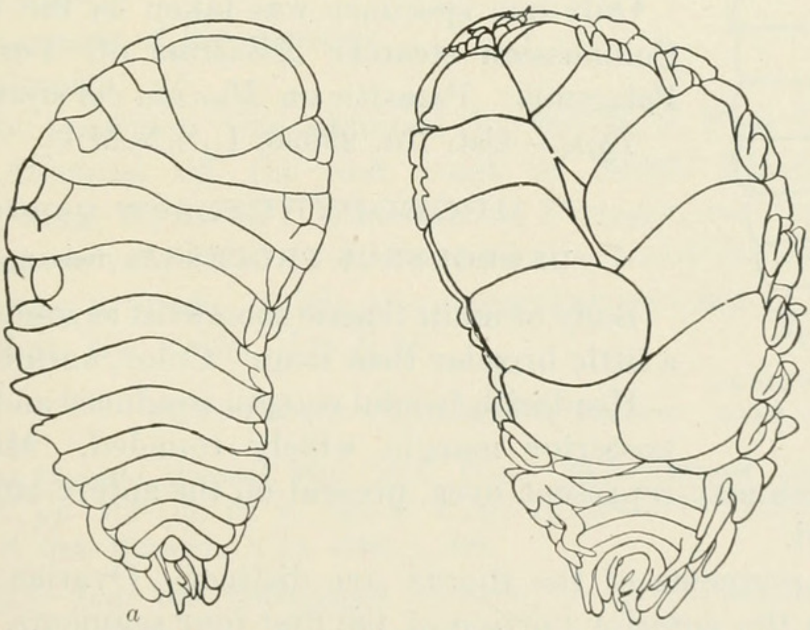

FIG. 88.—PSEUDIONE PAUCISECTA. *a*, DORSAL VIEW OF FEMALE; *b*, VENTRAL VIEW OF SAME. × 8.

rounded or arcuate. A wide frontal border, somewhat irregular in outline, surrounds the anterior portion. Eyes absent. First pair of antennæ consist of three joints; second pair of five joints.

Ovarian bosses present on the anterior portion of the first four thoracic segments; lateral to these, on the anterior portion of the segments, are the wide epimeral plates, which have a tendency to be irregular along the lateral margin. The epimera occupy the whole of the lateral margin of the three posterior segments, and are produced laterally into irregular processes.

The segments of the abdomen are distinct with the epimera extending as narrow, elongated plates on either side of the first five segments. Terminal segment knoblike in appearance with well-rounded margins.

FIG. 89.—PSEUDIONE PAUCISECTA, FIRST LAMELLA OF MARSUPIUM. ×10.

Pleopoda consist of five pairs of double-branched, narrow, elongated tapering lamellæ directed backward, the inner branches being smaller than the outer branches in the last two segments. The uropoda are a single pair of lamellæ, both lamellæ being irregular in outline.

The five pairs of incubatory plates completely inclose the incubatory pouch, meeting in the median ventral line. The terminal lobe of the distal segment of the first pair is not defined. All the legs have a high and narrowly rounded expansion or carina about the middle of the basis.

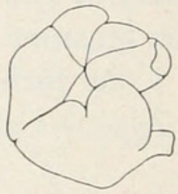

FIG. 90.—PSEUDIONE PAUCISECTA, LEG OF SIXTH PAIR OF ADULT FEMALE. ×20½.

The male is twice as long as broad. Head transverse; eyes absent. Segments of thorax of equal length. Abdomen short, occupying less than one-sixth of the entire length and composed of only five segments, all distinct, with terminal segment small, rounded.

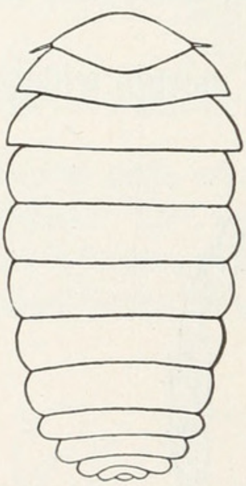

FIG. 91.—PSEUDIONE PAUCISECTA, MALE. ×14½.

Only one specimen was taken by the U. S. Fish Commission steamer *Albatross* off Port Ortway, Patagonia. Parasitic on *Munida curvipes* Benedict.

Type.—Cat. No. 29096, U.S.N.M.

UROBOPYRUS, new genus.

UROBOPYRUS PROCESSÆ, new species.

Body of adult female somewhat asymmetrical, and a little broader than long. Color, uniformly white. Head with frontal margin produced and upturned; posterior margin widely rounded. Markings of black, which may represent eyes, present on the antero-lateral angles of the head.

All the segments of the thorax are distinct. Ovarian bosses are present on the anterior portion of the first four segments. The epimera of these segments are represented by narrow plates on the outer margin of the segments, lateral to the ovarian bosses. On the three posterior segments the epimera are produced as large plates, larger on one side than on the other, beyond the margin of the segments.

All six segments of the abdomen distinct. The lateral margins are rounded, the lateral parts not being produced. The terminal segment is bi-lobed.

The uropoda are a pair of double-branched appendages attached to the terminal abdominal segment; the inner branches are smaller and more slender than the outer branches.

The pleopoda consist of five pairs of double-branched, elongated lamellæ, the inner branches being smaller than the outer and directed inward, the outer branches extending beyond the margins of the abdomen.

The incubatory lamellæ consist of five pairs of plates affixed to the sides of the thorax, five on either side. They do not completely cover

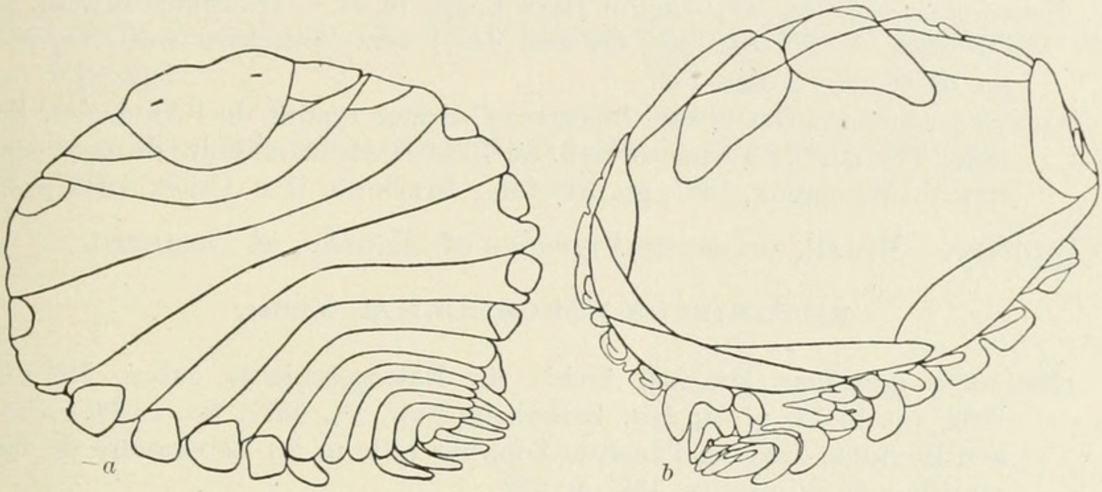

FIG. 92.—UROBOPYRUS PROCESSI. *a*, DORSAL VIEW OF FEMALE: *b*, VENTRAL VIEW OF SAME. × 14½.

the incubatory pouch, but a large area remains open, which is normally filled with eggs.

All seven pairs of legs present.

Male unknown.

A single specimen was obtained by the U. S. Fish Commission steamer *Albatross* off the east coast of South America, lat. N. 6° 59′ 30″, long. W. 34° 47′. Parasitic on *Processa canaliculata* Leach.

This genus is very close to *Probopyrus* Giard and Bonnier, but differs in having uropoda, which are altogether wanting in that genus.

Type.—Cat. No. 29098, U.S.N.M.

CRYPTIONE ELONGATA Hansen.

Cryptione elongata HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 112–115, pl. III, figs. 5, 5ᵃ; pl. IV, figs. 1–1ᵍ.—RICHARDSON, Proc. U. S. Nat. Museum, XXI, 1899, p. 869.

Locality.—Near the Galapagos Islands, in the branchial cavity of *Nematocarcinus agassizii* Faxon, which occurs as far north as Acapulco, Mexico.

MUNIDION PRINCEPS Hansen.

Munidion princeps HANSEN, Bull. Mus. Comp. Zool. Harvard College, XXXI, 1897, pp. 115–117, pl. IV, figs. 2–2ᵉ; pl. V. fig. 1–1ᵈ.

Locality.—Cocos Island, lat. 3° 58′ 20″ N., long. 81° 36′ W., on *Munida refulgens;* off the coast of Ecuador, on *M. refulgens* Faxon. *Depth*, 112 fathoms.

GRAPSICEPON FRITZII Giard and Bonnier.

Grapsicepon fritzii[a] GIARD and BONNIER, Travaux de l'Institut zoologique de Lille et du Laboratoire de Zoologie maritime de Wimereux, V, 1887, p. 70.

Locality.—Branchial cavity of a *Grapsus* (*Leptograpsus rugulosus?*) found on the coast of Brazil, at Desterro.

Family ENTONISCIDÆ.

CANCRION CANCRORUM (Müller).

Entoniscus cancrorum MÜLLER, Für Darwin, figs. 16, 41. (Translated in Bull. Sci. du Nord, XIV, 1882, pp. 422 and 449); Jen. Zeitschrift Nat., VI, 1871, pp. 53–56, pl. III, figs. 1–3.

Cancrion cancrorum GIARD and BONNIER, Comptes rendus de l'Acad. des. Sci., 1886; Travaux de l'Institut zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, pp. 239–240.—STEBBING, Hist. Crust., 1893, p. 407.

Locality.—Brazil, on several species of *Xantho*, at Desterro.

ENTONISCUS PORCELLANÆ Müller.

Entoniscus porcellanæ MÜLLER, Archiv für Naturgeschichte, Jahrg. XXVIII, 1862, pp. 10–17, pl. II; Jen. Zeitschrift Nat., VI, 1871, pp. 53–56.—GIARD and BONNIER, Trav. de l'Institut Zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, p. 232.

Locality.—Brazil, on *Porcellana* sp. ?, at Desterro.

ENTONISCUS BRASILIENSIS Giard and Bonnier.

Entoniscus No. 2, FRITZ MÜLLER, Jenaische Zeitschrift für Naturwissenschaft, VI, 1871, p. 53.

Entoniscus brasiliensis GIARD and BONNIER, Trav. de l'Institut zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, p. 235.

Locality.—Desterro, Brazil, parasitic on *Porcellana* sp. ?

This species may be identical with the preceding species.

ENTONISCUS CREPLINII Giard and Bonnier.

Entoniscus No. 3, FRITZ MÜLLER, Jenaische Zeitschrift für Naturwissenschaft, VI, p. 54, 1871.

Entoniscus creplinii GIARD and BONNIER, Travaux de l'Institut zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, p. 236.

Locality.—Desterro, Brazil, parasitic on *Porcellana creplinii*, F. Müller.

ENTIONE ACHÆI Giard and Bonnier.

Entoniscus No. 4, FRITZ MÜLLER, Jenaische Zeitschrift für Naturwissenschaft, VI, p. 53, 1871.

Entione achæi GIARD and BONNIER, Travaux de l'Institut zool. de Lille et du Laboratoire de Zool. maritime de Wimereux, 1887, p. 237.

Locality.—Desterro, Brazil, parasitic on *Achæus* sp. ?

[a] See note under *Probopyrus alphei* (Richardson), p. 67.

Family CRYPTONISCIDÆ.

CRYPTONISCUS PLANARIOIDES Müller.

Cryptoniscus planarioides Müller, Jen. Zeitschrift Nat., VI, 1871, pp. 61-64.—Stebbing, Hist. Crust., 1893, p. 402.

Locality.—Brazil, on *Peltogaster purpureus.*

MICRONISCUS FUSCUS Fritz Müller.

Microniscus fuscus Müller, Jen. Zeitschrift Nat., VI, 1871, p. 65.

This form is probably the Microniscus stage in the development of some Epicarid.[a]

[a] See Sars, Crust. of Norway, II, Pts. 11, 12, pp. 218-220.