UNIVERSITY OF WASHINGTON PUBLICATIONS
IN
BIOLOGY

Volume 10, No. 5, pp. 155-274 December, 1947

THE CHELIFERA AND ISOPODA OF WASHINGTON AND ADJACENT REGIONS

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SEATTLE
UNIVERSITY OF WASHINGTON PRESS
1947

Issued December 31, 1947

PRINTED IN THE UNITED STATES OF AMERICA

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By MELVILLE H. HATCH

INTRODUCTION

Some years ago the author took up the collection and study of terrestrial isopods as an activity incidental to his interest in beetles and the fauna of the Pacific Northwest, especially of the state of Washington. Gradually the collection came to include, with reasonable completeness, the aquatic forms as well. Finally, as inadequacies developed in Harriet Richardson's (1905) excellent but 40-year-old *Monograph on the Isopods of North America,* it was determined to prepare a systematic account of the species for the use of persons interested in this component of the Northwest fauna.

The task has proved more complex than was at first anticipated. For the small number of species involved, the isopods represent a range of habitats almost without parallel in the animal kingdom. Moreover, with the terrestrial forms, one is in the presence of a series of common, highly cosmopolitan types to which a large amount of attention has been given by zoologists throughout the world.

The present report does not aim at accounts of the several species that are complete from either a morphological, an ecological, a distributional, or a bibliographic point of view. It concerns itself first with the differentiation, local ecology, local distribution, and previous Northwest records of the species involved. Secondly, however, it attempts to give the general setting of each species so that the user of the paper may not be entirely without world perspective. For this reason, an attempt has been made to have the descriptions full enough to exclude the more important extralimital forms, and to have the brief ecological and distributional accounts refer to the overall status of the species considered. The author has done what he could in this connection with the bibliographic sources and time at his disposal, but, especially in the matter of the Oniscoidea, the survey is at best fragmentary.[1]

Acknowledgments for specimens are due the following persons: Mrs. R. E. Barrilleaux, Frances Bjorkman Baker, Gertrude Hoppe Bash, R. H. Beamer, Arnie Brown, L. W. Bryce, Raymond Coopey, Ervin F. Dailey, Jared J. Davis, W. W. Dowdy, Kenneth M. Fender, M. J. Forsell, Harriet Exline Frizzell, C. G. Goodchild, Elville Gorham, John E. Guberlet, Don P. Haevers, R. H. Hagadorn, J. L. Hammond, E. H. Herrick, Norman Johnson, Trevor Kincaid, Herbert Knutsen, Eloise Kuntz, James E. Lynch, Borys Malkin, Rita McGrath, James A. McNab, Gertrude Minsk, Mitchell Mondala, F. O. Morrison, Neil Nellis, Robert Parker, Marion Pettibone, F. A. Pitelka, Edith Pope, Philip H. Pope, W. B. Rasmussen, Irma Rodenhouse, Bill Rumans, M. B. Schaeffer, Victor E. Shelford, G. J.

[1] Cf. the bibliographies of Van Name (1936:491-508; 1940:140-142; 1942: 328-329) and Wächtler (1937:307-317).

Spencer, Lyle M. Stanford, W. C. Stehr, Belle A. Stevens, Daniel E. Stuntz, Arthur Svihla, Cherie Tanasse, Roland Walker, E. B. Webster, Ira L. Wiggins.

Moreover, I am greatly indebted to Mr. Robert W. Rogers for assistance in collecting isopods in greenhouses in the summer of 1946, to Prof. Trevor Kincaid and Dr. Belle A. Stevens for the identification of the shrimps, and to Professor Kincaid for help in the preparation of the plates.

Especially am I indebted to Prof. Trevor Kincaid for permission to incorporate his extensive data on our two species of fresh-water isopods, and to Mr. G. M. Shearer who has allowed me to study his collection of eighteen species, mostly from Coos Bay, Oregon.

The Chelifera and Isopoda are two closely related groups of Malacostracan Crustacea which, together with the Amphipoda, are sometimes united under the names Edriophthalma Leach 1815 or Arthrostraca Burmeister 1834. From other Malacostraca the Edriophthalma are distinguished by their sessile or immovable eyes, their abdomen of seven segments or less, the three-segmented first antennal peduncle (protopodite), and by the reduction of the carapace to two thoracic segments (Chelifera) or by its complete absence (Isopoda and Amphipoda).

ORDERS OF EDRIOPHTHALMA

1. Carapace involving the first two thoracic segments and covering the branchial epipodite of the first thoracic appendage (maxilliped); second thoracic appendage (first leg) chelate; telson fused with the penultimate abdominal segment; form depressed or subcylindrical .... **CHELIFERA**

1′. Carapace absent; head fused with the first and sometimes (e. g., Caprellidea) with the second thoracic segment; second thoracic appendage (first leg) not chelate.

2. Branchial function performed by the pleopods (abdominal appendages); abdomen never aborted, the telson usually fused with the penultimate abdominal segment (except in Anthuridea); form usually depressed, rarely (Phreatoicidea) compressed............ **ISOPODA**

2′. Branchial function performed by inner appendages on the thoracic limbs (sometimes likewise on the first abdominal segment); telson usually distinct from the penultimate abdominal segment, the abdominal segments in Caprellidae generally fused and aborted with vestigial appendages; form typically compressed, sometimes cylindrical (*Rhabdosoma*, Caprellidae) or depressed (*Pereionotus*, Cyamidae) .... **AMPHIPODA**

Only the Chelifera and Isopoda are treated in the present study, which is based primarily on specimens in the author's collection at the University of Washington. The material from Coos Bay, Oregon, is in the collection of Mr. G. M. Shearer and is so designated in the text. A total of 7 species of Chelifera and 70 species of Isopoda are known from the Pacific Northwest, of which 2 and 55, respectively, are known from Washington, 7 and 38 from British Columbia, 0 and 29 from Oregon, and 0 and 7 from Idaho. Of these, 2 species of Chelifera and 60 species of Isopoda are known to the author from actual specimens.

LIST OF SPECIES[2]

Order CHELIFERA

Family TANAIDAE

Heterotanais Sars
  **melacephala* Fee. B.C., s
Leptochelia Dana
  filum Stimpson. B.C., Wash., i
  dubia Krøyer. B.C., Wash., si
Paratanais Dana
  **nanaimoensis* Fee. B.C., s
Tanais Adouin and Edwards
  **loricatus* Bate. B.C., s
  **normani* Rich. B.C., s
Leptognathia Sars
  **longiremis* Lilljeborg. B.C., s

Order ISOPODA

Suborder Asellota

Superfam. ASELLOIDEA

Family ASELLIDAE

Asellus Geoffroy
 (*Asellus* s. str.)
  tomalensis Harford. B.C., Wash., Ore., f
 (*Conasellus* Stammer)
  communis Say. Wash., f

Superfam. PARASELLOIDEA

Family JANIRIDAE

Janira Leach
  maculosa Leach. B.C., Wash., si
  occidentalis Walker. Wash., si
  solasteri sp. nov. Wash., s
Ianiropsis Sars
  pugettensis sp. nov. Wash., i
Jaera Leach
  **wakishiana* Bate. B.C., s
Jaeropsis Koehler
  lobata Rich. Ore., i

Family MUNNIDAE

Munna Krøyer
  minuta Hansen. Wash., i
  kroyeri Goodsir. B.C., Wash., s

[2] Symbols are used throughout this list, as follows: *—not seen by author; i—intertidal; f—fresh-water; l—littoral; s—sublittoral; t—terrestrial.

Suborder Oniscoidea

Superfam. PROTOPHORA ARCHAICA

Family Ligiidae

Ligia Fab.
  (*Ligia* s. str.)
    pallasii Br. B.C., Wash., Ore., l
Ligidium Br.
  (*Ligidium* s. str.)
    gracile Dana. B.C., Wash., Ore., t

Superfam. ENDOPHORA

Family Trichoniscidae

Subfam. Trichoniscinae

Trichoniscus Br.
    demivirgo Blake. Wash., t
    species? Ore., t
Cordioniscus Graeve
    stebbingi Patience. Ore., t
Oregoniscus gen. nov.
    **nearcticus* Arcangeli. Ore., t

Superfam. EMBOLOPHORA

Family Scyphacidae

Subfam. Scyphacinae

Detonella Lohmander
    papillicornis Rich. B.C., Wash., l

Subfam. Armadilloniscinae

Armadilloniscus Uljanin
    tuberculatus Holmes & Gay. Wash., l

Family Oniscidae

Subfam. Oniscinae

Philoscia Latr.
  (*Littorophiloscia* subg. nov.)
    richardsonae Holmes & Gay. Wash., l
  (*Philoscia* s. str.)
    muscorum Scop. Wash., t
Alloniscus Dana
    perconvexus Dana. B.C., Wash., Ore., l
Oniscus L.
    asellus L. B.C., Wash., Ore., t

Family PORCELLIONIDAE

Porcellionides Miers
pruinosus Br. B.C., Wash., Ore., Id., t
Porcellio Latr.
(*Porcellio* s. str.)
scaber var. *niger* Say. B.C., Wash., Ore., Id., t
dilatatus Br. B.C., Wash., Ore., Id., t
Trachelipus Budde-Lund
rathkei Br. B.C., Wash., Ore., Id., t
Cylisticus Schnitzler
convexus DeG. B.C., Wash., Id., t

Family ARMADILLIDIIDAE

Armadillidium Br.
(*Pseudosphaerium* Verh.)
nasatum B.-L. B.C., Id., t
(*Armadillidium* s. str.)
vulgare Latr. B.C., Wash., Ore., Id., t

Suborder Flabellifera

Family CIROLANIDAE

Cirolana Leach
harfordi Lockington. B.C., Wash., Ore., si
**vancouverensis* Fee. B.C., i
kincaidi sp. nov. Wash., Ore., i

Family AEGIDAE

Aega Leach
**symmetrica* Rich. B.C., s
Rocinela Leach
belliceps Stimpson. B.C., Wash., s
subsp. *pugettensis* nov. Wash., s
tridens sp. nov. Wash., s
propodialis Rich. Wash., s
angustata Rich. B.C., Wash., s

Family CYMOTHOIDAE

Livoneca Leach
vulgaris Stimpson. Wash., Ore., s
californica Schioedte & Meinertz. B.C., Wash., s

Family LIMNORIIDAE

Limnoria Leach
lignorum Rathke. B.C., Wash., Ore., si

Family SPHAEROMIDAE

Tecticeps Rich.
pugettensis sp. nov. Wash., s
Exosphaeroma Stebbing (213)
amplicauda Stimpson. Wash., i
oregonensis Dana. B.C., Wash., Ore., sif

Dynamene Leach
  glabra Rich. Ore., i
  sheareri sp. nov. Ore., i
  dilatata Rich. Ore.
Cymodoce Leach
  japonica Rich. Wash., si

Suborder Valvifera

Family Idotheidae

Mesidotea Rich.
  entomon L. B.C., Wash., Ore., sif
Pentidotea Rich.
  wosnesenskii Br. B.C., Wash., Ore., si
    var. *exlineae* nov. Wash., i
  stenops Benedict. Ore., i
  whitei Stimpson. Wash., i
  resecata Stimpson. B.C., Wash., si
Idothea Fab.
  fewkesi Rich. B.C., Wash., Ore., si
  urotoma Stimpson. Wash., i
  ochotensis Br. B.C., Wash., si
  rufescens Fee. B.C., Wash., s
Synidotea Harger
  *"*bicuspida* Owen." Wash.
  nebulosa Benedict. Wash., si
  angulata Benedict. Wash., s
  ritteri Rich. Ore., i
  pettiboneae sp. nov. Wash., s
  **nodulosa* Krøyer. B.C., s

Suborder Epicaridea

Tribe BOPYRINA

Family Bopyridae

Munidion Hansen
  **parvum* Rich. B.C., Wash., s
Pseudione Kossman
  **giardi* Calman. Wash., s
  galacanthae Hansen. B.C., Wash., s
Phyllodurus Stimpson
  **abdominalis* Stimpson. B.C., Wash., s
Argeia Dana
  pugettensis Dana. B.C., Wash., Ore., s
Bopyroidea Stimpson
  hippolytes Krøyer. B.C., Wash., Ore., s
Ione Latr.
  **cornuta* Bate. B.C., s
Phryxus Rathke
  abdominalis Krøyer. B.C., Wash., si

Order CHELIFERA Sars 1882

Tanaidea Gerstaecker 1886
Anisopoda Claus 1888
Tanaidacea Hansen 1895
Tanaioidea Richardson 1902:278
Tanoidea Fee 1926:4

The Chelifera are a small group of bottom-dwelling marine and brackish-water Crustacea, with two species occurring in fresh water in South America (Van Name 1936:417-421). They range in size from 1 to 15 or 20 millimeters, being for the most part nearer the lower than the upper limit of this range. They occur to depths of 4000 meters. "Many burrow in mud, some inhabit tubes of mud agglutinated by the secretion of the dermal glands, and several species . . . are recorded as living in rock-crevices among a felt-like mass of filaments, presumably also secreted by the animals" (Calman).

Up to 1925, 34 genera and 239 species were known from all seas. Sars (1899) recorded 28 species from Norway; Nierstrasz and Stekhoven (1930), 33 species from the North Sea and the Baltic; and Richardson (1905), 24 species from North America, including two from California and one from southern Vancouver Island. Fee (1926) added five species from southern Vancouver Island. The present author has taken two of these in Washington, but more adequate collecting will probably reveal others.

Bibliography. Sars 1899:4-42, pl. 1-18.—Richardson 1905:3-54, figs. 1-40.—Calman 1909:190-195.—Fee 1926:4-11, figs. 1-11.—Zimmer 1927:683-696, figs. 693-718.—Nierstrasz & Stekhoven 1930:134-167, 40 figs.

Key to Family and Genera of Chelifera

Body not narrowed posteriorly; first antenna with only one flagellum or none, usually well developed in male, not so in female; mandible lacking a palp.......TANAIDAE

1. Eyes present
2. Uropods biramous; five pairs of pleopods present
3. Inner branch of uropod many-segmented
4. Gnathopods not extensively developed in male.......**Heterotanais** Sars

4′. Gnathopods of male extensively developed, with tuberculate processes on the cutting margin.......**Leptochelia** Dana

3′. Inner branch of uropod two-segmented.......**Paratanais** Dana

2′. Uropods uniramous; three pairs of pleopods present.......**Tanais** Adouin & Edwards

1′. Eyes lacking.......**Leptognathia** Sars

Family Tanaidae

Heterotanais Sars

Length 2 mm. (figs. 7-11).......**melacephala** Fee

Habitat. In mud and fine sand at depth of 10 fathoms.
Distribution. BRITISH COLUMBIA: Gabriola Pass (*Fee*).
Bibliography. Fee 1926:21, figs. 7-11.

Leptochelia Dana

1. Exopodite of uropod with one or two segments, endopodite with three or four segments; length 1.5 (male) to 2.5 (female) mm. (fig. 161) .... **filum** Stimpson

Stimpson speaks of the uropod as "of four or five articles," including, presumably, the peduncle. Wallace describes the exopodite as having "two very short articles . . . which usually have a stout hair at the joint between them" and the endopodite as having four distinct articles. Fee describes the endopodite with four articles and the exopodite as "small and imperfectly bi-articulate." I count one segment in the exopodite and three in the endopodite in my specimens, which may represent another species.

Distribution. Bay of Fundy and Gulf of St. Lawrence (*Richardson*). BRITISH COLUMBIA: Departure Bay (*Fee*). WASHINGTON: Seattle (Carkeek Park, 2 females, intertidal).

Bibliography. Stimpson 1853:43-44 (*Tanais*).—Richardson 1905:23, 31-32.—Wallace 1919:12-16, fig. 4.—Fee 1926:20.

1′. Exopodite of uropod with one segment, endopodite with five segments; male with basal segment of first antenna about one-third the length of the entire antenna, which is about half the length of the body; male chelipeds with the carpus extending beyond the apex of the basal segment of the first antenna, the digital process of the propodus longer than the basal portion of the segment and armed with two teeth; length to 4.75 mm. (figs. 15-21) .... **dubia** Krøyer

Taken by washing sand at the strand line during low tide. Richardson records specimens from dead coral, and Fee records them from near the surface on hydroids and algae, from 15 to 20 fathoms in soft gray mud and sand, and from 25 fathoms in a sponge bed. Dr. J. E. Lynch describes specimens at Seattle as occurring intertidally in very flimsy slime tubes, similar to those of the amphipod *Corophium* but flimsier.

Distribution. Brazil (type locality), Puerto Rico, Bermuda (*Richardson* 1905); Jamaica (*Richardson* 1912); Ireland, Red Sea, Hawaiian Is. (*Miller*). BRITISH COLUMBIA: Departure Bay (*Fee*). WASHINGTON: Lopez Is. (Fisherman's Bay), San Juan Is. (False Bay), Seattle (West Seattle, intertidal).

Bibliography. Richardson 1905:23, 28-29, fig. 29; 1912:187.—Fee 1927:7.—Miller 1940:298-300, fig. 4.

Paratanais Dana

Length 1.75 to 2 mm. (figs. 1-6) .... **nanaimoensis** Fee

Habitat. A single specimen dredged from a depth of 15 to 20 fathoms from a bottom of gray mud and sand.

Distribution. BRITISH COLUMBIA: Departure Bay (*Fee*).

Bibliography. Fee 1926:17-18, figs. 1-6.

Tanais Adouin & Edwards

1. Legs with first three segments short and broad, affixed to the sides of the thorax like plates of mail; second antenna scarcely half the length of the first .... **loricatus** Bate

Taken in the hollow of a sponge at about 10 fathoms.

Distribution. BRITISH COLUMBIA: Victoria (*Bate*).

Bibliography. Bate 1866:282.—Richardson 1899:819; 1899a:159; 1905:7.—Fee 1926:22.

1′. Legs with segments slender, not dilated; body narrow, elongate; cephalothorax not greatly wider behind; first pair of legs with finger and thumb not widely separated; first and second antennae about equal in length; abdomen six-segmented, the three posterior segments about half as wide as those in front; uropods composed of a peduncle and five segments; length 2.5 mm. .... **normani** Rich.

Habitat. On Polyzoa, Hydroidea, and red algae.

Distribution. Middle California (Monterey Bay, *Richardson*). BRITISH COLUMBIA: False Narrows, Nanoose Bay (*Fee*).

Bibliography. Richardson 1905:7, 14-16, figs. 16-18.—Fee 1926:22.

Leptognathia Sars

Female with endopodite of uropod two or three times as long as exopodite; second (first free) segment of thorax about as long as the last one and shorter than those in between; propodus of first pair of legs scarcely smaller than the carpus, the dactylus without teeth; pleopods biramous; uropod with both exopodite and endopodite two-segmented; length, male 2.55 mm., female 4 mm. (figs. 22-30) .... **longiremis** Lilljeborg

Habitat. Seven to 200 fathoms (*Richardson*); in sandy mud at 15 to 20 fathoms; in gray mud at 30 fathoms; from sponge beds at 25 fathoms (*Fee*).

Distribution. Denmark and Scotland to Spitzbergen, Jan Mayen, and Greenland (*Richardson, Nierstrasz & Stekhoven*). BRITISH COLUMBIA: Departure Bay, Pylades Channel, Snake Is. (*Fee*).

Bibliography. Sars 1896:27-28, pl. XII.—Richardson 1905:18-21, fig. 22.—Fee 1926:23.—Nierstrasz & Stekhoven 1930:151, 153, fig. 23.

Order ISOPODA Latreille 1817

Polygonata Fab. (exclusive of *Monoculus*)
Tetracera Latreille 1810:423
Euisopoda Kossman

There is no appropriate colloquial term other than the vulgarized "isopod" for members of this order. Such common names as do exist refer only to the terrestrial Oniscoidea.

Isopoda go back in their geological history to the Devonian *Oxyuropoda ligioides* Carpenter and Swain. This species as shown in the figure reproduced by Eastman (1913:757) was a creature about 2½ inches long, with body segments and uropods corresponding in a general way to *Ligia*. Species probably referable to existing families of the suborders Flabellifera and Valvifera are found in Jurassic and later formations, but true Oniscoidea (Oniscidae, Trichoniscidae) are said not to appear until the upper Eocene (Van Name 1936:21).

Number of described species. In the absence of a world catalogue, it is not possible to state the total number of described species with any precision. Gerstaecker (1882:240) estimated that 815 species (298 Oniscoidea) were then known. Budde-Lund (1885:308-309) listed 390 species of Oniscoidea from the world, of which he had seen 282. Pratt (1935:433) estimated that over 3000 species were known (including the Chelifera). Richardson

(1905) recognized 352 species from North America (including 76 Oniscoidea). Van Name (1936:23-32; 1940:109; 1942:299) lists 358 land and fresh-water species (289 Oniscoidea) from the New World. Jackson (1941) lists 158 land and fresh-water species (147 Oniscoidea) from Oceania. Wolf (1934) lists 149 species from caves (113 Oniscoidea). Sars (1899) listed 116 species (22 Oniscoidea) from Norway. Nierstrasz *et al.* (1926, 1930) listed 109 species (exclusive of Oniscoidea) from the North Sea and the Baltic, to which may be added the 26 species of Oniscoidea which Meinertz (1932:353) lists from Denmark, the 80 species (76 Oniscoidea) which Wächtler (1937) lists from central Europe, or the 36 species of Oniscoidea which Collinge (1942:162-163) lists for Great Britain and Ireland. In North America, 60 species (14 Oniscoidea) were known from the Middle Atlantic States (New York to Virginia) in 1911 (Fowler 1912: 515-533); 25 species (9 Oniscoidea) from Connecticut in 1918 (Kunkel 1918:190-191); and 25 species (3 Oniscoidea) from the Bay of Fundy in 1919 (Wallace 1919). The present paper cites 70 species from the Pacific Northwest (19 Oniscoidea). In the foregoing tabulations the figures for Oniscoidea have been indicated because of the special interest that attaches to this terrestrial group, to which upwards of a third of described isopods apparently belongs. Further comments on the Oniscoidea are found below in the section devoted to them.

Key to Suborders of Isopoda

1. Not parasitic on Crustacea, usually free-living; rarely parasitic on fish, but if so, neither sex exhibiting more than a rather slight degree of parasitic degeneration
2. Uropods terminal
3. Second antennal peduncle of six segments; coxopodites of thoracic legs small, distinct; abdominal segments usually fused, the first two segments free in *Stenasellus;* both pairs of antennae distinct............... ....ASELLOTA
3.′ Second antennal peduncle of five segments; abdomen of six segments
4. Body compressed; both pairs of antennae distinct; coxopodites of thoracic legs small, distinct; fresh-water and terrestrial in the Old World ..........PHREATOICIDEA
4′. Body depressed; first pair of antennae a rudimentary two- or three-segmented appendage just within the conspicuous second antennae; coxopodites of thoracic legs expanded into plates, usually fused with body; pleopods for aerial respiration..........ONISCOIDEA
2′. Uropods lateral to terminal abdominal segment; both pairs of antennae distinct; coxopodites of thoracic legs more or less expanded into coxal plates
5. Uropods forming, together with the terminal abdominal segment, a caudal fan
6. Adult usually with seven pairs of legs
7. Exopodite of uropod not arching over the base of the terminal abdominal segment; second antennal peduncle of five or six segments......... ..........FLABELLIFERA

7′. Exopodite of uropod arching over base of telson, which is not fused with the last abdominal segment; body elongate, cylindrical; not on Pacific Coast .... ANTHURIDEA

6′. Adult apparently with only five pairs of legs; not on Pacific Coast .... GNATHIIDEA

5′. Uropods valve-like, inflexed, arching under the pleopods; second antennal peduncle of five segments .... VALVIFERA

1′. Parasitic on Crustacea; female more or less profoundly modified for a parasitic existence; larval forms with terminal uropods and distinct abdominal segments .... EPICARIDEA

Bibliography. Richardson 1905.—Calman 1909:219-221.—Monod 1922.—Zimmer 1927:757-763.

Suborder **Asellota** Latreille 1806

Aselloidea Richardson 1902:294

The members of this suborder are marine and fresh-water in distribution. The new species of *Janira* described below is apparently ectocommensal or ectoparasitic on a starfish and involves a type of ecological relationship not previously recognized in this group.

Key to Families and Genera of Asellota

Eyes present (in our species); legs not at all natatory

1. Fresh-water: male with first pleopods not coupled with second pair, the protopodites short and free; the second pair small and situated below the first pair with branches attached at the distal end of the protopodite, the endopodite not geniculate, the distal segment having an inner cavity, the exopodite nearly as long as the endopodite; female with first apparent pair of pleopods[3] small, each consisting of a small protopodite and a single branch; third pair in both sexes forming a compound operculum; last pair of pleopods with both branches .... Superfam. ASELLOIDEA: ASELLIDAE

Body usually elongate, depressed; head usually narrower and shorter than first thoracic segment; eyes usually present; mandible with three-segmented palp; abdomen usually not longer than broad .... **Asellus** Geoffroy

1′. Marine; male with first pleopods coupled with the large second pair forming a large operculum, the protopodites elongate; female with first apparent pair of pleopods large, forming an operculum; third pleopods not forming an operculum.... Superfam. PARASELLOIDEA

2. Eyes not on peduncle-like projections of head; first antennae approximate at base; the three posterior thoracic segments not differentiated; legs subequal in length (in our species); abdomen large, shield-like .... JANIRIDAE

Second antennae long, the segments of the peduncle not dilated, the flagellum multisegmented; mandibles with cutting parts composed of one or two serrated teeth

[3] Hansen (1916:10) shows that the females of the Asellota lack the first pair of pleopods.

3. Uropods well developed
4. First antennae well developed, the flagellum many-segmented; second antennae with "scale" outside of the third segment of the peduncle; eyes subdorsal
5. Male with apex of first pleopod not dilated at apex; second and third segments of maxillary palpi not or only moderately expanded.......... ....**Janira** Leach

5′. Male with apex of first pleopod dilated at apex; second and third segments of maxillary palpi more or less evidently expanded............ ....**Ianiropsis** Sars

4′. Uropods extremely small, the branches short, nodiform; first antennae extremely small, with a two-segmented flagellum; second antennae without scale attached to peduncle....................................**Jaera** Leach

3′. Second antennae short, their length equal to the width of the head, the flagellum rudimentary; cutting part of mandible with five teeth; uropods short, minute...**Jaeropsis** Koehler

2′. Eyes when present at tips of lateral peduncle-like projections of head; first antennae widely separated at base; three posterior thoracic segments markedly narrower than the more anterior ones; first pair of legs shorter, the succeeding pairs more or less rapidly increasing in length; abdomen more or less vaulted above, subpyriform................. ....MUNNIDAE

Eyes present; uropods uniramous..................................**Munna** Krøyer

Superfamily ASELLOIDEA

Family ASELLIDAE

Asellus Geoffroy[4]

1. Male with inner margin of posterior surface of propodite of first legs not produced in teeth or immovable spines......subg. **ASELLUS** s. str.

Male with inner margin of posterior surface of propodite of first legs subarcuate, with numerous short movable spines or stiff hairs; uropods slender, about as long as the abdomen, frequently shorter, the protopodite somewhat shorter than the branches, the endopodite about a fifth longer than the exopodite; length to 10 mm. (figs. 31-32) ....**tomalensis** Harford

Habitat. Reported from a well, a peat bog (*Fee*), and slightly brackish water (*Carl*) in British Columbia.

Distribution. British Columbia to northern California (*Van Name* 1936) BRITISH COLUMBIA: Ischaschat and Vancouver (*Fee*); Metchowsin, Nanaimo. WESTERN WASHINGTON: Grays Harbor Co. (Copalis, Duck L., Whites), King Co. (Renton, Stillwater), Lewis Co. (Chehalis—mill pond), Mason Co. (Grapeview), Pacific Co. (Bay Center, Black L., Hawks Point, Longbeach, Nahcotta, Nasel, Raymond, Skating L., South Bend—slough), Pierce Co. (Bow L.), Skagit Co. (Pass L.), Thurston Co. (Clear L., Offuts L.,

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[4] I am under special obligation to Prof. Trevor Kincaid for nearly all the material on which this study of *Asellus* is based.

Patterson L., Summit L., Tumwater—pond). OREGON: Algoma, Klamath L., Skipanon, Waldport.

Bibliography. Richardson 1904:224-226, figs. 110-112; 1904a:668-669, figs. 15-17; 1905:420, 431-433, figs. 487-489.—Fee 1926:20-21.—Van Name 1936: 459-461, fig. 288; 1940:133.—Carl 1937:451.

1′. Male with inner margin of posterior surface of propodite of first leg produced in one or two teeth or immovable spines..subg. **CONASELLUS** Stammer

Male with inner margin of posterior surface of propodite of first legs produced in a single prominent tooth; uropods stout, somewhat more so in the male than in the female, about as long as the abdomen, the protopodite very little shorter than the branches, the endopodite slightly longer than the exopodite; color brown or dusky, more or less spotted or mottled with small yellowish markings noticeable only on magnification; length to 15 mm. (figs. 33, 129)......**communis** Say

Habitat. Ponds, lake margins, and streams, especially where there are water plants.

Distribution. Ontario, Quebec, and Nova Scotia (*Van Name* 1936) to Virginia, Illinois, Mississippi (*Richardson*), and Oklahoma (*Mackin* and *Hubricht*). WESTERN WASHINGTON: Bothell, Ruggs L. (Snohomish Co.), Seattle (Arboretum, Lake Washington at Univ. of Wash. Campus, Plantation Pond, Univ. of Wash. Campus). All these localities are in the Lake Washington drainage.

Bibliography. Richardson 1905:419-421, figs. 472-473.—Van Name 1936:453-456, figs. 284-285; 1940:132.—Mackin and Hubricht 1938:629.

Superfamily PARASELLOIDEA

Family JANIRIDAE (*Ianirini* Hansen)

Janira Leach (*Ianira* auct., *Iolella* Rich.)

I follow Hansen (1916:13) in including *Iolella* Richardson in this genus.

Epimeral plates developed on all thoracic segments, those of the second, third, and fourth segments bilobed; thoracic segments smooth on dorsal surface

1. Hind angles of abdomen evenly rounded, serrate; anterior angles of head rounded, not prominent; epimeral plates and fore and/or hind angles of the thoracic segments only very slightly prominent; front of head straight; color yellowish, densely mottled with reddish brown specks; length, male 10 mm., female 7 mm. (figs. 37-38) ....**maculosa** Leach

Distribution. Gibraltar and the western Baltic Sea to Greenland (*Nierstrasz & Stekhoven*). BRITISH COLUMBIA: Departure Bay, Gabriola Pass, 10 to 20 fathoms (*Fee*). WASHINGTON: Turn Is. (San Juan Co., intertidal).

Bibliography. Richardson 1905:468-470, fig. 524.—Hansen 1916:14-16, pl. I, fig. 1.—Fee 1926:22.—Nierstrasz & Stekhoven 1930:117-118, fig. 17.

1′. Hind angles of abdomen not serrate, each with a single acute tooth; lateral margin of head produced in a single more or less acute lobe at the anterior angle; epimeral plates and fore and/or hind angles of the thoracic segments more or less prominent

2. Front of head trilobate, the central lobe subacute and longer than the others but not rostrate; the tooth at the hind angles of the abdomen and the epimeral plates and the fore and/or hind angles of the thoracic segments somewhat less prominent than in the next species; color yellowish, densely mottled with reddish brown specks; length 6 mm. (figs. 35-36) .... **occidentalis** Walker

Distribution. WASHINGTON: San Juan Co. (Turn Is., intertidal; Cypress Is., 30 fathoms).

Bibliography. Walker 1898:280-281, pl. XV, figs. 7-10.—Richardson 1899:859; 1899a:326; 1900:300; 1904:224; 1904a:667; 1905:469, 472-474, figs. 526-528.

2'. Front of head produced in an acute rostrum which is slightly narrower than, but about as prominent as, the produced front angles; the tooth at the hind angles of the abdomen and the epimeral plates and the fore and/or hind angles of the thoracic segments somewhat more prominent than in last species; color yellowish, immaculate except in a single specimen from Waldron Is., which is mottled with reddish-brown specks; length to 5.7 mm. (figs. 158-160) ...... **solasteri** sp. nov.

Type male and nine paratype females: Hood Canal, WASHINGTON, July 26, 1941, on several specimens of the starfish *Solaster stimpsoni* Verrill, Trevor Kincaid, collector. Single additional paratypes: Waldron Is. (San Juan Co., 40 fathoms); Egeria Bay, Langara Is., Queen Charlotte Is., B.C. (50-90 meters); Cape Muzon, Dall Is., Alaska (70 meters).

From other American species of *Janira* and *"Iolella," solasteri* is distinguished by the following combination of characters: head rostrate, the sides produced in only a single lobe; thoracic segments smooth above, each with one or two epimeral lobes visible from above; hind angles of abdomen with a single prominent tooth.

Ianiropsis Sars (*Janiropsis* auct.)

Dorsal surface whitish, irrorate with brown, maculate with larger white spots; head with front margin feebly and broadly lobed; abdomen with margins towards the hind angles not serrate, the apex broadly feebly lobed at the middle, very slightly sinuate towards either side, the hind angles feebly obtusely prominent lateral to the sinuation; uropods about two-thirds as long as the abdomen; length to 4 mm. (not including antennae and uropods) (figs. 170-171) ....

= Ianiropsis kincaidi kincaidi .... **pugettensis** sp. nov. ←

Menzies (1952, p. 139)

Type male and about 25 paratypes (males and females): False Bay, San Juan Is., WASHINGTON, July 20, 1940, M. H. Hatch collector; intertidal.

This species is distinguished from the other American species (*californica* and *kincaidi* Richardson) by its longer uropods (two-thirds as long as abdomen in *pugettensis*, one-half as long in *californica* and *kincaidi*), in which respect it resembles *breviremis* G. O. Sars of northwestern Europe, in which species, however, the side margins of the abdomen are serrate. The posterior margin of the abdomen of *pugettensis* conforms in shape most closely to that of the Alaskan *kincaidi*, to which it is, perhaps, most closely related.

Jaera Leach (*Iaera* auct.)

Jaera wakishiana was described from a sponge dredged in about eight fathoms in Esquimault Harbor at Victoria, British Columbia by Bate (1866:282-283) but has not since been recognized. It is apparently to be distinguished from the North Atlantic *marina* Fab. by the nearly straight anterior margin of the head, and by the fact that the abdominal notch where the short uropods are located is divided by a median pointed lobe which does not extend beyond the extremities of the sides. Kesselyák (1938:228, 247) questions whether we know enough about this species to give it a generic assignment.

Jaeropsis Koehler

Head with two prominent triangular processes, the space between which is nearly filled by a broadly rounded median lobe that is about twice as prominent as the acute lateral lobes; eyes small, at lateral margins of the dorsal surface of head; thorax with lateral margins of the several segments separated, not continuous; anterior angles of first thoracic segment acute, of second and third subrectangular, of fourth narrowly rounded, of fifth and sixth broadly rounded, of seventh obsolete; posterior angles of thoracic segments one to three broadly rounded, of four to seven increasingly strongly but arcuately produced; abdomen about six-sevenths as long as wide, glabrous, rounded, the extreme apex minutely notched for insertion of uropods; length 3.2 mm. (fig. 34) .... **lobata** Rich.

In several respects the single specimen at hand differs from the two specimens described and figured by Richardson. The angles of the thoracic segments are more diverse than Richardson's figure shows. The color is blackish, especially the head, except for the apical portion, which is abruptly paler. Richardson's specimens had the first, fifth, and sixth thoracic segments abruptly paler.

Distribution. Middle California (Monterey Bay, *Richardson*). OREGON: Coos Bay (Squaw Is., on reef, *G. M. Shearer*).

Bibliography. Richardson 1905:477-478, figs. 533-536.

Family MUNNIDAE

Munna Krøyer

The two species noted below may really be new, but until definite distinguishing characters can be pointed out, it is better to associate them with what appear to be their nearest allies.

Surface of body smooth, without spines

1. Side margins of abdomen without or with only one spine; first antenna with a three-segmented peduncle beyond which is a four-segmented flagellum consisting of a short first segment, two elongate intermediate segments, and an extremely minute apical segment; flagellum of second antenna subequal in length to the peduncle; uropods obliquely truncate at apex; length 2.2 mm. (*fabricii* G. O. Sars nec Krøyer) (figs. 42-44) .... **minuta** Hansen

Distribution. North Atlantic from the English Channel and Novaya Zemlya to Greenland (*Nierstrasz & Stekhoven*). WASHINGTON: Seattle (Carkeek Park, intertidal, on *Polysiphonia*). Our two specimens do not show the uropods or the spine along the side margin of the abdomen; the second antennal flagellum is very slightly shorter than the peduncle.

Bibliography. Sars 1899:108-109, pl. XLV, fig. 2 (*fabricii* G. O. Sars nec Krøyer).—Richardson 1905:480-482, figs. 538-539 (*fabricii*).—Hansen 1909: 213, pl. III, fig. 2; 1916:39-40, pl. III, fig. 6.—*Nierstrasz & Stekhoven* 1940:109, 111-112, fig. 61.

1′. Side margins of abdomen with about four spines; first antenna with a three-segmented peduncle beyond which is a three-segmented flagellum consisting of a short first segment, an elongate intermediate segment, and an extremely minute apical segment; flagellum of second antenna shorter than the peduncle; uropods with three or four dentiform projections at apex; length 1 to 3 mm. (figs. 45-47) ....**kroyeri** Goodsir

Distribution. North Atlantic from the English Channel to Norway (*Nierstrasz & Stekhoven*). BRITISH COLUMBIA: False Narrows, Gabriola Pass, Horswell Point; intertidal to 10 fathoms, among Polyzoa and on *Polysiphonia* (*Fee*). WASHINGTON: Seattle (North Beach).

Bibliography. Sars 1899:109-110, pl. XLVI, fig. 1.—Hansen 1916:37-38, pl. III, fig. 4.—Fee 1926:22.—*Nierstrasz & Stekhoven* 1930:109, 112, fig. 62.

Suborder **Oniscoidea** G. O. Sars 1882

Cloportides Latreille 1810
Oniscides Latreille.—Leach 1815 (a family)
Oniscodea Gerstaecker 1882:204 (a family)
Oniscoida Sars 1898:153

The Oniscoidea are the insects of the crustacean world. Because of their terrestrial habits they are at once the most familiar and the most highly differentiated of the isopods, upwards of a third of the described species belonging to this single suborder. Alone among the isopods they have since ancient times been noticed by the people, and there is scarcely a dooryard in the civilized world that is not inhabited by one or another of the small group of what the Germans call the "synanthropic" species. Their slate-gray color has given rise to the most satisfactory, if not the most widely used, of their common names, the English "slater." Their color has caused them to be likened to little asses,[5] and their crowding together to little pigs.[6] Species of *Armadillidium* and *Cylisticus* that roll into a ball are "pillbugs." The English call the oniscoids "woodlice."[7]

[5] Hartnack 1943 III:24. Latin "asellus" for "asinulus," diminutive of "asinus," "ass"; Latin "oniscus" from Greek ὀνίσκος, metaphorical diminutive of ὄνος, "ass"; German "Assel," cf. "Esel," "ass."

[6] Whence "sowbug," "hoglouse," "sow," "old sows," "St. Anthony's hogs" (Fowler 1912:222); Latin "porcellio," perhaps related to "porcellinus," "porcellus," "porculus," diminutives of "porcus," "pig." Hartnack (*l.c.*) suggests a "likeness to the old razor-back or carp-backed sow."

[7] The Welch call the oniscoids the "withered old woman of the wood," "the little pig of the wood," and "the little grey hog," also "grammar sows." Their word "gurach," like "grammar," means dried-up old dame (W. T. Fernie in *Herbal Samples,* quoted by Fowler 1912:222). The French call the oniscoids "cloporte," from "clos," "enclosure, garden" and "porte," "door, gate." See in this connection the tabulation by Budde-Lund (1885:204) of the colloquial names of these animals in many different European countries.

The proposal of English common names for the various species of oniscoids is no part of my present design. Since those who desire to employ such names may, however, care to consider the suggestions of some of their predecessors, the following notes are provided:

Oniscus asellus L., dooryard sowbug (Hartnack 1943 III:27)

Porcellionides pruinosus Br., unspotted porcellio (Fitch 1855:824)

Porcellio laevis Latr., dooryard sowbug (Popenhoe 1912:8)

Porcellio spinicornis Say, striped porcellio (Fitch 1855:824); spiny sowbug (Essig 1926:3)

The terrestrial oniscoids are apparently the last of the arthropods to have come out of the sea, since fossil forms are not known till the upper Eocene. Even if we take into account the imperfection of the geological record, this would seem to place them significantly later than the terrestrial arachnids and myriopod-insect groups, which are known from the Pennsylvanian or earlier, some 200 million years previous.[8] In correlation with this late development, oniscoids are but feebly adapted to terrestrial life, being restricted in their occurrence to the proximity of proper moisture. Paradoxically, their present center of distribution and evolution is the region of the Mediterranean Sea (Verhoeff 1938a:254), as though the search for moisture in these dry lands had had a stimulating effect superior to the quest for moisture in regions where it is readily found.

Oniscoids are, in fact, only just able to survive under terrestrial conditions and this only as a result of their delicate response to conditions of proper humidity. The respiratory organs of the isopod are the endopodites of the abdominal appendages, which serve as gills and to which the exopodites serve as a protective covering. This arrangement continues in the oniscoids, which breathe by keeping the surfaces of the endopodites moist—in part by moisture-secreting glands located on their surfaces, in part by a system of intersegmental and longitudinal grooves that convey water to the pleopods from the dorsal surface or even from the anus. The more primitive oniscoids (*Trichoniscus, Philoscia*) are entirely dependent on these aerial gills and require 80% or better relative humidity at 67 degrees F. (Heeley 1941:82). In the more specialized genera the exopodites become modified for aerial respiration. *Oniscus* accomplishes this by a radial wrinkling of the outer lobe of the exopodites. In *Porcellionides, Porcellio,* and *Armadillidium* the exopodites of the first two pairs of pleopods, and in *Trachelipus* and *Cylisticus* the exopodites of all five pairs, are permeated by tracheae (Zimmer 1927:739-740).[9] In partial correlation with this, Heeley (*l.c.*) finds *Oniscus* to require 77%, *Porcellio* 71%, and *Armadillidium* 65% relative humidity at 67 degrees F.[10]

The other principal terrestrial adaptation of the oniscoids is the marsupium or pouch on the under side of the thorax in which the eggs and newly hatched young are carried until ready to shift for themselves.[11] In the

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Porcellio scaber Latr., rough porcellio (Fitch 1855:825); scabby sowbug (Essig 1926:3); scabby slater (Hartnack 1943 III:25)

Trachelipus rathkei Br., pretty porcellio (Fitch 1855:824); mottled porcellio (for var. *varius* Koch) (Fitch, *l.c.*)

Cylisticus convexus DeG., smooth porcellio (Fitch 1855:823)

Armadillidium vulgare Latr., pillbug (Fowler 1912:226); greenhouse pillbug (Popenhoe 1912:7); common pillbug (Essig 1926:3)

[8] Negative paleontological evidence must always be used with reservation. The Lepidoptera are not known before the Cenozoic, yet there are strong reasons for believing that they have existed since early Mesozoic or late Paleozoic time.

[9] Collinge (1942a:310) records specimens of *Porcellio spinicornis* in which the third, the third and fourth, and the third, fourth, and fifth pleopods were tracheate; of *Trachelipus rathkei* in which only the first two or three, or only pleopods two to five, were tracheate; of *Cylisticus convexus* in which only pleopods two to five were tracheate; and of *Armadillidium vulgare* in which only pleopods two and three, or two, three, and four, or four and five, were tracheate.

[10] For discussion and literature of oniscoid ecology see Abbott 1918, Allee 1926, Miller 1938, Waloff 1941, Heeley 1941.

[11] Collinge (1943b:147-148) records an abnormal instance of a female of *Armadillidium nasatum* depositing viable eggs without first forming a marsupium!

rest of the isopods the marsupium performs the important function of general protection from enemies. But it was ready at hand to serve the oniscoids in meeting one of the major problems that a terrestrial organism must face, that of protecting the eggs and newly emerged young from the evaporating effect of the air.

The most comprehensive investigation of the life histories of our common oniscoids is contained in a recent study by William Heeley (1941) of the University of London, which treats the life cycles of *Trichoniscus pusillus* Br., *Philoscia muscorum* Scop., *Oniscus asellus* L., *Porcellio scaber* Latr., *Porcellio dilatatus* Br., and *Armadillidium vulgare* Latr. in southern England. Since this group of species closely parallels those in Seattle, five being identical with and the other one immediately related to our species, Heeley's account is applicable to our situation.

Development is accomplished by a series of moults which, except for the first, are accomplished in two steps two or three days apart. First the hind end and then the fore end of the animal moults. Each moult is accompanied by a period of helplessness extending over several hours. The first moult occurs within a day of leaving the marsupium, the next two at fortnightly intervals, and the next six or seven at intervals of about three weeks, at least under laboratory conditions. The period of the second instar is an extremely critical one. Respiration, as it was in the marsupium, is still carried on through the delicate uncalcified skin, and the larvae succumb to slight variations in humidity that older individuals are able to resist. With successive moults, however, the exoskeleton and the pleopods rapidly assume their adult functions. By the fifth moult the larvae have attained a length of 1.5 (*Trichoniscus*) to 3.25 mm. (*Oniscus*) and, except for pigmentation, are essentially similar to adults. The exact procession of subsequent events is not agreed upon by investigators. Heeley states that, after the first nine or ten moults, moults followed at monthly intervals during the first winter, after which the animals moulted at irregular intervals three to six times a year during the balance of their lives. Heeley found, moreover, that reproduction began the third year. One brood the third year, two the fourth, and one the fifth in *Porcellio* and *Oniscus* seemed to be the rule, with a total life span of five or six years. *Philoscia* and *Armadillidium* he discovered always to be single-brooded, and *Trichoniscus* to breed the second year and not to survive beyond the third. Verhoeff (1920), however, found that *Oniscus* and *Porcellio* bred the second year in Bavaria and that they might be triple-brooded in succeeding seasons. Collinge (1942:155-158; 1943:12-14; 1944a:113) in northern England reports a still more rapid sequence of events and suggests that undisclosed factors in Heeley's experiments exerted a general retardation. Collinge finds that *Oniscus, Porcellio,* and *Armadillidium* breed at least once their first year, and that those produced in the early part of the year breed twice, and that *Philoscia* may be triple-brooded its first year. *Armadillidium* is two-brooded, *Porcellio* is two- or three-brooded, *Oniscus* three- or four-brooded, and *Philoscia* four-brooded for two, possibly three, successive years.

A special moult precedes the formation of the marsupium, which disappears again in the succeeding moult. Sperm may survive in the oviduct in *Porcellio* and *Oniscus* long enough to fecundate the young for two successive years.

There is some evidence that sex in *Trichoniscus* and *Armadillidium* is determined by the ovum (Howard 1940:96-103). Moreover, only a few of the broods are amphogenic (50% males, 50% females). Many are monogenic, either arrhenogenic (entirely male) or thelygenic (entirely female); but others are intermediate. Vandel (1938) and Howard (1940) suggest that this is due to a selective segregation of the X- and Y-chromosomes so that, for example, in arrhenogenic females the Y-chromosome always goes into the first polar body and thus every egg contains an X-chromosome. This is further assumed to be controlled by the "cytoplasm of the female," which is determined by one or more hereditary factors. But these interesting problems are far from complete solution.

As already noted, the present-day center of oniscoid distribution appears to be the dry lands surrounding the Mediterranean. In central and northwestern Italy no fewer than 132 species are known (13 littoral, 73 endemic), of which 69 occur in the Piedmont-Liguria region alone (Verhoeff 1933:4-6). Forty species (1 littoral) are known from Sicily (Verhoeff 1933:25-26); 26 species (1 or 2 littoral) are known from Denmark (Meinertz 1932, 1933), 73 from Germany (Verhoeff 1942a:159) (27 from Berlin alone, Hartnack 1943 III:24), and 36 from the British Isles (Collinge 1942:162-163). One hundred forty-seven species (131 endemic) are known from Oceania (Jackson 1941). From North and South America 289 species (266 endemic) are known, of which, however, only 67 species (22 littoral) occur north of Mexico (Van Name 1936:30, 36-37; 1940:109; 1942:299); of these only 35 (14 littoral) are from the region north of California, Texas, and Georgia. Nineteen (5 littoral) are known from the Pacific Northwest. The littoral species, i.e., those occurring on the sea beach, are nearly always (exclusively so in the Pacific Northwest) endemic forms of restricted distribution. Their nearly complete absence from northern Europe is noteworthy.

Of the 21 fully terrestrial species that constitute this northern North American fauna,[12] only 3 are endemic species: *Ligidium gracile* Dana (Cal. to s.e. Alaska), *L. longicaudatum* Soller[13] (N.Y. and Ga. to Mo. and La.), and *Oregoniscus nearcticus* Arcangeli (Ore.). Four species are widely but sporadically distributed, all but perhaps the first introduced from Europe: *Trichoniscus demivirgo* Blake (N.B. to Pa. and Ont., Wash.), *Haplophthalmus danicus* B.-L. (N.J., Md., Ind., Ut.), *Philoscia muscorum* Scop. (Me. to N.J., Wash.), and the myrmecophilous *Platyarthrus hoffmannseggii* Br. (Conn.). Four species, all Trichoniscinae,[14] are of sporadic restricted distribution, all occurring in greenhouses, and all probably introduced from Europe, although this is not established for the fourth species cited: *Trichoniscus pygmaeus* Sars (intercepted in N.Y. in lily bulbs from Scotland,

[12] In 1923 Longnecker was able to cite only 6 terrestrial oniscoids from Iowa: *Porcellionides pruinosus, Porcellio scaber, Trachelipus rathkei, Cylisticus convexus, Armadillidium vulgare,* and *A. nasatum.* In addition *Oniscus asellus, Porcellio laevis,* and perhaps *P. spinicornis,* and *Ligidium longicaudatum* (known from Missouri) probably occur.

[13] Van Name (1940:134) suggests that *Euphiloscia elrodii* Packard from Indiana is synonymous, in which case Packard's specific name has priority.

[14] I follow Wächtler (1937:240-241) in regarding these groups as distinct genera rather than subgenera of *Trichoniscus,* without myself expressing either approval or disapproval of the procedure.

Ill.), *Cordioniscus stebbingi* Patience (Mass., Ore.), *Androniscus dentiger* Verhoeff (Ont.), *Miktoniscus medcofi* Van Name (Ill.)[15]

The ten remaining species are widely distributed and very common, and are usually presumed to have been introduced from Europe: *Oniscus asellus* L., *Porcellionides pruinosus* Br., *Porcellio laevis* Latr., *P. spinicornis* Say, *P. scaber* Latr., *P. dilatatus* Br., *Trachelipus rathkei* Br., *Cylisticus convexus* DeG., *Armadillidium vulgare* Latr., and *A. nasatum* B.-L. *P. laevis* and *P. spinicornis* have not so far been taken in the Pacific Northwest.

The best argument for the endemicity of any of these ten widely distributed species can be made in the case of *Porcellio scaber*. As pointed out under the discussion of that form, the American populations of this species may differ sufficiently to warrant the subspecific use of Say's name *nigra* (Say 1818:431). Moreover, Dana found the species in Washington in 1841, which he described (1855:725) as *gemmulatus*. The earliness of these dates, however, is apparently not by itself sufficient to establish endemicity. Van Name (1936:232) suggests that *Porcellio laevis* came in with the early Spanish colonists, and Say in 1818 (pp. 429-433) in the first paper on American oniscoids, in addition to *nigra*, described *Philoscia vittata, Oniscus affinis* (=*asellus*), *Porcellio spinicornis*, and *Armadillo pilularis* (=*Armadillidium vulgare*).

Gould in 1841 (pp. 336-337) from Massachusetts listed *Armadillo pilularis, Oniscus asellus* (with which he equated *O. affinis*), *Porcellio niger*, and "*Porcellio laevis* Latr." Since *laevis* is not now known from New England (Blake 1931a) or New York (Stoller 1902), it is not likely that Gould had that species. Three years later De Kay (1844:51-53) listed *Oniscus asellus, Porcellio spinicornis*, and *Armadillo pilularis* from New York. In 1855 (pp. 821-825) Fitch listed five species of "*Porcellio*," four of them from central New York: *Porcellionides pruinosus* (=*immaculatus* Fitch), *Porcellio spinicornis* (=*vittatus* Fitch), *P. scaber* from Ohio and Illinois, *Trachelipus rathkei* (=*limatus* Fitch, with the varieties *dorsalis, multiguttatus, marginatus, lateralis*, and *limbalis*) and var. *varius* Koch (=*mixtus* Fitch and var. *variegatus* Fitch), *Cylisticus convexus* (=*glaber* Fitch and var. *confluentus* Fitch).[16]

The uncertainty and confusion that prevailed in the study of the Nearctic terrestrial oniscoids are shown by the attempts of Stuxberg (1876) and Underwood (1886:360-364) to list our species. Stuxberg cited *Ligidium longicaudatum* from Niagara and *L. gracile* from San Francisco under the single name of the European *hypnorum* Cuvier; he added *Trichoniscus demivirgo* to the list from Niagara, Ont., under the name of

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[15] Data in this paragraph mostly from Van Name 1936, 1940, 1942.

[16] I agree with Budde-Lund (1885:78, 170) in the interpretation of Fitch's *immaculatus* ("uniform brown color unvaried by spots or stripes save the short longitudinal lines which are so faint as scarcely to be perceived and are frequently wholly wanting") and *glaber* ("doubles itself into a ball," but not so compact and spherical as *Armadillo*). But I reverse Budde-Lund's (1885:86, 124) assignment of *vittatus* ("head deeper black") and *mixtus* ("yellow variously dotted and spotted with black . . . with a row of whitish spots . . . often confluent into stripes along the middle of the back and near the outer margin") and *limatus* ("our most common species"). *Trachelipus rathkei* (cf. *infra*) is the most common oniscoid throughout northeastern North America. Van Name's assignment of *limatus* to *Oniscus asellus* ignores Fitch's own careful exclusion of that genus (p. 822).

pusillus Br.; and he added *laevis* to the list, but without precise locality, under the name of *dubius* Br.;[17] but he did not identify Say's species and was ignorant of Fitch's. Underwood listed no fewer than 18 species of *Oniscus–Porcellio–Armadillidium.* While Underwood's paper was in press, however, Budde-Lund's *Crustacea Isopoda Terrestria* (1885) had appeared. Budde-Lund identified the American forms with their European congeners and reduced the 18 species to 8, with only the Californian *P. formosus* Stux. and *Oniscus affinis* Say unaccounted for (even though Gould and De Kay had already insisted on the latter's identity with *asellus* L.). Richardson finally accepted the identity of *Oniscus affinis* with *asellus* L. in 1905 (p. 600) and Blake identified *Armadillidium quadrifrons* Stoller (1902) with *nasatum* B.-L. in 1931 (1931a:351). Finally, it is interesting to note the reluctance of certain authors (Budde-Lund 1885:124; Sars 1898:177; Verhoeff 1907; 1917a:221; Blake 1931a:352; Meinertz 1934:234; Wächtler 1937:282) to acknowledge that Say's *spinicornis* (1818:431-432) could have priority over Brandt and Ratzeburg's *pictus* (1833:78), even though the fact has been repeatedly pointed out (Richardson 1901:567; 1905:619; Dahl 1916:52; Van Name 1936:232; Collinge 1942a:311). In view of the known complexion of the oniscoid fauna of northeastern North America, it is difficult to see how there can be any doubt about the identity of Say's species ("head . . . and disc of the tail blackish . . .; antennae with the third joint elevated above, and armed with an acute spine").

Dominant Species. The commonest species of oniscoids in the Pacific Northwest as well as throughout western, central, and northern Europe (Wächtler 1937:283) is *Porcellio scaber.* In California the most abundant form is *Porcellio laevis* (Essig 1926:2; Miller 1936:171), and from collections received I suspect that the same may be true at Tucson, Arizona, and Negritos, Peru. In southern Michigan in 1936 I found *Trachelipus rathkei* to be the dominant species, and the same seems to hold for New York (Stoller 1902:212), much of New England (Blake 1931a:353), and eastern Canada (Walker 1927:177, 179). *Armadillidium vulgare* is the commonest type in Mississippi and other southern states.

Habits and Economic Importance of Oniscoids. "In former times [oniscoids] were highly reputed for their supposed medicinal virtues, and old books upon the materia medica inform us that when dried and pulverized 'they have a faint disagreeable smell, and a somewhat pungent sweetish nauseous taste, and are highly celebrated in suppressions, in all kinds of obstructions of the bowels, in the jaundice, ague, weakness of sight, and a variety of other disorders.' And the wine of Millipedes, prepared by crushing these animals, when fresh, and infusing them in 'Rhenish wine,' is spoken of as 'an admirable cleanser of all the viscera, yielding to nothing in the jaundice and obstructions in the kidneys.' In the light of modern science," our author concludes in a masterpiece of understatement, they "are now wisely discarded from the pharmacopoeias" (Fitch 1855:823).

Oniscoids live in moist situations which are protected from sudden changes in temperature (Hartnack 1943 III:25). Their food consists largely of decaying vegetable matter, and, in consideration of the enormous

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[17] Budde-Lund (1885:140) was the first to record *laevis* from a precise Nearctic locality, New Orleans.

numbers in which the widely distributed introduced species exist, they do comparatively little economic damage.

Occasionally oniscoids become extremely abundant on city dumps. Thus in 1931 *Porcellio laevis* developed "in a temporary garbage dump, on the outskirts of the City of Brantford [Ontario] . . . . There were literally millions of these crustaceans present, and the slope where the garbage had been allowed to accumulate was covered with them. These creatures were not causing any particular harm, beyond the fact that they annoyed the householders in the vicinity. They migrated nightly mainly to the cellars and there made themselves objectionable by crawling over preserved fruit and other eatables. The sidewalks during late evening were reported to be black with sowbugs" (Thompson 1932:87). A similar outbreak was reported at Dayton, Ohio, in 1938. Basements of houses near a dump were invaded by *Porcellio laevis, Porcellionides pruinosus,* and *Armadillidium vulgare,* so that the walls were "covered thick with them" and they piled up "3 or 4 inches deep in the furnace pipes." The "houses smelled like dead animals" (Bishopp 1938). Usually, however, oniscoids can be eliminated from basements simply by drying out their hiding places. A case is on record of a well in a woodshed near Lawrence, Massachusetts, being fouled by great numbers of *Trachelipus rathkei* and *Porcellio scaber* (King 1895).

When circumstances warrant it, such conditions as just described can be controlled by the proper management of the dump. Only one portion is used at a time and it is tightly packed. Tin cans are flattened to eliminate hollow spaces. After about two weeks dumping is started in another place. The old spot is covered with about six inches of clean clay or earth, but not with sand or anything containing organic matter. The surface may then be sprinkled with ammonia and rolled (Hartnack 1943:I, 193).

Oniscoids may be present in large numbers without doing appreciable damage, but occasionally, especially in the southern states, they attack growing plants. Pierce (1907) discovered cotton seedlings being tipped and killed at Dallas, Texas, principally by *Armadillidium vulgare,* but likewise by *Porcellio laevis* and *Porcellionides pruinosus;* and he noted that at Austin *Armadillidium vulgare* had been reported as attacking butter beans, radishes, lettuce, mustard, potted plants, and flower seed (p. 16; cf. Bishopp 1923).

In Mississippi *Armadillidium vulgare*[18] has been reported as damaging tomatoes, beans, and phlox (Harned 1929), and undetermined oniscoids have been variously reported as damaging mustard, radishes, young beans (Cockerham 1925), strawberries (Harned 1927:46), lilies, petunias, snapdragons (Harned 1927:68), turnips (Cockerham 1929), violets (Lyle 1932), butter beans, and peppers (Bond 1941). So extensive was the damage that in 1927 K. L. Cockerham reported that "along the coast these bugs appear as a pest practically every spring and they threaten to become serious to certain crops" (cf. Harned 1928, 1930, 1931; Lyle 1935). Prof. Clay

[18] Due to the kindness of Prof. Clay Lyle, I have been able to examine specimens of this species from the following Mississippi localities where damage was reported: Bay St. Louis (6-21-'29), Canton (5-22-'31, tomato), Columbus (6-28-'41, squash), Gulfport (3-10-'30, tomato and lilies; Feb. '32, strawberry), Hattiesburg (5-17-'32), Laurel (3-9-'31), Lexington (5-7-'31, flowers), Maben (12-15-'31), Meridian (4-8-'29, phlox), Rosedale (4-16-'30, carrot), Sherard (2-9-'31), Vicksburg (2-8-'31). A single vial of *Porcellionides pruinosus* from Greenville (8-15-'29).

Lyle in a personal letter notes that their occurrence is spotty, there being sections in which damage by them is not known at all.

In California *Armadillidium vulgare, Porcellio laevis,* and *P. scaber* are the injurious species reported. They breed from March to October, with two generations annually under field conditions in the case of *Armadillidium,* and more in the case of *Porcellio* (Essig & Hoskins 1944:141). *P. scaber* eats holes in the stems of artichoke plants (Essig 1926:3), and it and *A. vulgare* have been reported as especially destructive to young plants in the vicinity of San Francisco Bay (Pierce 1923; Essig 1926:3). *A. vulgare* and *P. laevis,* under certain conditions, may attack field crops, especially legumes, and in the San Joaquin Valley they have been reported as injurious to cotton seedlings following alfalfa in rotation (Bohart & Mallis 1942:654). *P. laevis* is often destructive to the roots of strawberries (Essig 1915:3).

Oniscoids have likewise been reported as damaging strawberries in Alabama (Robinson 1935) and Kansas (Bryson 1932) and ornamental plants (Nettles 1934) and celery (Todd 1937) in South Carolina. *Armadillidium vulgare* has been reported as injuring violets in the District of Columbia (Chittenden 1901:82), and *Oniscus asellus* has been found chewing rhododendron seedlings in Connecticut (Britton 1936). An early report of *"Oniscus"* in the southern states (Shattuck 1892) has not been confirmed.

The most effective control of oniscoids under field conditions appears to be a calcium arsenate dust (5 parts by weight of insecticide to 2 parts of white flour) applied with a small dust gun thinly over the infested area at the rate of 5 lbs. of calcium arsenate per 1000 square feet (Bohart & Mallis 1942; Essig & Hoskins 1944:141). This is considered more satisfactory than the bait of Paris green, molasses, and bran previously used.

Oniscoids in Mushroom Cellars. Mushroom cellars are infested by *Armadillidium vulgare* and *Porcellio laevis* (Popenhoe 1912:7-8), and Richardson (1905:667) records such damage by *A. vulgare* at Berkley, Virginia. The oniscoids "occasionally become numerous enough . . . to cause . . . damage by eating holes in the buttons and in the caps of matured mushrooms." They may be controlled by hand picking or by a dust composed of 60% pyrethrum and 40% of finely ground diatomaceous earth or clay applied at the rate of two or three ounces per 1000 cubic feet of air space. This will give some control if it comes into actual contact with the pests. "The beds should be allowed to dry slightly, and should not be watered for approximately 24 hours after application of the insecticide." Light fumigation with calcium cyanide at night or drenching clusters of the animals with hot water are likewise suggested, but poison baits are no longer recommended, due to the danger of getting poison on the mushrooms (Davis 1938:15, 21).

Oniscoids in Greenhouses. In greenhouses, "in addition to their injury to seedlings, they are often a general nuisance, crushing underfoot along the walks, separating the earth from the sides of the benches so as to cause uneven drainage, devouring fertilizers as fast as they are applied, and girdling plants at or near the ground level" (Bohart & Mallis 1942:654).

In greenhouses in London, Ontario, in the fall of 1912 and the spring of 1913, due "to their depredations the carnations were stunted . . . and the sweet peas had to be sown again. The seedlings of *Asparagus plumosus, Primula obconica, Petunia, Lobelia, Solanum capsicum* and of many other plants were badly attacked. Tender cuttings, such as those of begonia and coleus, were also severely injured" (Ross 1914:23). McDaniel (1931:30) reports calendula, cineraria, fern, gardenia, smilax, pansy, and violet as likewise subject to attack; "they feed on the fibrous roots, often to the extent of perceptibly checking the growth of the plants."

Armadillidium vulgare is the greenhouse species usually encountered (Nebraska: Swenk 1929; Ohio: Mendenhall 1930; Louisiana: Richardson 1905:667), but *Porcellio laevis* is likewise involved (McDaniel 1931:31), and Ross (1914:24) found *Armadillidium nasatum* and *Oniscus asellus* associated with *vulgare* in London, Ontario. *Trachelipus rathkei* has been reported as doing damage in greenhouses in Ohio (Gossard 1923).

Control methods in greenhouses are the same as in the field, except that poison bait is more successful because it it not subjected to washing by rain. "Five parts of granulated or brown sugar and 1 part of Paris green are mixed dry and placed on small wooden or tin plates throughout the beds, or poured on the frames of the bed" (Essig & Hoskins 1944:141). Another remedy that is suggested is trapping the oniscoids under chips of wood scattered over the surface of the soil (McDaniel 1931:31). Recently *Armadillidium nasatum* has been controlled in a greenhouse at Bettsville, Maryland, by spraying the infested quarters with various 5% DDT aerosol solutions (Smith & Goodhue 1945:177).

Oniscoids in Pacific Northwest Greenhouses. Spencer in 1942 (p. 23) cited *Oniscus asellus, Porcellio scaber, Armadillidium vulgare,* and *A. nasatum* from greenhouses in Vancouver and the Fraser River Valley in British Columbia, where the last named "tunnels readily into flower pots, eats away roots of plants, and will not respond to control measures that keep down . . . *P. scaber.*"

In 1946 the author visited 67 greenhouses in 45 localities in the Pacific Northwest extending from North Vancouver, B. C., to Corvallis, Ore., and from Aberdeen, Wash., to Moscow and Lewiston, Idaho.[19] In 66 of these 67 greenhouses oniscoids were encountered, the single exception being a small, very neatly maintained greenhouse in Moscow, Idaho. Nine of these greenhouses contained only a single species, 27 had 2 species, 23 had 3 species, 6 had 4 species, and one (in Seattle) had 5 species. A total of 11 species was found. The distribution of the five commoner species is shown in the accompanying table.

[19] I am especially indebted to Mr. Robert W. Rogers, who accompanied me on most of the trips and assisted in making the collections.

WHERE FOUND	O.a.	P.p.	P.s.	P.d.	A.v.
B. C.					
Burnaby 1	x		x		x
Burnaby 2	x		x	x	x
Burnaby 3	x		x	x	x
Burnaby 4	x		x		x
Langley Prairie	x		x		x
North Vancouver 1	x				x
North Vancouver 2	x		x		x
W. Wash.					
Aberdeen		x		x	x
Bellingham 1			x		
Bellingham 2			x	x	x
Burlington				x	
Centralia 1	x		x		x
Centralia 2			x	x	x
Chehalis				x	x
Enumclaw	x		x	x	x
Everett			x		
Kent			x	x	x
Lynden			x		
Marysville 1			x	x	x
Marysville 2			x		x
Monroe			x	x	x
Montesano			x	x	x
Mt. Vernon 1				x	x
Mt. Vernon 2			x		x
Mt. Vernon 3			x		
Olympia			x		x
Port Angeles 1			x		x
Port Angeles 2				x	x
Port Townsend			x	x	x
Seattle 1	x			x	
Seattle 2	x		x	x	x
Seattle 3			x		x
Tacoma				x	x
Vancouver					x
E. Wash.					
Cashmere		x			x
Cheney			x	x	
Clarkston		x	x		x
Cle Elum				x	x
Colfax			x	x	
Dayton		x			x
Ellensburg 1				x	x
Ellensburg 2		x		x	x
Grandview					x
Kennewick		x		x	x
Leavenworth		x		x	x
Prosser					x
Pullman 1			x		x
Pullman 2			x		
Rosalia				x	x
Spokane 1				x	x
Spokane 2		x	x	x	x
Sunnyside				x	x
Walla Walla 1		x			x
Walla Walla 2		x			x
Walla Walla 3		x	x		x
Wenatchee			x	x	x
Yakima	x			x	x
N. Idaho					
Lewiston 1		x		x	x
Lewiston 2		x	x		
Moscow 1				x	x
Moscow 2			x		x
W. Ore.					
Clackamas		x		x	
Corvallis			x		x
Dayton			x	x	x
Portland		x		x	x

Legend: O.a., *Oniscus asellus*; P.p., *Porcellionides pruinosus*; P.s., *Porcellio scaber*; P.d., *Porcellio dilatatus*; A.v., *Armadillidium vulgare*.

Of the six remaining species, *Philoscia muscorum* occurred in Seattle 1 and 2; *Armadillidium nasatum* in Langley Prairie, B. C. (in the same greenhouse from which Spencer reported it in 1942), and Lewiston 1, Id.; *Trichoniscus* species (?) and *Cordioniscus stebbingi* in the greenhouse of the Oregon State College at Corvallis, Ore.; *Cylisticus convexus* in Pullman 2; and two females of *Trachelipus rathkei* in the drug garden greenhouse at the University of Washington, Seattle—a greenhouse in which no other oniscoids occurred.

All 11 of these species are presumably introduced, with the single problematical exception of *Porcellio scaber,* and four of them occur in the Northwest exclusively in greenhouses so far as the present data show: *Trichoniscus* species (?), *Cordioniscus stebbingi, Porcellio dilatatus, Armadillidium nasatum.* A few comparative notes on the commoner species are given here. For details, reference should be made to the discussions under the several species in the systematic section below.

Armadillidium vulgare is the commonest and probably the most injurious of the species, occurring in 81% of the greenhouses. It was the only species met with in three greenhouses, and was the commonest form encountered in about half the others. It lives outdoors readily, so that it can either invade greenhouses directly or be introduced from other greenhouses.

Porcellio scaber was taken in 55% of the greenhouses. It is the commonest and most widely distributed outdoor species in the region and is, I suspect, the first species to invade a greenhouse in the Northwest. It was found in five out of the nine greenhouses which contained a single species, but in only three or four cases did it predominate when other species were present. This shows that it has a tendency to give way readily before the invasion of other forms.

The most unexpected finding was the presence of *Porcellio dilatatus* in 54% of the greenhouses. Though previously known, in North America, only from Arizona and California, this was the commonest species found in 15 greenhouses (22%). In 18 greenhouses it occurred without *P. scaber,* in 16 greenhouses it occurred in company with that species, and in 22 greenhouses *scaber* occurred without it. At Montesano, Wash., and at Dayton, Ore., single specimens were taken immediately outside greenhouses, which hardly mitigates the proposition that in the Northwest *dilatatus* is exclusively a greenhouse species. When it and *scaber* occur together, it is nearly always in the ascendancy, though this was not the case in greenhouses at Marysville and Colfax, Wash., and at Dayton, Ore. Accordingly, I suspect that this species is introduced into a greenhouse on materials from another greenhouse and that, when so introduced into a greenhouse already populated by *scaber,* it tends to displace that species.

Oniscus asellus occurred in 19% of the greenhouses, but most of these were in southwestern British Columbia, where it was the commonest species encountered in five out of the seven greenhouses visited. Elsewhere it occurred rarely (5 out of 55 greenhouses). It is said by Heeley (1941:82) to require a higher degree of humidity than do species of *Porcellio* and *Armadillidium* and may not be as readily transported as they are.

Most of the occurrences of *Porcellionides pruinosus,* which was found in 22% of the greenhouses, were east of the Cascade Mountains, in those areas where it is more common outdoors. It is readily distinguished from *Porcellio* or *Oniscus* by its much greater agility.

Oniscoids were most readily obtained in greenhouses with boards or other litter on the floor. They were scarcer where such litter was eliminated. Soil sterilization with steam and poison baits were among the remedies in use by the greenhouse operators, and the few establishments in which a strong DDT dust had been used were nearly free from them.

Color Variation. The color variation of our common species has been studied by Collinge (1916a:121-124; 1918:31-43; 1918a:101-102). This variation seems to be more frequent (or more persistently searched for) in British material than in American, perhaps because only the commoner strains have been carried across the ocean.

Key to Families and Genera of Oniscoidea

The following classification is based on that of Verhoeff (1938), but has been arranged in such a way as to make identification possible without reference to the male genitalia. In the endophore type, the vasa deferentia fuse within the penis, in the embolophore type the two vasa deferentia open by separate pores on either side of the penis towards its apex.

1. Flagellum with more than 10 segments (as few as 6 in immature specimens); uropods elongate; male copulatory apparatus involving only the endopodites of the second pleopods, not fused along median line; tracheae and water-transport systems absent.. ....Superfam. PROTOPHORA ARCHAICA

Telson not produced at middle...LIGIIDAE

2. Hind angles of telson produced (in our species); inner angle of endopodite of uropods not produced; littoral .... **Ligia** Fab.
2′. Hind angles of telson not produced; inner angle of endopodite of uropods produced; terrestrial .... **Ligidium** Br.
1′. Flagellum two- to four- or five-segmented (7-12 in the Old World *Titanethes*); male copulatory apparatus frequently involving the endopodites of both first and second pleopods, those of the first pleopods fused with a median appendage; uropods visible from above (*Oniscinea* Brandt)
3. Flagellum markedly slenderer than the peduncle, three- to five-segmented (in our species)
4. Usually terrestrial (at least in our species); male copulatory apparatus of the endophore type; mandibles with a masticatory process; tracheae and water-transport system absent .... Superfam. ENDOPHORA Verh.

Body not contractile into a ball; telson and protopodite of uropod well developed .... TRICHONISCIDAE

Thoracic segments without longitudinal elevations or rows of tubercles .... TRICHONISCINAE

Antennal flagellum three- to five-segmented

5. Eyes with three ocelli; body elongate, the abdominal segments abruptly narrower than the thorax; dorsal surface more or less evidently reticulate with a dark pigment; uropods elongate, prominent
6. Dorsal surface smooth or with very minute tubercles; penis slender, not swollen at apex .... **Trichoniscus** Br.
6′. Thoracic segments each with about three rows of prominent tubercles; penis swollen towards apex .... **Cordioniscus** Graeve
5′. Eyes and pigment absent; body opaque, the surface roughened with granulations each consisting of a conoidal group of serrate scales; generitype *Trichoniscus nearcticus* Arcangeli .... **Oregoniscus** gen. nov.
4′. Littoral; penis of the embolophore type; mandibles without a masticatory process .... Superfam. EMBOLOPHORA (part)

Tracheae absent; body with a water-conductor system .... SCYPHACIDAE

7. Front of head feebly bisinuate, the median lobe in our species just visibly sinuate to strongly notched .... SCYPHACINAE

Elongate, the abdominal segments abruptly narrower than the thoracic, the uropods elongate, prominent; antennae with inner margins of last three segments of peduncle set with numerous strong tubercle-like papillae each surmounted with a tuft of short stiff hairs or bristles; eyes moderately developed, consisting of numerous ocelli; length 3 to 4 mm .... **Detonella** Lohmander

7′. Front of head strongly bisinuate, the lateral and median lobes prominent .... ARMADILLONISCINAE

Oval, the abdominal segments only gradually narrower than the thoracic, the uropods continuing the even oval outline by means of the expanded outer lobe of the protopodite and the very short branches; antennal segments not tuberculate................**Armadilloniscus** Uljanin

3′. Flagellum nearly as stout as the peduncle, two- or three-segmented (in our species); penis of the embolophore type; mandible without a masticatory process; water-transport system usually present.......... ....Superfam. EMBOLOPHORA (part)

8. Uropods extending beyond the telson, which is produced in an angle or narrowly rounded

9. Flagellum three-segmented; body not contractile into a ball; tracheae absent ....ONISCIDAE
Penis not forked at apex...ONISCINAE
Eyes present (in our species)

10. Hind angles of the anterior thoracic segments not produced, the hind margins towards the hind angles nearly straight or broadly or narrowly rounded into the side margins

11. Abdominal segments abruptly narrower than the thoracic, at least in our species; lateral and median lobes of head feeble; antennae extending beyond the second thoracic segment, the segments of the flagellum of variable length; telson acutely angulate; littoral and terrestrial ....**Philoscia** Latr.

11′. Abdominal segments only gradually narrower than the thoracic; lateral and median lobes of head prominent, tuberculate; antennae not extending beyond first thoracic segment; telson obtusely angulate; littoral ....**Alloniscus** Dana

10′. Hind angles of all thoracic segments produced and acute, the hind margins towards the hind angles broadly emarginate; abdominal segments only gradually narrower than the thoracic; lateral and median lobes of head prominent, not tuberculate; antennae extending beyond second thoracic segment; telson acutely angulate; terrestrial............. ....**Oniscus** L.

9′. Flagellum two-segmented; antennae extending beyond second thoracic segment; tracheae present in the exopodites of at least the first two pleopods; terrestrial (in our species)................PORCELLIONIDAE
Eyes present

12. Median lobe of head rounded, the median line below not carinate; body not at all contractile into a ball; lateral margins of third abdominal segment strongly arcuate, much shorter than those of the last thoracic segment

13. Abdominal segments abruptly narrower than the thoracic segments; apex of telson not attaining the level of the middle of the endopodite of the uropod; hind angles of the anterior thoracic segments rounded, not at all produced; first segment of flagellum longer than second in our species; front of head with obtusely angulate V-shaped carina in front of frontal line in our species; tracheae present in the exopodites of the first two or three pleopods................**Porcellionides** Miers

13′. Abdominal segments only gradually narrower than the thoracic segments; apex of telson surpassing the middle of the endopodite of the uropod; first segment of flagellum shorter or longer than second; front of head without obtusely angulate carina in front of frontal line

14. Tracheae present in the exopodites of the first two or three pleopods, opening by a single orifice near the articulation of the exopodite; exopodite of first male pleopod variously formed, but not produced in a more or less laterally extending hook; hind angles of anterior thoracic segments variable..**Porcellio** Latr.[20]

14'. Tracheae present in the exopodites of all five pleopods, opening by a row of small pores along the external margin of the plate; outer angle of exopodite of first male pleopod acutely produced in a more or less laterally extending hook; hind angles of anterior thoracic segments produced..**Trachelipus** B.-L.[20]

12'. Median lobe of head angulate, the median line below the angle carinate; body partially contractile into a ball; lateral margins of third abdominal segment when fully exposed are seen to be feebly arcuate, nearly as long as those of the last thoracic segment; abdominal segments only gradually narrower than the thoracic segments; hind angles of anterior thoracic segments broadly rounded, those of the first segment somewhat produced, of the second slightly produced, of the others not or very slightly produced; first segment of flagellum slightly shorter than the second; telson subacutely produced; tracheae present in the exopodites of all five pleopods.......................... .... **Cylisticus** Schnitzler

8'. Uropods not extending beyond the telson which is truncate or broadly rounded at apex; antennae short, not extending beyond the first thoracic segment; front margin of head with lobes over the insertion of the antennae; body contractile into a ball; tracheae in the exopodites of the first two pleopods, opening by several pores situated along a furrow; terrestrial.......... ...............................ARMADILLIDIIDAE

Flagellum two-segmented; telson triangular, truncate at apex; uropods with exopodite large and flattened, endopodite conical....................... ....**Armadillidium** Br.

Superfamily PROTOPHORA ARCHAICA

Family LIGIIDAE

Ligia Fab. (*Ligyda* Rafinesque)

The members of this genus inhabit the rocky sea cliffs just above the water. They swim readily if compelled to, and *L. oceanica* L. can remain submerged for as long as eighty days. Our species, however, is said to drown in sea water in a matter of hours (Abbott). In Hawaii, in Colombia, and in Venezuela purely terrestrial species occur, living at altitudes of between 2000 and 6000 feet (Jackson 1922:700-701).

Uropods less than half the length of the body; telson arcuate, the lateral angles more or less produced; antennae shorter than thorax ....subg. **Ligia** s. str.

[20] The tracheae are sometimes revealed in preservative as white bodies, but are not easy to see. Superficially, our single species of *Trachelipus* may be distinguished from our four species of *Porcellio* by the following combination of characters: hind angles of anterior thoracic segments produced, dorsal surface obscurely tuberculate, first segment of flagellum shorter than second, apex of telson pointed, dorsal surface usually regularly marked with vittate series of dark and pale markings.

Body proportions from less than half (female) to nearly two-thirds (male) as wide as long, the extra width of the male being due to wider epimera; lateral portions of third, fourth, and fifth abdominal segments carinate; antennal flagellum with 15 segments (less in immature individuals); carpus and merus of first leg swollen, not grooved; uropods one-eighth as long as body, the branches twice as long as the peduncle; length to 35 mm. (figs. 127-128)....**pallasii** Br.

Habitat. Rocky sea cliffs.

Distribution. Western Aleutian Islands (Attu, *Richardson* 1910) to middle California (Point Montara and Farallone Is., *Miller, Van Name*). BRITISH COLUMBIA: Departure Bay, Prince Rupert (*Walker*); Calvert Is. (Safety Cove), Queen Charlotte Is. (Pillar Bay near Dixon Entrance). WASHINGTON: Bay Center, Deception Pass, Fort Steilacoom (*Stimpson*), Mora, Nasel River, Ocean Park, San Juan Co. (Bell Is., Brown Is., Davis Bay, False Bay, Flattop Is., Friday Harbor, Iceberg Point, Skipjack Is.), Seattle (Golden Gardens), Tatoosh Is. OREGON: Coos Bay (*G. M. Shearer*), Depoe Bay, Florence, Glenada (Lane Co.). The species is uncommon in Puget Sound south of Admiralty Inlet.

Bibliography. Stimpson 1857:88 (*dilatata* Stimpson); 1857a:507-508, pl. xxii, fig. 8 (*dilatata* Stimpson).—Budde-Lund 1885:261-262.—Calman 1898:282.—Richardson 1899:866; 1899a:334; 1905:674, 682-684, figs. 726-727; 1910:125 (*Ligyda*).—Jackson 1922:689, 691-692.—Walker 1927:175, 176 (*Ligyda*).—Fee 1926:42-43 (*Ligyda*).—Van Name 1936:46-48, fig. 7.—Miller 1938:116-118, 135, fig. 1.—Abbott 1940:509 (*Ligyda*).

Ligidium Br.

Eyes present; antennal flagellum 10- to 15-segmented (less in immature individuals)........................subg. **Ligidium** s. str.

Body smooth; color above brown, the head mottled, the thoracic segments brown along the mid-line with mottling on either side, the abdominal segments somewhat mottled; the brown pigment absent in var. *flavum* Jackson from Massett, B.C.; eyes large, in lateral view separated from the dorsal and anterior margins of the head by less than their own length; first thoracic segment without a patch of setae along the hind margin towards either hind angle; telson broadly evenly arcuate, without terminal setae, notched towards either side above the point of insertion of the uropod; uropod with the length of the inner process of the protopodite greater than the width of the base, the endopodite less than one-seventh longer than the exopodite; exopodite of first male pleopod with a single large bristle at inner posterior margin, the endopodite of the second male pleopod without an oval appendix at apex; length male 7 mm., female 9 mm. (figs. 124-126) ....**gracile** Dana

Habitat. Under cover in moist situations in woods up to 4500 feet elevation.

Distribution. Southeastern Alaska (Sitka) to middle California (Santa Clara) west of the Cascade and Sierra Nevada mountains (*Jackson*). BRITISH COLUMBIA: Haney (*G. J. Spencer*), Massett (var. *flavum* Jackson), Vancouver, Victoria (*Fee*). WESTERN WASHINGTON: Bay Center, Carson, Cedar River near Renton, Edmonds, Elwha River, Green River Gorge (*Arcangeli*), Lake Forest Park, Lake City, Lewis and Clark State Park, Mt. Rainier (Paradise—*Arcangeli,* Narada Falls), Mt. Vernon, Olympia, Olympic Hot Springs, Ozette L., Sammamish L., San Juan Co. (Doubleneck, Sportsman's L.), Seattle, Snoqualmie Falls, South Bend, Tukwila. OREGON: Bear Trap Creek (near Gold Beach), Cascade Head Exper. Forest, Eugene, Glenada (Lane Co.), McMinnville (Peavine Ridge), Multnomah Falls, Portland; Eugene and Mt. Hood (*Arcangeli*).

Bibliography. Richardson 1905:686, 688 (*tenue* B.-L.), 690, fig. 732.—Jackson 1923:828, 832-834, fig. 6.—Fee 1926:43-44.—Walker 1927:175, 176, figs. 1-5.—Arcangeli 1932:139-140.—Van Name 1936:67-69, figs. 22-23.—Miller 1938: 116-119.—Hatch 1939:256.—Spencer 1942:23.

Superfamily ENDOPHORA

Family TRICHONISCIDAE

Subfamily TRICHONISCINAE

Trichoniscus Br.

1. Dorsal surface absolutely smooth; telson feebly emarginate at apex; flagellum of second antenna with four or five segments; length to 4.0 mm.; females only known (figs. 130-131)..........**demivirgo** Blake

This species was first recorded from northeastern North America under the name of the European *pusillus* Br. by Stuxberg in 1876, and this was confirmed by Richardson (1905), Lohmander (1927), and others. Meanwhile (Graeve 1913, 1914; Verhoeff 1917; Herold 1929), it became apparent that, despite the highly parthenogenetic character of many of the populations, rising to nearly 100 per cent in more northern latitudes, almost the only specific characters in *Trichoniscus* are in the male pleopods. As a result, the single species (*pusillus*) that Dahl found sufficient to cover the German species in 1916 (pp. 37, 39) was increased to nine species and two subspecies by Wächtler in 1937 (pp. 242-251), with "*pusillus*" itself reserved as a "Sammelname" for undetermined parthenogenetic populations. It was in the light of this situation that Blake (1931) proposed the name *demivirgo* for the so far completely parthenogenetic population of northeastern North America and that Dailey and Hatch (1940) applied the same name to the similar western Washington population. The further elucidation of this matter must await the finding of males or the discovery of specific characters in the females.

Habitat. Under stones on very moist ground or muck and in very moist decaying humus.

Distribution. New Brunswick and Ontario (*Walker*) to Pennsylvania (*Lohmander*). WESTERN WASHINGTON: Lake Forest Park, Seattle.

Bibliography. Stuxberg 1876:49 (*pusillus*).—Richardson 1905:693-695, fig. 733 (*pusillus*).—Lohmander 1927:1-3 (*pusillus*).—Walker 1927:175, 177 (*pusillus*).—Blake 1931:341-345, figs. 1a-h.—Van Name 1936:78-80, fig. 29.—Dailey and Hatch 1940:252.

1'. Dorsal surface obscurely minutely tuberculate; telson truncate at apex; flagellum of second antenna three-segmented; length to 3.0 mm...species?

The specimens referred to here were taken in damp earth under pots in July, 1946, in the greenhouse of the Oregon State College at Corvallis, Ore. They are almost surely introduced, but do not appear to belong to any species previously recorded from North America. They somewhat resemble *T. pygmaeus* Sars (Lohmander 1927:3; Van Name 1936:80-81) but are 50 per cent larger than that species, which is said not to exceed 2 mm. in length. The status of the species must remain in doubt, at least until additional males are available.

Cordioniscus Graeve

Body oblong-oval, the dorsal surface of the head and thorax strongly tuberculate, the segments of the latter each with about three transverse rows of prominent tubercules; flagellum of second antenna with four or five segments; telson broadly rounded at apex; length to 3.5 mm. (fig. 157) .... **stebbingi** Patience

Specimens assigned to this species occurred with the preceding in the damp earth under pots in the greenhouse of the Oregon State College at Corvallis, Ore., in July, 1946. Elsewhere the species is likewise known primarily from greenhouses, but has been taken outdoors in England.

Distribution. Belgium and Great Britain, with closely related subspecies in Germany (*Wächtler*); Massachusetts (*Blake*); OREGON: Corvallis.

Bibliography. Blake 1931:350.—Van Name 1936:86-87, fig. 35.—Wächtler 1937:254-256, figs. 45-46.

Oregoniscus gen. nov.

The restriction of *Trichoniscus* as indicated above makes it necessary to seek another genus for *T. nearcticus* Arcangeli.

Length 2.73 mm.; body surface with granulations each consisting of a conoidal group of scales, the granulations disposed in three transverse rows on the first, and in two rows on the remaining thoracic segments, and in one row along the posterior margins of the abdominal segments (figs. 132-137) .... **nearcticus** Arcangeli

This species is based on a single female taken by Prof. Filippo Silvestri in Portland, Oregon, in 1930. In order to make the basic information on this species available in English, the following paraphrase of Arcangeli's original Italian description is presented.[21]

Trichoniscus (subgenus?) **nearcticus** sp. n.

Locality: MacLeay Park, Portland, Oregon; 28-vii-1930; one female.

With the typical form of *Trichoniscus* but more convex anteriorly; opaque, colorless, only the apex of the mandibles and the external lamina of the first maxillae slightly brown; dorsal surface set with minute granulations each consisting of a conoidal group of closely appressed scales concealing in their midst a complex structure, the precise nature of which can be determined only when additional material is available; granulations more or less evidently arranged in three transverse rows on the first and in two transverse rows on the other thoracic segments, one of these rows very near the posterior margin; abdominal segments with only the single posterior marginal row of granulations; space between the granulations with discrete minute recumbent scales, the free margins of which are curled to simulate hairs.

Head deeply set in first thoracic segment, its frontal margin granulate, broadly arcuate, the median lobe slightly protuberant relative to the well-developed trapezoidal lateral lobes, the distal margins of which are continuous with the lateral margins of the first thoracic segment.

Eyes absent.

Second antennae extending little beyond the first thoracic segment; the segments of the peduncle well developed and granulate, the fifth segment incurved dorsally on its dorsal external half and with a long bristle at its external distal angle; flagellum a little shorter than the fifth segment of the peduncle, 4-segmented, the segments decreasing in length from the first to the last, which bears a long thick tuft of bristles.

First antennae with the third segment slender and elongate, its apex with a tuft of sensory rods.

Maxillipedal palp 2-segmented, the second segment about five times as long as the first, conical, somewhat incurved, set with a terminal and a subterminal group of bristles; mandible conical, truncate at end and set with two strong teeth, one at the internal, the other at the external angle.

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[21] I am indebted to Prof. Walter B. Whittlesey of the University of Washington for preparing the literal translation from which this paraphrase was made.

Hind angles of thoracic segments two to seven, especially the seventh, acute; the posterior margin of the epimeron somewhat bent forward in thoracic segment one, transverse in thoracic segments two and three, extending backwards in thoracic segments four to seven; the hind angles of thoracic segment seven not attaining the level of the posterior margin of abdominal segment two.

Tergite of thoracic segment one not longer than that of two; thoracic epimera with a series of granulations extending obliquely forward from the posterior angles and becoming lost.

Tergites of abdominal segments three to five subequal in length, the epimeron of each with an acute hind angle which is not closely appressed to the epimeron of, and extends half way along, the succeeding segment.

Telson subtrapezoidal, rounded at the apex, at most attaining the level of the distal margin of the protopodite of the uropods.

Uropods with exopodite somewhat longer than the telson, about twice as long as the protopodites, the endopodites more than half as long as the exopodites.

Segments of the thoracic appendages, especially the meropodite, carpodite, and propodite, relatively short and broad.

Length 2.73 mm.; width 1.13 mm. at the sixth thoracic segment.

Bibliography. Arcangeli 1932:137-139, fig. VII.—Van Name 1936:509-510, fig. 313.

Superfamily EMBOLOPHORA

Family SCYPHACIDAE

Subfamily SCYPHACINAE

Detonella Lohmander

Length 3 (male) to 3.8 (female) mm.; dorsal surface more or less obscurely tuberculate, irrorate with brown enclosing irregular paler spots and paler side margins, the mid-dorsal line more or less conspicuously vittate; antennal flagellum 4-segmented; head with lateral lobes semicircular; telson produced between the protopodites of the uropods in a broad lobe the sides of which are broadly sinuate, the apex feebly arcuate or subtruncate with obtuse narrowly rounded angles; uropods with the exopodite a little longer and about twice as broad as the endopodites (figs. 41, 144-148, 172)..**papillicornis** Rich.

Verhoeff (1942), by insisting on the seven-segmented flagellum, the subquadrate lateral cephalic lobes, the broadly rounded telson, and the endopodite of the uropod two-thirds as broad as the exopodite as revealed in Richardson's figures (1904, 1904a, 1905), has attempted to show that Lohmander's (1927) material from Bering Is. is distinct (*lohmanderi* Verh.), as is also another species (*sachalina* Verh.) that he describes from Sakhalin Is. The matter of the seven-segmented flagellum would seem to have been settled by Lohmander's footnote (1927:17) in which he says that "Mr. C. R. Shoemaker, of the United States National Museum, has examined the antennae of the type of *Trichoniscus papillicornis* Richardson and finds that, owing to the fact that the type is a small, immature specimen, the exact number of articles in the flagella is rather obscure. As well as he is able to determine, there are four or possibly five articles, but the fifth is very obscure and uncertain." Since Washington specimens conform to Lohmander's Bering Is. material, I suggest that the other points cited by Verhoeff be set down to the inadequacies of Richardson's description and figures and that *lohmanderi* Verh. be regarded as a synonym. *D. sachalina* Verh. may be distinct (more prominent lateral cephalic lobes, more angulate telson), but it is very close.

Habitat. In moist sand under debris in the upper tidal zone in association with *Armadilloniscus tuberculatus* Holmes & Gay and *Philoscia richardsonae* Holmes & Gay.

Distribution. Komandorski Arch. (Bering Is.—*Lohmander*); southern Alaska (Seldovia on Cook Inlet—*Richardson*; Ketchikan). BRITISH COLUMBIA: Hammond Bay (*Fee*). WASHINGTON: Friday Harbor, Whidbey Is. (Ebey's Landing).

Bibliography. Richardson 1904:670-671, figs. 18-22; 1904a:227, figs. 113-117; 1905:693, 695-696, figs. 734-738 (*Trichoniscus*).—Fee 1926:44 (*Trichoniscus*). Lohmander 1927:8-17, figs. 3-6.—Van Name 1936:100-102, fig. 44.—Verhoeff 1942:171-174.

Subfamily ARMADILLONISCINAE

Armadilloniscus Uljanin

Broadly oval; dorsal surface more or less obscurely tuberculate; head with a narrowly rounded median lobe, the lateral lobes broadly rounded to subtruncate; fifth segment of antennal peduncle longer than fourth; first segment of antennal flagellum shorter than second or third (except in immature specimens), the terminal (fifth) segment longer than the fourth; side margins of thoracic segments nearly straight, those of the abdominal segments straight or feebly arcuate; hind angles of first thoracic segment acute, narrowly rounded, scarcely produced; telson obtusely triangular; length 4 mm. (fig. 153) .... **tuberculatus** Holmes & Gay

Habitat. In moist sand under cover in the upper tidal zone in association with *Detonella papillicornis* Richardson and *Philoscia richardsonae* Holmes & Gay.

Distribution. California (San Diego—*Holmes & Gay*; Alameda—*Miller*). WASHINGTON: Friday Harbor.

Bibliography. Holmes & Gay 1909:377-378, fig. 5 (*Actoniscus*).—Van Name 1936:103-104, fig. 46.—Miller 1938:114, 116, 117 (*Actoniscus*).

Family ONISCIDAE

Subfamily ONISCINAE

Philoscia Latr.

Abdominal segments abruptly narrower than the thoracic; median and lateral lobes of head feeble but distinct; the outer division of the first maxillae with the teeth of the inner group not serrate along their inner margins

1. Supra-antennal line absent, the anterior margin of the head formed by a line coincident with the upper margin of the antennal sockets; abdominal segments not margined at sides; carpopodite of anterior legs scarcely sexually dimorphic; littoral; generitype *Philoscia richardsonae* Holmes & Gay .... subg. **Littorophiloscia** nov.

Length 5 mm.; surface smooth,[22] irrorate with brown enclosing paler spots so arranged as to give the effect of a median and two sublateral interrupted pale vittae (fig. 154) .... **richardsonae** Holmes & Gay

[22] The dorsal surface in specimens of both this species and the next appears smooth as long as the specimens are submerged in the preservative. Minute granulations appear when the surface is covered by only a film of liquid immediately after its removal from the preservative.

Habitat. In moist sand under debris in the upper tidal zone in association with *Detonella papillicornis* Rich. and *Armadilloniscus tuberculatus* Holmes & Gay.

Distribution. California (San Diego—*Holmes & Gay,* Laguna Beach—*Stafford,* Alameda—*Miller*). WASHINGTON: San Juan Co. (Friday Harbor, Sucia Is.), Whidbey Is. (Ebey's Landing).

Bibliography. Holmes & Gay 1909:378-379, fig. 6.—Stafford 1912:127-129, fig. 71.—Van Name 1936:172-174, fig. 89.—Miller 1938:115-117.

1'. Supra-antennal line present, situated well above the upper margin of the antennal sockets and close to the lower margin of the eyes; abdominal segments margined at sides; carpopodite of anterior legs (especially the first) widened in male and with a brush of stiff hairs on the inner aspect; terrestrial............................subg. **Philoscia** s. str.

Male with first pleopods with endopodites gradually slenderer towards apex, the apex itself broadly rounded and not dentate; the seventh leg of the male with meropodite with the basal tooth along the lower margin *in profile* not prominent; length up to 11 mm.; dorsal surface smooth, pale with irregular dark markings which leave the side margins pale and themselves form a more or less evident median and sublateral vitta, each of these enclosing pale spots, at least on the thoracic segments (figs. 174-180)..............................**muscorum** Scop.

The status of *muscorum* in America is not entirely clear.[23] Dahl separated the var. *sylvestris* Fab. from typical *muscorum* on the basis of its broad pale side margins, and Verhoeff separated the two forms largely on the basis of the form of the exopodite of the first male pleopod: as long as broad in *muscorum,* the posterior margin strongly sinuate, the outer lobe posteriorly evidently produced; broader than long in *sylvestris,* the posterior margin feebly sinuate, the outer lobe posteriorly very feebly produced. Northwestern specimens correspond in color pattern to Dahl's concept of *sylvestris,* while in the form of the exopodite of the first male pleopod they correspond more or less to Verhoeff's concept of *muscorum,* though not always in the extreme form figured by him. I leave them under the more inclusive term.

Habitat. Synanthropic; occurring under stones, boards, and other cover in moderately dry situations in alleys and parks and about residences in Seattle (since 1938) and vicinity (Lake Forest Park, 1945) in such a fashion as to suggest that it is an introduced species. Two lots from Seattle were taken in greenhouses.

Distribution. Europe and north Africa (*Budde-Lund*); Costa Rica (*Richardson*); Massachusetts? (*Richardson, Van Name*). WESTERN WASHINGTON: Lake Forest Park, Seattle.

[23] The maritime *vittata* Say (Maine to New Jersey) has been equated with *muscorum* by Budde-Lund (1885:209) and with the var. *sylvestris* Fab. by Blake (1931:351). Blake quotes Herold as associating *sylvestris* with saline soils in Europe, but other authors (Dahl, Verhoeff, Wächtler, Collinge) report *muscorum* or *sylvestris* as widely distributed in inland localities in Europe, and my Northwestern specimens were taken four or five miles from salt water. It seems unlikely that a species elsewhere of varied ecological distribution would become strictly maritime in the northeastern United States, so that it is probable that *vittata* is a distinct species. Its characters are very like those exhibited by *muscorum,* and I cannot confirm the differences cited by Van Name (1936:115-116). However, a male collected by Mr. Herbert Knutsen at Kingston, R. I., shows the posterior margin of the expodite of the first male pleopod obtusely angulately incised, rather than sinuate as in *muscorum,* and this may serve to distinguish the species. Inland specimens from New England should be re-examined to make sure they do not belong to an introduced species.

Bibliography. Budde-Lund 1885:207-209.—Richardson 1910:95.—Dahl 1916: 34-35.—Verhoeff 1934:274-275, figs. 3-4.—Van Name 1936:113-115, figs. 50-51. —Wächtler 1937:269, figs. 67-68.—Dailey and Hatch 1940:252.—Collinge 1943:17-18.

Alloniscus Dana

Length up to 16 mm.; very convex, not quite twice as long as broad; dorsal surface smooth, finely punctate, pale, variably marked except at the extreme lateral margins with brownish black enclosing pale spots; lateral processes of head not very prominent; thorax with anterior angles not serrate, the three anterior segments with the posterior margin towards the hind angles nearly straight, the hind angles narrowly rounded; the hind angles of the remaining thoracic segments increasingly acutely produced (figs. 40, 155-156)............... ....perconvexus Dana

Habitat. Under cover in the moist sand of the upper beach.

Distribution. Southern California (San Diego) to British Columbia. BRITISH COLUMBIA: Tolfino (*G. J. Spencer*). WASHINGTON: Seaview, San Juan Is. (Cattle Point), Whidbey Is. (Ebey's Landing). OREGON: Coos Bay (*G. M. Shearer*), Big Creek, Port Orchard, Tillamook.

Bibliography. Richardson 1905:596-598, figs. 652-654.—Stafford 1912:124, fig. 69.—Van Name 1936:215-217, figs. 119-120.—Miller 1938:114, 116, 117.

Oniscus L.

Length to 18 mm.; color of dorsal surface variable, especially in young, but usually dark gray, the lateral margins broadly pale, the thoracic segments marmorate with pale on either side of the mid-dorsal line and with a large sublateral pale spot; dorsal surface shining, punctate, set with smooth tubercles; head tuberculate and with a transverse furrow at least in adults (individuals at least 11 mm. long), the median lobe broadly arcuate and more prominent than the lateral lobes, in immature individuals varying to less prominent than the lateral lobes, and obtusely subdentate or dentate in the adult; abdominal segments smooth; exopodite of the first male pleopod with the two lobes forming an acute angle along the posterior margin, the exopodite of the second male pleopod with a nearly rectangular incision along the posterior margins; telson acutely elongately produced, less so in the young (*murarius* auct.) (figs. 39, 181-186)....... ....asellus L.

Color variations of this species have been described by Collinge (1918:34).

Habitat. Synanthropic; under cover in moderately dry situations, both outdoors and in greenhouses. Extremely abundant in greenhouses in southwestern British Columbia. Recorded as attacking rhododendron seedlings in Connecticut (*Britton*).

Distribution.[24] Wächtler, following Verhoeff (1908) and Strouhal (1929), divides the old "*Oniscus asellus*" into four varieties, some of which are more or less geographically discrete and may represent valid subspecies. The most widely distributed of these, called *murarius,* is apparently the typical form of the species, and is the one represented by my material (Connecticut, Washington, Oregon) and described above. It cannot necessarily be assumed, however, that all the published records refer to this same subspecies.

[24] An introduced species cannot be assumed to have a continuous distribution in the region of its introduction. Hence the detailed data in the present paper.

Typical *asellus* is apparently native to the region from Scotland, Ireland (*Collinge* 1942), and the Pyrenees to Austria and eastern Germany (*Wächtler*). It has, however, been widely distributed, probably largely by human agency, beyond this area: Azores, Norway, Poland, Transylvania (*Budde-Lund*); Sweden, Iceland (*Sars*); Cuba (*Hay*); Haiti (*Van Name*).

In North America *asellus* was first recognized by Say under the name of *Oniscus affinis* in 1818. Newfoundland (*Stuxberg*); Nova Scotia (Halifax, *Hatch*); Quebec (*Johansen*); Ontario (*Stuxberg, Walker*); New England (*Blake*); New York (*Stoller*); New Jersey (*Fowler*); Pennsylvania, Illinois (*Richardson*). BRITISH COLUMBIA: Burnaby, Langley Prairie, North Vancouver; State Park (Kootenays near Fernie) and Vancouver (*G. J. Spencer*). EASTERN WASHINGTON: Yakima. WESTERN WASHINGTON: Aberdeen, Centralia, Enumclaw, Seattle (1932). OREGON: Portland.

Bibliography. Say 1818:430-431 (*affinis*).—Stuxberg 1876:50-51 (*vicarius*).—Budde-Lund 1885:202-214 (*murarius*).—Sars 1898:171-172, pl. LXXV.—Hay 1903:431.—Richardson 1905:600-602, fig. 657.—Verhoeff 1908; 1934:272-274, fig. 2 (*murarius*).—Fowler 1912:235-236, pl. 71.—Collinge 1918:34; 1942:162.—Herold 1924.—Johansen 1926:165-166.—Walker 1927:175, 177.—Strouhal 1929:205-209.—Blake 1931a:350-351.—Britton 1936.—Van Name 1936:182-185, fig. 97; 1942:326.—Wächtler 1937:271-272, figs. 72-73.—Hatch 1939:256.—Heeley 1941 (life history).—Waloff 1941 (ecology).—Spencer 1942:23.

Family PORCELLIONIDAE

Porcellionides Miers (*Metoponorthus* Budde-Lund)

Length to 12 mm.; above light brown, the head and thorax marmorate with paler spots, the mid-dorsal line with the suggestion of a paler vitta, the anterior and narrow posterior margin of the head and the posterior margin of the thoracic segments darker; head and thoracic segments moderately tuberculate; eyes strongly swollen, shining; frontal line of head feebly arcuate at middle, at sides produced in narrow rounded lobes restricted to the front of the eyes; head in front of frontal line marked with an obtusely angulate V-shaped carina; antenna three-fifths as long as body, the basal segment of flagellum as long as or longer than the second; third, fourth, and fifth segments of abdomen only feebly arcuate at sides; telson almost flat, not excavated; exopodite of first male pleopod more or less arcuately produced behind, somewhat variable.............**pruinosus** Br.

Thoracic segments two to four with the transverse series of tubercles somewhat distant from the hind margin on either side (figs. 50, 187-193)...subsp. **pruinosus** s. str.

Habitat. Under cover in moderately dry situations; occasionally of economic importance (see introductory remarks on Oniscoidea above). Occurs likewise in greenhouses, especially in eastern Washington.

Distribution. Apparently native to the Mediterranean region, where it is known from Spain and Algeria to European Turkey (*Budde-Lund*), and where, in Italy at any rate, it is not synanthropic (*Wächtler*). North of the Alps it is usually synanthropic, extending to Ireland, Scotland (*Collinge*), middle Norway (*Sars*), and central Russia (*Budde-Lund*); Ascension, Madagascar, Sumatra, Luzon (*Budde-Lund*); Japan (Osaka); Norfolk Is., New Zealand, Kermadec Is., Tahiti, Marquesas Is., Tuamotou Is., Fanning Is., Fiji (*Jackson*); Marshall Is. (Eniwetok); Hawaii (Honolulu); Mexico (Mexico City, Atepec near Ixtlan); Bermuda Is., Bahama Is. (*Richardson*); Greater and Lesser Antilles, Central America (*Van Name*); Venezuela (*Richardson*); Colombia (*Richardson* 1912a); Ecuador (*Stebbing*); French Guiana, Peru, Chile, Uruguay (*Budde-Lund*); Buenos Aires (*Giambiagi de Calabrese*).

The species was probably first recorded from North America by Fitch in 1855 under the name of *Porcellio immaculatus.* Ontario (*Walker*); New York

(*Fitch, Stoller*); Massachusetts, Maryland, Virginia, Florida, Ohio (*Richardson*); North Carolina (*Brimley*); South Carolina (Columbia); Mississippi (Greencastle); Louisiana (Baton Rouge, Cinclare); Tennessee, Michigan (*Hatch*); Illinois (*Fitch*); Minnesota (Artichoke Twp. in Big Stone Co.); Iowa (*Longnecker*); Missouri (Columbia); Oklahoma (Lawton, Shawnee); Kansas, Texas, New Mexico, Utah (*Richardson*); California (*Stuxberg* as *maculicornis* Koch; *Richardson*); Arizona (*Mulaik*); Wyoming (Glendo in Platte Co.); Montana (Little Pipestone Creek). BRITISH COLUMBIA: Lytton (1931, *G. J. Spencer*). EASTERN WASHINGTON: Cashmere, Clarkston, Coulee City, Dayton, Ellensburg, Kennewick, Lacrosse, Leavenworth, Park L. (Grant Co.), Pasco, Soap L., Spokane, Walla Walla. WESTERN WASHINGTON: Aberdeen, Chehalis, Seattle (on ship from New York, 1946). OREGON: Clackamas, Portland, Robinette. IDAHO: Emmett, Lewiston, Pocatello.

Bibliography. Stuxberg 1876:55-57 (*Porcellio maculicornis*).—Budde-Lund 1885:169-171 (*Metoponorthus*).—Stebbing 1893:429.—Sars 1898:184-185, pl. LXXX, fig. 2 (*Metoponorthus*).—Stoller 1902:213 (*Metoponorthus*).—Richardson 1905:625, 627-629, fig. 674 (*Metoponorthus*); 1912a.—Fowler 1912; 517-518 (*Metoponorthus*).—Collinge 1918:38; 1942:162; 1944:5-6.—Longnecker 1923 (*Metoponorthus*).—Walker 1927:175, 177 (*Metoponorthus*).— Giambiagi de Calabrese 1931:422-423, pl. VI.—Van Name 1936:238-240, figs. 133-134.—Wächtler 1937:275-276, figs. 77-78 (*Metoponorthus*).—Miller 1938:115, 116, 119 (ecology).—Brimley 1938:503 (*Metoponorthus*).—Hatch 1939:257.—Jackson 1941:14-15.—Mulaik 1942:7.

Porcellio Latr.

1. Hind angles of anterior thoracic segments rounded, not produced........ ....subg. **Mesoporcellio** Verh.

Length up to 18 mm.; color above slate gray without a pale lateral border, the entire head and the thoracic segments on either side of the mid-dorsal line marmorate with pale; dorsal surface almost smooth (when submerged in preservative), with a few low tubercles towards the sides and along the hind margins of the abdominal segments; head with prominent semicircular lateral lobes and a less prominent broadly arcuate median lobe, both lateral and median lobes somewhat reflexed; flagellar segments subequal; "nodules" of thoracic segments distinct, those of the first four segments two to three times as distant from the lateral as from the posterior margins and nearer the lateral margins than those of segments five to seven; posterior margin of anterior thoracic segments slightly sinuate towards the rounded hind angle; telson narrowly produced, not extending appreciably beyond the hind angles of the fifth abdominal segment; protopodite of uropod squarely truncate along hind margin; exopodite of first male pleopod acutely produced behind, ciliate along inner and outer margins (figs. 194-198)..................**laevis** Latr.

Habitat. Under cover in moderately dry situations. Not so far taken in the Pacific Northwest, but it will probably eventually be found, since it occurs in both Montana and California. See the section above on "Economic Importance" for further reference to this species. It is the common oniscoid in California (*Essig, Miller*).

Distribution. Occurs throughtout the Mediterranean region (*Budde-Lund*), where it is probably native (*Wächtler*). In central Europe it is introduced and synanthropic (*Wächtler*), extending to Ireland, Scotland (*Collinge*), Sweden (*Budde-Lund*), and southern Norway (*Sars*); Azores (*Richardson*); Madeira, Tenerife, Turkestan (*Budde-Lund*); New Caledonia, Tuamotou Is., Marquesas Is., Hawaii (*Jackson*); Lower California, Mexico, Bermuda (*Richardson*); Central America (*Van Name*); St. Croix Is. (*Pearse*); Cuba, St. Thomas, Peru, Rio de Janeiro, Uruguay, Argentina, Chile (*Budde-Lund*); Paraguay (*Giambiagi de Calabrese*); Galapagos Is. (*Hansen*); Juan Fernandez Is. (*Wahrberg*). I have specimens from Monterrey and Atepec near Ixtlan (Mexico) and Negritos (Peru).

The species was first recorded from the United States (without mention of locality) by Stuxberg in 1875.[25] Ontario (*Thompson*); New Jersey (*Fowler*); North Carolina (*Brimley*); District of Columbia, Ohio, Georgia, Florida, Texas, New Mexico, Arizona, California (*Richardson*); Louisiana (*Budde-Lund*); Oklahoma (Lawton, Shawnee); Utah (*Mulaik*); Montana (*Hatch*); Unalaska (*Richardson*). Van Name suggests that the last occurrence requires confirmation!

Bibliography. Stuxberg 1876:43 (*dubius* Br.).—Budde-Lund 1885:138-141.—Hansen 1897:124.—Sars 1898:181-182, pl. LXXIX, fig. 2.—Richardson 1905: 612, 614-616, fig. 666.—Fowler 1912:231-232, pl. 70.—Pearse 1917:7.—Collinge 1918:38; 1942:162; 1943a:72.—Wahrberg 1922:286.—Essig 1926:2-3, fig.1.—Giambiagi de Calabrese 1931:420-422, pls. IV-V.—Thompson 1932.—Van Name 1936:229-232, fig. 129.—Miller 1936:166, 171, figs. 4, 9, 16, 22, 27; 1938:114, 116, 119 (ecology).—Wächtler 1937:278-279, fig. 81.—Brimley 1938:502.—Hatch 1939:257.—Jackson 1941:14.

1′. Hind angles of anterior thoracic segments produced (*Euporcellio* Verh.) .... subg. **Porcellio** s. str.

Head and thoracic segments more or less evidently set with from four to six more or less regular transverse rows of tubercles; telson subsimilar to the hind angles of the fifth abdominal segment; protopodite of uropod transversely subtruncate at apex

2. First segment of antennal flagellum longer than second, second and third segments of peduncle each with a prominent tooth along the dorsal apical margin; median lobe of head very broadly arcuate, filling the space between the lateral lobes, which in certain aspects are straight or subsinuate along their outer margin; telson acutely produced; color yellowish gray, variegated with lighter and darker patches in longitudinal series, the head and abdominal disc conspicuously darker, the side margins of thorax and abdomen broadly pale, the thorax marked with a median and a sublateral series of larger pale spots with numerous smaller spots in between; exopodite of first male pleopod with inner angle and apex arcuate, not sinuate, not or very finely ciliate; length to 15 mm. (*pictus* Br.) (figs. 205-209) .... **spinicornis** Say

Collinge (1918) has described six color variations of this species.

Habitat. According to Blake, this distinctly marked species is decidedly xerophilous in its habits, though Stoller earlier had associated it with rock crevices and shady limestone ledges. My only specimens were taken at Eagle Harbor, Michigan, in rock crevices along the Lake Superior shore. Not so far taken in the Pacific Northwest.

Distribution. France (*Sars*), Ireland, and Scotland (*Collinge*) to southern Norway, Sweden, and Russia (*Sars*); not indigenous in the Mediterranean region, where at times it is introduced (*Wächtler*); northwest Italy (*Verhoeff*). It was first recorded from North America by Say in 1818. Quebec (*Johansen*); Ontario (*Stuxberg* as *pictus*; *Walker*); New York (*Fitch, Stoller*); Maine, Vermont, Rhode Island (*Blake*); Connecticut (*Richardson*); upper peninsula of Michigan (*Hatch*).

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[25] The earlier records of *laevis* from Massachusetts (Gould 1841:337) and New York (De Kay 1844:52) probably refer to other species, since this species has not since been recorded from either of these states.

Bibliography. Say 1818:431-432.—Fitch 1855:824 (*vittatus*).—Stuxberg 1876:59 (*pictus*).—Budde-Lund 1885:123-125 (*pictus*).—Sars 1898:177-178, pl. LXXVIII, fig. 1 (*pictus*).—Stoller 1902:213.—Richardson 1905:612, 619-621, figs. 669-670.—Collinge 1918:37 (*pictus*); 1942:162 (*pictus*); 1943c:264-265.—Johansen 1926:166.—Walker 1927:176, 179.—Blake 1931a:352.—Verhoeff 1933:5 (*pictus*).—Van Name 1936:232-234, fig. 130.—Wächtler 1937:281-282, fig. 85 (*pictus*).—Hatch 1939:257.

2'. First segment of antennal flagellum shorter than or subequal to the second, second and third segments of peduncle with no more than a small tooth along the dorsal apical margin; median lobe of head narrowly subtriangularly produced leaving an arcuate sinus on either side between it and the rounded lateral lobes

3. Telson subacutely produced; form more narrowly oval; anterior thoracic segment more coarsely tuberculate, especially towards the lateral margins; color gray without regularly arranged maculation or at most with a sublateral series of pale spots (typical form) (fig. 48) varying to a condition with pale lateral margins (var. *marginatus* Brandt & Ratzeburg) or irregularly maculate varying from gray marmorate with pale to pale maculate with gray (var. *marmoratus* Brandt & Ratzeburg) (fig. 49); exopodite of first pleopod with inner angle rounded and ciliate, the apex slightly emarginate, the outer angle rounded; length 16 mm. (figs. 48-49, 199-204) .... **scaber** Latr.

Ischiopodite of male hind leg more or less strongly incurved along inner margin; exopodite of first male pleopod usually shorter than broad; exopodites of first and second female pleopods with the lobe along the posterior margin towards the outer angle proportionately smaller, that of the second pleopod usually half as long as the remainder of the posterior margin (figs. 138-143) .... subsp. **niger** Say

The subspecific distinctness of the American populations of *scaber* was first suggested by Arcangeli in 1932[26] under the new name of *americanus* on

[26] In order to make Prof. Arcangeli's remarks (Arcangeli 1932:127-129) available to English readers, I present the following paraphrase based on a literal translation very kindly prepared for me by Prof. Walter B. Whittlesey of the University of Washington.

Porcellio scaber Latr. subsp. **americanus** nov.

Localities: San Mateo, Calif. (14-VIII-1930; 4 males); Victoria, B.C. (17-18-VII-1930; 2 males, 3 females with larvae in the marsupium); Agassiz, B.C. (15-VII-1930; 1 female); Sooke on Vancouver Is., B.C. (19-VII-1930; 1 male). I have also received specimens collected by Prof. Ghigi on Vancouver Is., B.C.

Unquestionably distinct in comparison with European specimens. First, they are much pigmented, especially the males, the pigment being extended in an attenuated degree onto the ventral surface and onto the pleopods, even of the females. The frontal lobe is more acute; the dorsal tubercles are larger, more distinct, and more sharply defined. All the segments of the seventh thoracic legs of the male exhibit perceptible differences, especially the ischiopodites; the exopodites of the first two pairs of pleopods differ in both sexes. These are not ordinary individual variations encountered in European specimens. For the sake of brevity I have limited myself, but additional differential characteristics could be adduced. Figures of the same parts in both American and European specimens, the latter from Cervasca in Piedmonte, illustrate some of the above-mentioned differences. In addition, the basis of four specimens from California and seven from British Columbia. In the light of this, Arcangeli suggested that the Pacific Coast populations should be regarded as endemic rather than introduced. Miller (1936) confirmed the presence of *americanus* in California, where he found true *scaber* likewise; and, although his figures deviate considerably from Arcangeli's, they probably represent no more than the variation to which the American populations are subject.[27] The most definite of the characters of the American subspecies is the bowing of the ischiopodite of the hind legs of the male. The proper evaluation of this character depends on the angle from which the leg is viewed, and it frequently appears more as Miller has figured it than in the extreme form shown by Arcangeli. Nevertheless, the phase illustrated by Arcangeli appears frequently enough to make one realize that it is a truly variable character that one is dealing with. I am satisfied that I have at least subtypical *americanus* from points as distant as Michigan (Calumet), Ohio (Athens), and Mexico (Moralia), and suspect that it occurs throughout North America, although not always in a typical form. This being the case, previous names applied to the North American populations become available, of which *niger* Say (Say wrote it *"nigra"*) 1818 has priority.[28]

The color in America varies as described by Brandt & Ratzeburg (1830-34; *Budde-Lund*) for Europe, and I find fully developed *marginatus*- and *marmoratus*-forms frequent in my Northwestern collections.[29]

Habitat. This is the common oniscoid of the Pacific Northwest, and the typical subspecies is said by Wächtler to be the commonest species of western, central, and northern Europe. In the Pacific Northwest it occurs in a great variety of moderately dry situations, usually in the vicinity of human occupancy, but also frequently along the margins of streams and along river, lake, and marine beaches. On marine beaches it may extend practically to the zone of the true littoral forms. It is common in greenhouses, occurring in 55 per cent of those visited, apparently readily entering them from the outside; but it

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I may note that specimens of *Porcellio scaber* from Dunedin, New Zealand, do not show perceptible differences when compared with European material.

As is well known, *Porcellio scaber* has a worldwide distribution, due in important measure to its synanthropic habits. Most authors assume the species to have originated in Europe, in the northern and central portions of which it is common. In Italy the species does not descend, so far as I know, into the plains of either Lombardia or Venezia, although I have taken it in the central Alps. In Piedmonte it comes down to certain points in the province of Turin, remaining, however, in hilly terrain. In all the rest of Italy it is lacking. In Spain it occurs only in the north, penetrating as far as Madrid as a synanthrope. It appears to avoid localities having a typical Mediterranean climate.

In North America (Richardson 1905:622) the species appears to be widely distributed. American colleagues, upon being questioned, have been unable to give any positive answer as to whether it is endemic or introduced. I incline to the former view because Prof. Silvestri collected specimens far from the works of man, because of the very different facies of American as compared with European material, and for a number of other reasons that I shall adduce at a later date.

Previously (Arcangeli 1927:225) I have called attention to the dark brown color of males of *P. scaber* from Jeso in Japan. I did not insist on other peculiarities because at that time I did not have a sufficient series of European specimens for comparison. Verhoeff (1928:36), however, has established a subspecies *japonicus* on specimens from Hokkaido on the basis of their more strongly developed dorsal tubercles. If, as this author affirms, Japanese specimens correspond in general to those from Europe, especially in the structure of the male pleopods, it seems to me that the erection of a separate subspecies is hardly warranted.

[27] In one respect I cannot reconcile Miller's figures with those of Arcangeli's, and I am led to suggest that the labeling on Miller's figures 17 and 18 is reversed.

[28] If, for any reason, Say's name should prove inacceptable, *gemmulatus* Dana 1853, *tuberculata* Stimpson 1856 (*Philoscia*), and probably *montezumae* Saussure 1857 are available.

[29] If the purist objects to using identical varietal names in distinct subspecies, I suggest the hyphenated *"marginatus*-form" and *"marmoratus*-form" as adequate designations. As noted by Wächtler, these varieties are "ohne systematischen Wert," and new Latin names should not be coined. See Collinge (1918) for further color varieties.

tends to give way before the more characteristic greenhouse species: *Armadillidium vulgare* Latr., *Porcellio dilatatus* Br., and, in southwestern British Columbia, *Oniscus asellus* L. This species sometimes becomes of economic importance in California, as pointed out above.

Distribution. A native of western Europe, this is the commonest oniscoid of the western, central, and northern portions of that continent (*Wächtler*); less common in southern Europe (*Sars*); northwest Italy (*Verhoeff*); northern Spain (*Arcangeli*); Iceland, Ascension Is., Cape of Good Hope, St. Paul Is., Kamchatka (*Budde-Lund*); Japan, New Zealand (*Arcangeli*); Hawaii, Rapa Is. (*Jackson*); Bermuda (*Richardson*); Guatemala, St. Croix Is., Colombia (*Van Name*); São Paulo (*Moreira*); Galapagos Is. (*Thielemann* after *Van Name*); Juan Fernandez Is. (*Dollfus*).

As noted above, *scaber* appears to be represented in North America by the somewhat variable subsp. *niger* Say, which may be an endemic form, and which was first recorded from North America by that author in 1818 and was taken in Oregon by Dana in 1841. Alaska (Bering Is., *Richardson*); Labrador (*Johansen*); Newfoundland (*Stuxberg*); Nova Scotia, New Brunswick, Quebec (*Richardson, Walker*); Ontario (*Stuxberg, Walker*); Maine, Massachusetts (*Richardson*); Rhode Island (*Blake*); Connecticut, New York, New Jersey, Maryland (*Richardson*); Pennsylvania, Virginia (*Fowler*); North Carolina (*Brimley*); Florida, Indiana, lower Michigan (*Richardson*); Kentucky (Kuttawa, Versailles); Ohio, Illinois (*Fitch*); upper Michigan (*Hatch*); Iowa (*Longnecker*); Missouri (Columbia, Jefferson City, Versailles); Wyoming, Utah (*Mulaik*); California (*Stuxberg, Richardson, Miller*); Mexico (*Budde-Lund*; Moralia, *Hatch.*)

BRITISH COLUMBIA: Agassiz (*Arcangeli*), Burnaby, Comas (*Richardson*), Departure Bay (*Fee*), Gabriola Is. (*Richardson*), Gold Stream, Langley Prairie, North Vancouver, Queen Charlotte Is., Salmon Arm, Vancouver (*G. J. Spencer*), Victoria (*Richardson, Arcangeli*). EASTERN WASHINGTON: Asotin, Chatteroy, Cheney, Clarkston, Cle Elum, Colfax, Coulee, Grand Coulee, Kahlotus, Park L. (Grant Co.), Prosser, Pullman, Spokane, Walla Walla, Wenatchee. WESTERN WASHINGTON: Aberdeen, Ballinger L. (Snohomish Co.), Bay Center, Bellingham, Castle Rock, Cedar River (Renton), Centralia, Chehalis, Chinook, Custer, Deception Pass State Park (Fidalgo Is.), Elwha R., Enumclaw, Everett, Granite Falls, Kalalock, Kalama, Kent, Lake Forest Park, Lake City, Lewis and Clark State Park, Lynden, Marysville, Monroe, Montesano, Mora, Mt. Vernon, North Bend, Ocean Park, Olympia, Onalaska, Oysterville, Port Angeles, Port Ludlow, Port Townsend, Quinault L., Renton, Sammamish L., San Juan Co. (Blakely Is., Brown Is., Doubleneck, Flattop Is., Friday Harbor, Henry Is., James Is., Mt. Constitution, San Juan Is. south end, Skipjack Is.), Seattle, Snoqualmie Falls, Tenino, Vancouver, Warm Beach, Whidbey Is. (Coupeville, Ebey's Landing). OREGON: Burns, Clackamas, Condon, Coos Bay (*G. M. Shearer*), Cornelius, Corvallis, Dayton, Eugene, Glenada (Lane Co.), Glendale, Klamath Falls, McMinnville, Merrill, Multnomah Falls, Ocean L. (Lincoln Co.), Park Place, Pendleton, Portland, Port Orford, Sauvies Is. (near Portland), Spencer's Butte (near Eugene), Tillamook, Triangle L. (Lane Co.). IDAHO: Caldwell, Coeur d'Alene, Lewiston, Moscow, Pend Oreille L., Pocatello, Waha L.

Bibliography.[80] Say 1818:432 (*nigra* Say).—Dana 1855:725, pl. XLVII, fig. 7 (*gemmulatus* Dana).—Stimpson 1856:97 (*Philoscia tuberculata*); 1857a:506 (*gemmulatus*).—Saussure 1857:307 (*montezumae*).—Stuxberg 1876:58-59.—Budde-Lund 1885:129-131.—Dollfus 1890:66.—Sars 1898:176-177, pl. LXXVII.—Richardson 1905:621-624, fig. 671.—Fowler 1912:229-231, pl. 69.—Collinge 1918:36-37; 1942:162.—Longnecker 1923.—Fee 1926:41-42.—Johansen 1926:166.—Walker 1927:175, 177.—Moreira 1927:194.—Arcangeli 1927:225; 1932:127-129, figs. II-III (*americanus* Arcangeli).—Verhoeff 1928:36; 1933:5.—Blake 1931a:352-353.—Van Name 1936:226-229, fig. 127; 1940:136-137, fig. 28.—Miller 1936:166-168, figs. 2, 6, 10, 17, 24, and (*americanus*) 1, 5, 11, 18; 1938:115, 116, 119 (ecology).—Wächtler 1937:283, figs. 86, 87.—Brimley 1938:502.—Hatch

[80] References are to *scaber* unless otherwise noted.

1939 (including *littorina*[31]).—Heeley 1941 (life history).—Jackson 1941:14.—Waloff 1941 (ecology).—Spencer 1942:23.—Mulaik 1943:6.

3′. Telson narrowly rounded; form more broadly oval; anterior thoracic segments less coarsely tuberculate, especially towards the lateral margins; color gray to dark brown, the extreme side margins and a group of spots on either side of the middle line of the thoracic segments paler; exopodite of first male pleopod with inner angle rounded and ciliate, not emarginate at apex, the outer angle rounded; length to 18 mm. (figs. 210-213) .... **dilatatus Br.**

Habitat. In the Pacific Northwest as in central Europe this is nearly exclusively a greenhouse species, occurring in 54 per cent of the greenhouses and frequently being the commonest species present. Those specimens taken outdoors have occurred immediately adjacent to a greenhouse. In the San Francisco Bay area it occurs outdoors.

Distribution. Probably endemic in the western Mediterranean region (*Wächtler*); in central Europe extending to France (*Sars*), Ireland, Scotland (*Collinge*), southern Norway, and Poland (*Sars*), but exclusively synanthropic in cellars and greenhouses (*Wächtler*). New Guinea (*Sars*); Queensland (Cape York, *Budde-Lund*).

The first published account of this species from North America is that by Miller, who recorded it from California under the name of *spinicornis* subsp. *occidentalis* nov.; my first Northwestern specimens were taken in Seattle in 1933. Arizona (Indian Gardens, Grand Canyon, 1938, *Van Name*); California (Berkeley and Moss Beach—*Miller*, Palo Alto). BRITISH COLUMBIA: Burnaby. EASTERN WASHINGTON: Cheney, Cle Elum, Colfax, Ellensburg, Kennewick, Leavenworth, Rosalia, Spokane, Sunnyside, Wenatchee, Yakima. WESTERN WASHINGTON: Aberdeen, Bellingham, Burlington, Centralia, Chehalis, Enumclaw, Kent, Marysville, Monroe, Mt. Vernon, Port Angeles, Port Townsend, Tacoma. OREGON: Clackamas, Dayton, Portland. IDAHO: Lewiston, Moscow.

Bibliography. Budde-Lund 1885:106-107.—Sars 1898:179, pl. LXXVIII, fig. 2.—Collinge 1918:38; 1918a:102; 1942:162; 1943a:72.—Miller 1936:166, 170, figs. 8, 12, 20, 25, 26; 1938:115, 116, 117-135 (*spinicornis* subsp. *occidentalis*).—Wächtler 1937:283-284, fig. 88.—Van Name 1940:117-118, figs. 9, 10 (*occidentalis* and *dilatatus*).—Heeley 1941 (life history).

Trachelipus Budde-Lund (*Tracheoniscus* Verhoeff)

Length up to 15 mm.; color uniform brown or gray (var. *ochraceus* Koch) or more commonly with narrow pale lateral margins and a sublateral and median series of pale spots with smaller spots in between (typical form=var. *trilineatus* Koch), sometimes with the entire surface pale and more or less irregularly set with dark spots (var. *varius* Koch); head with the median and lateral lobes well developed, the median lobe and the margins between it and the lateral lobes broadly arcuate; antennae with second and third segments of peduncle with no more than a small tooth along the dorsal apical margin, the first segment of the flagellum shorter than or subequal to the second; dorsal surface obscurely tuberculate; thoracic segments with the hind angles produced, the hind margins just within the hind angles sinuate, the lateral margins distinctly longitudinally swollen towards the hind angles, the lateral pores on segments two

[31] I am now convinced that the specimen reported from Bay Center, Wash., as *Porcellio littorina* Miller (Hatch 1939:257) is an immature female of *scaber*. Immature specimens of *Porcellio* tend to have the first segment of the flagellum shorter in proportion to the other segment than do more mature individuals.

to four, three times as distant from the hind margins as from the side margins; telson subacutely produced, subequal to the hind angles of the fifth abdominal segment; basal segment of uropod transversely subtruncate at apex (figs. 51-52, 214-218)....**rathkei** Br.

The nomenclature of the color varieties follows Dahl. I have not so far seen var. *ochraceus* in American material, but both the others are frequent. The numerous variations described by Fitch, except *mixtus*, which is equivalent to *varius*, are too finely drawn to be of any value.

Habitat. Under cover in moderately dry situations. Blake states that the moisture requirement of this species is less than that of *Porcellio scaber*, but in Michigan I found *rathkei* in much the same range of situations as those in which *scaber* occurs in the Pacific Northwest. The extreme variability of their habitat is attested to by Wächtler. This is the commonest oniscoid in northeastern North America. A single female has been taken in a greenhouse in Seattle, and it likewise occurs outdoors.

Distribution. The Pyrenees, northern Italy, Greece, and Roumania (*Arcangeli*) to the eastern Baltic (*Wächtler*), southern Norway (*Sars*), Scotland, and Ireland (*Collinge*), where it is one of the commonest oniscoids and may be native; Transcaucasia (*Budde-Lund*); Vera Cruz (*Pearse*); Buenos Aires (*Giambiagi de Calabrese*).

This species was first recorded from North America in 1855 by Fitch under the names of *limatus* and *mixtus* (=var. *varius*). Nova Scotia (Halifax); New Brunswick (*Wallace*); Quebec (*Walker*); Ontario (*Stuxberg, Walker*); New England (*Blake*); New York (*Fitch, Stoller*); New Jersey (Bergenfield, Ramsey, Stockholm); Pennsylvania (Easton); District of Columbia, Georgia, Texas, Ohio, Michigan (*Richardson*); Kentucky (Versailles); Minnesota (*Arcangeli*); Iowa (*Longnecker*); Indiana, Colorado, Wyoming (*Hatch*); Illinois (Alpha, New Windsor, Urbana); Nebraska (Kearney); Utah (*Mulaik*). BRITISH COLUMBIA: Salmon Arm (*G. J. Spencer*); Shuswap L.; Vancouver (*Spencer*). EASTERN WASHINGTON: Grand Coulee. WESTERN WASHINGTON: Seattle. OREGON: Robinette. IDAHO: Twin Falls.

Bibliography. Fitch 1855:824-825 (*Porcellio mixtus, variegatus, limatus, dorsalis, multiguttatus, marginatus, lateralis, limbalis*).—Stuxberg 1876:59-60 (*trilineatus* Koch).—Budde-Lund 1885:85-87 (*Porcellio*).—Sars 1898:180-181, pl. LXXIX, fig. 1 (*Porcellio*).—Stoller 1902:212.—Richardson 1905:612, 617-619, fig. 668 (*Porcellio*).—Pearse 1911:108 (*Porcellio*).—Collinge 1918:38; 1942:162; 1943a:72 (*Porcellio rathkii*).—Blake 1931a:353-354.—Arcangeli 1932: 132 (*Tracheoniscus*).—Giambiagi de Calabrese 1935 (*Porcellio*).—Van Name 1936:262-264, figs. 147B, 149; 1940:138 (*Tracheoniscus*).—Wächtler 1937:291-292, figs. 100, 101 (*Tracheoniscus*).—Hatch 1939:257.—Spencer 1942:23 (*Porcellio*).—Mulaik 1943:8 (*Tracheoniscus*).

Cylisticus Schnitzler

Length to 13.5 mm.; body gray, the lateral margins, a sublateral series of large spots, and a submedian series of numerous small spots on either side pale; surface nearly smooth; head with lateral lobes broader than long, their anterior angles distinct and subrectangular, the median lobe acutely angular; sublateral nodule of fourth thoracic segment nearly twice as removed from the lateral margin as in segments one to three and five and six; thoracic segments on either side slightly but evidently incurved along the posterior margin; endopodite of uropod completely filling the space between the telson and the hind angles of the fifth abdominal segment (figs. 53-54, 219-223) ....**convexus** DeG.

Habitat. Under cover in moderately dry situations. Stoller and Van Name both refer to the tendency of this species to occur away from human cultivation. In view of the fact that the only other species of the genus occur from southern Europe to Armenia, it hardly seems likely that *convexus* is other than introduced in the New World. Two specimens were taken in a greenhouse in Pullman.

Distribution. Endemic in eastern and central Europe, whence it has been introduced as far as Italy, Spain, France (*Wächtler*), Ireland, Scotland (*Collinge*), Scandinavia, the eastern Baltic, Poland, Hungary, and Bulgaria (*Wächtler*); Turkey, Caucasus (*Sars*); Mexico (*Van Name* 1942); Buenos Aires (*Giambiagi de Calabrese*).

This species was first recorded from North America by Fitch in 1855. Newfoundland (*Van Name* 1936); New Brunswick (*Wallace*); Quebec (*Walker*); Ontario (*Stuxberg, Walker*); New England (*Blake*); New York (*Fitch, Stoller*); Pennsylvania (Pittsburgh); District of Columbia (*Richardson*); Virginia (Luray); West Virginia (Ronceverte); North Carolina (*Brimley*); Tennessee (*Hatch*); Ohio, Illinois, southern Michigan (*Richardson*); northern Michigan (*Hatch*); Minnesota (*Arcangeli*); Iowa (*Longnecker*); Missouri (Jefferson City); Kansas (Manhattan); Colorado (*Cockerell*); New Mexico (*Richardson*); Wyoming (*Hatch*); Montana, Utah (*Mulaik*); Nevada (*Pearse*). BRITISH COLUMBIA: Kamloops (*G. J. Spencer*). EASTERN WASHINGTON: Coulee, Lacrosse, Pullman. WESTERN WASHINGTON: Seattle (waterfront, 1946). IDAHO: Twin Falls.

Bibliography. Fitch 1855:823 (*Porcellio glaber* and var. *confluentus*).—Stuxberg 1876:60-62.—Budde-Lund 1885:77-79.—Sars 1898:186-187, pl. LXXXI.—Stoller 1902:213.—Richardson 1905:609-611, fig. 665.—Cockerell 1912:50.—Pearse 1914:4 (*Cyclisticus*).—Collinge 1918:35; 1942:162; 1943b:139; 1943d: 99-100.—Wallace 1919:40-41.—Longnecker 1923.—Walker 1927:175-179.—Blake 1931a:351-352.—Arcangeli 1932:126-127.—Giambiagi de Calabrese 1935.—Van Name 1936:259-261, figs. 147A, 148; 1940:134; 1942:325.—Wächtler 1937:296-297, fig. 108.—Brimley 1938:502.—Hatch 1939:257.—Mulaik 1943:8.

Family ARMADILLIDIIDAE (*Armadillina* Br.)

Armadillidium Br.

Upper (posterior) margin of median lobe of head extending not more than half way to the eyes, the triangular surface of the median lobe forming an angle with (not on the same plane as) the epistome; antennal (lateral) lobes transverse; thoracic segments not impressed anteriorly

1. Body less strongly arched, the sides of the thoracic segments oblique, the anterior angles of the first thoracic segment somewhat reflexed; body less completely contractile into a ball.. ....subg. **Pseudosphaerium** Verh.

Upper margin of median lobe of head produced in a prominent transverse concave subquadrilateral lobe with rounded anterior angles, in dorsal view about two-fifths as long as broad, the margin of the epistome just behind the median lobe forming two rounded knobs with a prominent notch between them; antennal (lateral) lobes less prominent than the median lobe; dorsal surface sparsely set with inconspicuous tubercles, especially at the sides; head dark, marmorate with pale; thorax and abdomen pale with variable sublateral and submedian vittae and the hind margins of the segments dark; anterior thoracic segments with hind angles produced, the hind margins of the first segment subrectangularly emarginate towards either hind angle; telson narrowly produced, the apex broadly rounded, the sides just visibly sinuate, at base narrower than long; exopodite of uropod rounded at apex; ischiopodite of seventh leg in male with a patch of setae on lower surface towards apex; endopodite of first male pleopod straight, the extreme apices slightly hooked; length to 13 mm. (figs. 54, 224-228) .... **nasatum** B.-L.

Distribution. Spain and central Italy (*Wächtler*) to Ireland, Scotland (*Collinge*), Netherlands, Denmark, and Poland (*Wächtler, Meinertz*). This species was first recorded from America in a greenhouse at Schenectady, New York, in 1902 by Stoller under the name of *quadrifrons*. Elsewhere it has been reported in greenhouses in Ontario (London, *Ross*), Massachusetts (Cambridge, *Blake*), Connecticut (Middletown, *Blake*), New York (New York, *Van Name* 1936), Maryland (Bettsville, *Smith & Goodhue*), and Iowa (Mt. Pleasant, *Longnecker*), and I have specimens so taken in Quebec (Quebec), New York (New Rochelle, Troy), and New Jersey (Summit). Van Name (1940) recorded the species outdoors from Glenview, Ill., and I have specimens so collected from Pennsylvania (Fairfield, Pittsburgh), Virginia (Luray), West Virginia (Ronceverte), Ohio (Athens), Missouri (Columbia, Jefferson City, Warrensburg), Kansas (Douglas Co., Manhattan), and California (Redwood City). So far in the Northwest this species has occurred only in greenhouses: BRITISH COLUMBIA: Langley Prairie (since 1941); IDAHO: Lewiston. At Langley Prairie this form was especially abundant in the gravel under pots of heather. Spencer says "it tunnels readily into flower pots, eats away root systems of plants, and will not respond to control measures that keep down . . . *P. scaber*."

Bibliography. Budde-Lund 1885:51-52, 294.—Stoller 1902:211-212, fig. 2 (*quadrifrons* Stoller).—Richardson 1905:666, 668-669, figs. 707-708 (*quadrifrons*).—Ross 1914:23-24 (*quadrifrons*).—Dahl 1917:67, 69, fig. 104.—Collinge 1918:40-41; 1942:163; 1943b:144; 1944a:121.—Longnecker 1923 (*quadrifrons*). —Walker 1927:176, 179 (*quadrifrons*).—Blake 1929:11, figs. 3-4; 1931a:354.—Verhoeff 1931:496 (*nasutum*).—Meinertz 1934:281-284, fig. 31.—Van Name 1936:279-280, fig. 160; 1940:132, fig. 25.—Wächtler 1937:302-303, fig. 116 (*nasutum*).—Spencer 1942:23 (*quadrifrons*).—Smith & Goodhue 1945.

1′. Body more strongly arched, the sides of the thoracic segments nearly vertical, the anterior angles of the first thoracic segment not reflexed; body more perfectly contractile into a ball .... subg. **Armadillidium** s. str.

Upper margin of median lobe of head not at all produced, overlapping the anterior margin of the epistome on either side, the median lobe itself overlapping the epistome which is neither impressed nor notched along its anterior margin; dorsal surface smooth and shining, finely densely punctate; color of male usually slate gray with inconspicuous pale markings on either side of middle, the posterior margin of the segments pale; the female usually with variably extensive pale markings which may form conspicuous wide sublateral, submedian, and median vittae; anterior thoracic segments with hind angles produced, the hind margin of the first segment simply sinuate towards either hind angle; telson broadly produced, the apex broadly rounded, the sides scarcely sinuate, at base broader than long; exopodite of uropod truncate at apex; seventh leg of male with ischiopodite twice as long as meropodite, concave along ventral surface; first male pleopods with endopodites more or less outwardly arcuate towards apex; length to 15 mm. (figs. 55-56, 229-234) .. **vulgare** Latr.

If Dahl interprets correctly Zenker's "*Oniscus cinereus*," "*cinereum* Zenker" must be adopted as the name of this species.

The color varieties have been described by Collinge (1918:39-40, 102; 1942:168), but the only ones I find in my material are *plumbeus* and *variegatus* Lereb., which appear to be the male and female respectively of the typical form. I do not, however, find any entirely black or slate-gray individuals, all my specimens possessing at least obscurely paler markings on either side of the middle line. Howard discusses sex determination in this species and shows that some of the color variations act as sex-limited dominants when crossed with the typical form.

Habitat. Under cover both outdoors and in greenhouses on chalky soil. This is the principal species of economic importance throughout the United States, outdoors especially in the southern states, and in greenhouses and mushroom cellars. This is the commonest greenhouse species in the Pacific Northwest, occurring in 81 per cent of the greenhouses visited.

Distribution. Almost all of Europe, where it is apparently native, and adjacent portions of Africa and Asia (*Budde-Lund*); Algeria, Azores (*Richardson*); Madeira, Australia (Melbourne) (*Budde-Lund*); New Zealand (*Jackson*); Easter Is. (*Van Name*); Juan Fernandez Is. (*Wahrberg*); Buenos Aires (*Giambiagi de Calabrese*); Uruguay, French Guiana (*Budde-Lund*); São Paulo (*Moreira*); Guatemala (Guatemala City); Mexico (*Van Name*; also Mexico City and Moralia in Hatch coll.); Bermuda Is. (*Richardson*).

In the United States this species was first discovered by Thomas Say in 1818, who described it under the name of *Armadillo pilularis*. Massachusetts (*Gould*); New York (*De Kay*); Connecticut (*Kunkel*); Rhode Island (*Richardson*); New Jersey, Pennsylvania (*Fowler*); Maryland, Virginia, South Carolina, Mississippi, Louisiana, Texas, Kentucky, Ohio (*Richardson*); North Carolina (*Brimley*); Georgia (Gainesville); Florida (Tallahassee); Kentucky (Kuttawa in Lyon Co.); Tennessee, Michigan (*Hatch*); Ontario (*Ross, Walker*); Iowa (*Longnecker*); Missouri (Jefferson City, Springfield, Versailles); Kansas (Douglas Co., Manhattan); Nebraska (*Swenk*); Oklahoma (Lawton, Shawnee); Colorado (*Cockerell*); Montana (Little Pipestone Creek near Butte); Wyoming, Utah (*Mulaik*); California (*Arcangeli, Miller*). BRITISH COLUMBIA: Burnaby, Langley Prairie, North Vancouver, Vancouver, Victoria. EASTERN WASHINGTON: Cashmere, Clarkston, Cle Elum, Dayton, Ellensburg, Grandview, Kennewick, Leavenworth, Pasco, Prosser, Pullman, Rosalia, Spokane, Sunnyside, Walla Walla, Yakima. WESTERN WASHINGTON: Aberdeen, Bellingham, Centralia, Chehalis, Coupeville, Enumclaw, Kalama, Kent, Marysville, Monroe, Montesano, Mt. Vernon, Olympia, Port Angeles, Port Ludlow, Port Townsend, Seattle, Tacoma, Vancouver. OREGON: Corvallis, Dayton, Eugene, McMinnville, Medford, Oregon City (*G. M. Shearer*), Portland, Roseburg, Spencer's Butte (Eugene). IDAHO: Boise, Caldwell, Lewiston, Moscow, Pocatello, Twin Falls.

Bibliography. Zenker 1798:22 (*Oniscus cinereus*).—Say 1818:432-433 (*Armadillo pilularis*).—Gould 1841:336 (*A. pilularis*).—De Kay 1844:52 (*A. pilularis*).—Budde-Lund 1885:66-68.—Sars 1898:189-190, pl. LXXXII.—Richardson 1905:666-668, fig. 706.—Cockerell 1912:50.—Fowler 1912: 226-227, pl. 67, 68.—Ross 1914:23-24.—Dahl 1916:67-69, 74, 81 (*cinereum*).—Kunkel 1918: 251-253.—Collinge 1918:39-40; 1942:162, 168; 1944a: 119-120.—Wahrberg 1922: 286.—Longnecker 1923.—Moreira 1927:194.—Walker 1927:176, 179.—Swenk 1929.—Blake 1931a:354.—Giambiagi de Calabrese 1931:417-419, pls. I-III.—Arcangeli 1932:126 (*cinereum*).—Meinertz 1934:266-270, figs. 24-25 (*cinereum*).—Miller 1938:114, 116, 119.—Van Name 1936:276-279, figs. 157-159; 1940: 132; 1942:325.—Wächtler 1937:300, fig. 113, pl. fig. 8.—Brimley 1938:503.—Hatch 1939:257.—Howard 1940:83-108, illus. (genetics).—Heeley 1941 (life history).—Jackson 1941:23.—Waloff 1941 (ecology).—Spencer 1942:23.—Mulaik 1942:8; 1943:9.

Suborder Flabellifera

Cymothoidea Richardson 1902:284.

The Flabellifera are a largely marine group of diverse habits. Some, like *Exosphaeroma,* may be intertidal, having the form and habits of the terrestrial pillbugs. Others, like *Sphaeroma,* bore in soft rock and wood (Burrows 1919), and *Limnoria lignorum* Rathke is a notorious enemy of marine timbers. Others again, like the Aegidae and the Cymothoidae, are parasites or commensals of fishes, externally or in the mouth or gill cavities. The Cymothoidae show traces of parasitic degeneration in the adult, the immature stages exhibiting an appreciably better developed abdomen; but Richardson (1904a:25) quotes G. B. Goode as saying that the East Coast *Olencira praegustator* is not a parasite, since it does not feed on the fish but only seeks shelter and transportation. Many groups in this suborder exhibit a restricted tendency to occupy fresh-water habitats, including underground waters and warm springs, and the marine *Exosphaeroma oregonensis* Dana at times occurs in brackish or even fresh water (Van Name 1936:421-451). The Flabellifera likewise include the enormous lilac-colored deep-sea circumtropical *Bathynomus giganteus* A. Milne Edwards, which may attain a length of nearly eleven inches.

KEY TO FAMILIES AND GENERA OF FLABELLIFERA

1. Abdomen of six distinct segments (in our genera)
2. Uropods with both branches well developed; body not contractile into a ball
3. Antennae of both pairs with well-defined peduncle and flagellum; first three pairs of legs prehensile (in our genera), the last four ambulatory
4. Maxillipedal palp free, the margins of the last two segments very setose, never furnished with hooks; head with well-developed frontal lamina (the plate between the second antennae), at least in our species; flagellum of first (the shorter) antenna many-segmented; propodite of prehensile legs not dilated (at least in our species); mandibles stout, conspicuous, tridentate; first maxillae with first segment with three spines, the third with many......**CIROLANIDAE**

Eyes extending onto dorsal surface of head; first antennae with first segment of peduncle not at right angles to second segment; second antennae with five-segmented peduncle; maxillipeds with hooks on second segment; pleopods without accessory branchiae; the first two pairs of pleopods with submembranous endopodites, similar, peduncle of second pair wider than long; uropods with inner angle of peduncle produced..**Cirolana** Leach

4′. Maxillipedal palp embracing distal end of mouth parts, the inner margin and apex never setose, the apex usually with hooks; mandibular palp with no inflated segments..**AEGIDAE**

Eyes present; abdomen only gradually narrower than thorax

5. Flagellum of first antennae many-segmented; head with frontal lamina evident; maxillipedal palp five-segmented; propodite of prehensile legs not expanded..**Aega** Leach

5′. Flagellum of first antennae four- to six-segmented; head with frontal lamina extremely narrow or obsolete; front of head produced (in our species); maxillipedal palp two-segmented, the second segment short; propodite of prehensile legs expanded along inner margin...... ....**Rocinela** Leach

3′. Antennae of both pairs reduced, without much distinction between peduncle and flagellum; all pairs of legs prehensile; maxillipedal palp embracing distal end of mouth parts, two-segmented, the second segment long and subacute .... CYMOTHOIDAE

Head not lobed behind, immersed in the first thoracic segment, the anterior margin of which is not trisinuate; antennae compressed, not dilated, the first pair widely separated at base; abdomen gradually narrower than thorax, very little immersed in it .... **Livoneca** Leach

2'. Uropods with exopodite clawlike, nearly obsolete; body contractile into a ball .... LIMNORIIDAE: **Limnoria** Leach

1'. Abdomen with first five segments more or less fused together, at least along the middle line; endopodite of uropods immovable; flagella of both antennae many-segmented .... SPHAEROMIDAE

Uropods with both branches well developed

6. Body somewhat flattened; the first (female) or first two (male) legs subchelate .... **Tecticeps** Richardson

6'. Body contractile into a ball; legs not at all chelate

7. Last segment of abdomen entire; maxillipedal palps with second, third, and fourth segments produced into lobes...... **Exosphaeroma** Stebbing

7'. Last segment of abdomen with a median emargination; maxillipeds with second, third, and fourth segments produced into lobes............. .... **Dynamene** Leach

7''. Last segment of abdomen trilobed .... **Cymodoce** Leach

Family Cirolanidae

Cirolana Leach

Head rounded at sides; eyes present

1. Head rounded in front, the frontal lamina about twice as long as wide; eyes separated by five or six times their width; fifth abdominal segment with lateral parts covered by the fourth segment; last abdominal segment narrowly arcuate, fringed with 16 to 26 short spines, not raised at base; uropod with inner angle of peduncle produced in an acute spine, the branches subequal in length, the margins of the branches fringed with hairs; length up to 19 mm. (figs. 58-62)........ .... **harfordi** Lockington

Distribution. Middle British Columbia to southern California (San Diego, *Richardson*). BRITISH COLUMBIA: Calvert Is. (Safety Cove, intertidal under stones); Victoria (*Richardson*). WASHINGTON: Orcas Is. (West Sound, dredged); San Juan Is. (N.E. side, 10 fathoms); Puget Sound (*Calman*); Waaddah Is. (intertidal). OREGON: Coos Bay (*G. M. Shearer*).

Bibliography. Calman 1898:274 (*californica* Hansen).—Richardson 1905:84, 109-111, figs. 91-92.

1'. Head with median spatuliform process; eyes larger; last abdominal segment with a conspicuous transverse carina at about basal two-sevenths .... (*linguifrons* group)

Cirolana linguifrons Rich. and *C. chiltoni* Rich. from middle California, *C. vancouverensis* Fee from Vancouver Is., and a new species to be described below from Washington and Oregon constitute a morphologically distinct group of closely related species living in the sand of the midtidal zone.

2. Last abdominal segment at apex arcuate, finely serrate, fringed with pectinate hairs, the base raised, the raised portion terminated by a trilobed carina that does not extend to the lateral margins of the segment, the median lobe subtruncate; uropods with posterior margins of branches fringed with pectinate hairs, the endopodite almost as long as the exopodite; eyes separated by about 2½ times their width; first antennae with first and third segments equal, the second slightly shorter; length 7 mm. (figs. 13-14).........**vancouverensis** Fee ?

Distribution. Described from examples taken at Long Beach, western Vancouver Island, BRITISH COLUMBIA, but not so far taken in Washington. This form was described as a subspecies of *chiltoni* Rich., but seems to be as close to *linguifrons* Rich. as to *chiltoni.*

Bibliography. Fee 1926:24-25, figs. 13, 14.

2'. Last abdominal segment at apex obtusely angulate, finely serrate, fringed with pectinate hairs; the base of the last abdominal segment raised, the raised portion terminated behind by a bisinuate furrow which does not quite attain the lateral margins and which on either side of the mid-line becomes foveiform, the anterior margins of the foveae cariniform, the anterior mesal margins in particular overhanging the foveae, the carina obsolete at the middle where it is replaced by a simple declivity; uropods with posterior margins of branches fringed with pectinate hairs, the exopodite slightly longer than the endopodite; eyes separated by about 2⅔ times their width; first antennae with the length of their first three segments represented by the figures 2, 1.25, 1.5; flagellum of first antenna with 11 to 16 segments, of second antenna with 9 to 13 segments; lateral margins of fifth abdominal segment not covered by the fourth segment; color white with irregular dark markings; length to 7.6 mm. (fig. 163)..**kincaidi** sp. nov.

Type and 20 paratypes: Ocean Park, WASHINGTON, Aug. 10, 1945, Trevor Kincaid, collector. Taken under dead crabs on the sand in the midtidal zone. 20 paratypes from Coos Bay, OREGON, G. M. Shearer, collector, all but two of these latter in the collection of the collector. This species is distinguished from other members of the *linguifrons* group by the obtusely angulate last abdominal segment.

Family Aegidae

The members of this family are ectoparasites of fish, but they become detached from their hosts readily and are usually taken free in the dredge.

Aega Leach

Color yellow, covered with light-brown spots which form a regular line along the margin of each segment; surface smooth; head with frontal margin produced in a point which meets the conical frontal lamina; eyes large, separated by a distance equal to the length of one eye; first antennae with first three segments subequal, compressed and rounded, the upper distal angle of the second not produced; last abdominal segment broadly arcuate, at apex serrate and spinulate; uropods extending beyond apex of the last abdominal segment, the posterior margins of the branches serrate and spinulate; length about 15 mm. (figs. 63, 65, 149)..**symmetrica** Rich.

Habitat. Dredged at depths of 41 to 480 fathoms.

Distribution. Southern Bering Sea; southeastern Alaska (Naha Bay on Behn Canal); California (Santa Cruz) (*Richardson*). BRITISH COLUMBIA: Vancouver Is. (off Fort Rupert). Not taken in Washington.

Bibliography. Richardson 1905:185-187, figs. 169-172; 1909:79-80.

Rocinela Leach

Eyes well separated; head without carinae; flagellum of first antennae six-segmented, of second 14- to 16-segmented; first thoracic segment with anterior angles not hornlike

1. Head without lateral lobes in front of eyes, which are separated by more than one-half their length; uropod with inner angle of peduncle usually as long as exopodite, which is shorter than the endopodite and subequal to it in width
2. Propodite of prehensile legs arcuately lobed; propodite and meropodite spinulose along inner margin
3. Head with the median lobe simple, sinuate to straight at sides, the apex subtruncate to broadly arcuate; eyes separated by about their own length; prehensile legs with propodite with three or four and the meropodite usually with three blunt spines along inner margin (typical form) or the propodite with five or six and the meropodite usually with three usually more elongate spines along inner margin (subsp. *pugettensis* nov.); body usually marked with black along the base of the last abdominal segment on either side of the middle line, frequently with a narrow margin of the last abdominal segment and the sides of the second to the fifth abdominal segments black, and sometimes with black spots at the sides of thoracic segments two to seven, especially four and five; length to 33 mm., of subsp. *pugettensis* nov. to 26 mm. .... **belliceps** Stimpson

Richardson originally (1905) described the propodite as having three spines, but later (1910) admitted four-spined specimens as well. East of the eastern end of the Strait of Juan de Fuca, the three- to four-spined population is replaced by a five- to six-spined one that I have termed the subsp. *pugettensis* nov. They are usually smaller than the typical form and have the meropodite spines somewhat longer. In Richardson's (1905) key they run to *laticauda* Hansen, but aside from the fact that *laticauda* is an inhabitant of middle-Mexican waters, the inner angle of the peduncle of its uropod is apparently much shorter than in *pugettensis* and the branches of the uropod are subequal in length. *Pugettensis* and typical *belliceps* are closely similar. It is the largely nonoverlapping distribution of the two that induces me to indicate *pugettensis* as a subspecies, but, as is to be expected, some slight overlapping occurs. I have a single specimen of *pugettensis* from the western end of Juan de Fuca Strait, and a single specimen of typical *belliceps* from off Argyle on San Juan Island and two specimens of typical *belliceps* from off Foulweather Bluff at the south end of Admiralty Inlet.

Habitat. Five to 688 fathoms (*Richardson*); a parasite of *Hydrolagus colliei* and cod (*Richardson*), *Sebastodes maliger* (*Fee*), *Gadus morrhua* and sculpin (*Boone*), *Gadus macrocephalus*, rock cod, halibut, and skate.

Distribution of typical form. Southern California (San Diego) to northwestern Alaska, Aleutian Islands, Kamchatka, Kurile Islands, and Sea of Japan (*Boone*). ALASKA: Atka Is., False Bay (on cod), Bering Sea (on halibut), Halibut Bay, Tanaga Is. (on *Gadus macrocephalus*). BRITISH COLUMBIA: Gulf of Georgia, Queen Charlotte Sound, Ucluelet (*Boone*); Round Is., Pylades Channel, E. of Departure Bay, Departure Bay, N. of Thetis Is., Trincomali Channel, Gabriola Pass (*Fee*). WASHINGTON: Clallam Bay (105 fathoms), Foulweather Bluff (180-200 meters), Juan de Fuca Strait (Swiftsure Bank), Pillar Point, San Juan Is. (off Argyle), Slip Point (Clallam Co., 3 mi. N.E.). Boone cites Port Townsend, Port Ludlow, Juan de Fuca Strait, and "Puget Sound," the type from the last named.

Distribution of var. pugettensis *nov.* WASHINGTON: Hood Canal (Kings Spit, 10 fathoms; Squamish Harbor, 40 meters; entrance to Hood Canal, 67 meters); Juan de Fuca Str. (Swiftsure Bank); King Co. (Pt. Robinson, 40 to 55 meters); Kitsap Co. (Apple Tree Pt.; Blakely Harb.; Foulweather Bluff, 50 to 80 meters; Point-No-Point); Pierce Co. (Herron Is., 20 to 25 fathoms); San Juan Co. (off Argyle; Canoe Is., 16 to 20 meters; False Bay, from rock cod; Friday Harbor, from rock cod and skate; Griffin Bay; Jones Is.; Lopez Is., Flat Pt., 25 fathoms; Mosquito Pass; San Juan Is., w. side); Sucia Is. (Echo Bay); Whidbey Is. (Mutiny Bay, 45 meters; Smith Is.); Vendovi Is. (10 to 20 fathoms). The holotype is from Friday Harbor, Wash., vii-6-1941. T. Kincaid.

Bibliography. Richardson 1905:190, 199-201, figs. 187-192; 1909:82-83.—Boone 1920:14-16.—Fee 1926:25-26.

3′. Head with the median lobe trifid, consisting of a large subspatulate median lobe slightly constricted at base and about as wide as long, with a much smaller slightly divergent lobe at either side at about half way from the level of the anterior margins of the eye to the apex of the subspatulate lobe; eyes separated by more than their own length; propodite of prehensile legs with a strongly arcuate lobe bearing six or seven spines, the meropodite set with five blunt teeth along inner margin; preserved specimen nearly immaculate with a faint suggestion of abdominal markings as in *belliceps;* length 25 mm. (fig. 164) .... **tridens** sp. nov.

Holotype: Canoe Is., San Juan Co., WASHINGTON, Aug. 12, 1941, Trevor Kincaid, collector. Distinguished from other American and Japanese species of the genus by the structure of the median lobe of the head.

2′. Propodite of prehensile legs with a distally curved process set with six blunt teeth meeting squarely and without interval; meropodite of prehensile legs with about five teeth; head with median lobe simple, not sinuate at sides, broadly subtruncate at end; eyes separated by less than their own length; preserved specimens nearly immaculate; length to 27 mm. (figs. 70-73) .... **propodialis** Rich.

Richardson (1905) figures her single specimen, a male, with the outer angle of the peduncle of the uropod much shorter than in my two females. Perhaps this is a sexual character in this species.

Habitat. 15 to 26 fathoms (Richardson); ectoparasitic on *Hippoglossus hippoglossus* (*Fee*), on *Raja binoculata,* and on rock cod.

Distribution. BRITISH COLUMBIA: Ucluelet (*Fee*). WASHINGTON: off Port Townsend (*Richardson*), Friday Harbor.

Bibliography. Richardson 1905:190, 203-204, figs. 196-200.—Fee 1926:26.

1′. Head with lateral lobes in front of eyes, especially towards their outer angles; the median lobe somewhat narrowly produced, the sides sinuate, the apex subtruncate; eyes separated by less than their length; prehensile legs with propodite with an arcuate lobe along inner margin; propodite with four and meropodite with four to six spines along inner margin; uropod with inner angle of peduncle only a little more than half as long as the exopodite, which is subequal to or longer than the endopodite and nearly twice as wide; body nearly immaculate; length to 39 mm. (figs. 74-77) .... **angustata** Rich.

Habitat. 16 to 464 fathoms (*Richardson*); ectoparasitic on halibut and *Raja binoculata.*

Distribution. Southern California (San Luis Obispo Bay) to southeastern Alaska, Bering Sea, and Hokkaido (*Richardson*). ALASKA: Bering Sea (on halibut), Wrangell. BRITISH COLUMBIA: Queen Charlotte Is. (Silwyn Inlet, 120-240 meters); Vancouver Is. (North Arm, 1½ mi. S.E. of Rocky Passage, 65 fathoms). WASHINGTON: Camano Is. (Sandy Pt., 100 fathoms), Carr Inlet (Green Pt., 100 meters), Hood Canal (near Ayres Pt. and Potlach, 55 to 60 fathoms), Possession Sound (40 fathoms), Puget Sound, San Juan Is. (Friday Harbor, on *Raja binoculata*).

Bibliography. Richardson 1899:827-828 (*laticauda*); 1904a:33; 1905:191, 206-207, figs. 203-208; 1909:83.

Family Cymothoidae

Livoneca Leach

Abdomen somewhat immersed in thorax, the sides of the first segment almost entirely covered by the seventh thoracic segment

1. Eyes separated by about three times their own width, the head terminating in a broad subtruncate lobe about twice the width of an eye; last abdominal segment about twice as broad as long, the apex broadly arcuate; length to 32 mm. (fig. 80)............**vulgaris** Stimpson

Habitat. A parasite of *Hyperprosopon argentateum, Steindachneria, Ophiodon elongatus,* rock cod, flounder, frequently in the gills (*Richardson*).

Distribution. Lower California (*Richardson*) to Washington (*Calman*). OREGON: Coos Bay (under operculum of *Ophiodon elongatus, G. M. Shearer*). WASHINGTON: Puget Sound (*Calman*).

Bibliography. Calman 1898:261.—Richardson 1905:256, 258-260, figs. 267-270.

1′. Eyes separated by about 1½ times their own width, the head terminating in a narrowly rounded median lobe about the width of an eye; last abdominal segment about as wide as long, the apex strongly rounded; length to 16 mm. (fig. 78)...**Californica** Schioedte & Meinertz

Habitat. Ectoparasitic on gills of "shiner" (*Richardson*), *Cymatogaster aggregatus* (*Fee*), smelt, *Hypomesus pretiosus.*

Distribution. Southern California (San Pedro, *Richardson*) to Alaska. ALASKA (on smelt). BRITISH COLUMBIA: Boundary Bay (on *Cymatogaster aggregatus, Fee*). WASHINGTON: Goat Is. (Skagit Co.) and Totten Inlet (Shelton), both from *Hypomesus pretiosus.*

Bibliography. Richardson 1905:256, 260-261, figs. 271-273.—Fee 1926:26-27.

Family Limnoriidae

Limnoria Leach

Length to 5 mm. (3 to 4 mm. in local material); color light grayish brown with darker spots; body about three times as long as broad; flagellum of first antennae three-segmented, of second antennae five-segmented; epipodite of maxillipeds shorter than basal segment; abdominal segments without tubercles or ridges, the last abdominal segment as long as the preceding five segments, with or without a median dorsal carina; peduncle of uropod longer than exopodite, which is shorter than the endopodite and clawlike (fig. 81)...**lignorum** Rathke

Habits. Commonly known at the "gribble," this organism is worldwide in distribution and, next to the shipworms (Teredidae), is the most important pest of marine timbers. The gribble, however, confines its attack to the surface, which it may eat away at the rate of one-half to one inch per year. It occurs on piles from midtide level to a depth of 40 feet or more (*Kofoid & Miller*), and as many as 200 to 240 burrows may be counted per square inch in heavily attacked timber (*Kofoid* 1921:53). Distribution is probably effected primarily in pieces of driftwood, although the adults are active swimmers, at least over short distances. At Friday Harbor, migration is most active from March to May and gravid females are most abundant from May to July, though neither migration nor breeding ever comes absolutely to a halt (*Johnson & Miller* 1935). The most detailed account of our *Limnoria* is that by Kofoid & Miller (1927), who cite much of the previous literature. For its importance in Nova Scotia see Henderson (1924), in Australia see Iredale, Johnson, & McNeil (1932, 1936), and in Norway see Somme (1941).

Distribution. Florida to Gulf of St. Lawrence (*Richardson*); Iceland, Norway, and Sweden to France (*Hansen*); Morocco (*Nierstrasz & Stekhoven*); Adriatic Sea, Black Sea (*Hansen*); California (*Richardson*) to British Columbia (*Fee*). Probably introduced in such southern localities as Falkland Is., Cape of Good Hope, New South Wales, New Zealand (*Hansen*); Queensland (*Iredale, Johnson, & McNeil* 1932:42); Hawaii (*Kofoid & Miller*). BRITISH COLUMBIA: Departure Bay (*Fee*). WASHINGTON: Puget Sound (*Calman*); Friday Harbor, Port Angeles, Seattle. OREGON: Coos Bay (*G. M. Shearer*).

Bibliography. Sars 1897:76-77, pl. XXI.—Calman 1898:261.—Richardson 1905:269-270, figs. 279-281; 1910:95-96.—Hansen 1916:177.—Kofoid 1921:51-54, pls. 31-34.—Henderson 1924.—Fee 1926:27-28.—Kofoid & Miller 1927:306-332, figs. 123-136.—Nierstrasz & Stekhoven 1930:79, fig. 18.—Iredale, Johnson, & McNeil 1932; 1936.—Johnson & Miller 1935:10-12.—Somme 1941.

Family SPHAEROMIDAE

Tecticeps Rich.

Broadly oval, nearly two-thirds as broad as long; head with anterior margin much broader than posterior margin, not wholly concealing the basal segments of the first antennae; eyes large, oval, two or three times as distant from the anterior as from the posterior margin, separated by about 1½ times their own transverse diameter; first antennae with 11 segments in flagellum, the second with 13; thoracic segments subequal, the first enclosing the head at the sides, the epimera almost twice as broad as long except the fifth which are produced backwards and are about as long as broad; first abdominal segment with three transverse sutures, incomplete at middle, with a tooth on either side along the posterior margin; last abdominal segment broadly rounded posteriorly; uropod with exopodite and endopodite subequal in length, the exopodite acute at apex, the endopodite narrowly rounded; first pair of legs with propodite dilated, the dactylus reflexible; legs two to five (female) subsimilar; legs six and seven with the propodite elongate; length 10.1 mm. (figs. 165-167) .... **pugettensis** sp. nov.

Holotype: female: Whidbey Is., WASHINGTON. Partridge Bay, 7 fathoms, M. Pettibone, collector. This species is intermediate in certain respects between *alascensis* Rich. from Alaska and *convexus* Rich. from California. From both it is distinguished by its larger, more approximate eyes. From *alascensis* it is distinguished by its rounded last abdominal segment and the subequal branches of its uropods: from *convexus* it is distinguished by the position of the eyes much nearer the posterior than the anterior margin of the head, and the elongate propodite of the last two legs.

Exosphaeroma Stebbing

Exopodite of uropod smooth along outer margin; first segment of abdomen with a tooth along posterior margin towards either side

1. Body widened from head backwards; thoracic segments each with three variably prominent tubercles along the posterior margin, those of the last three segments especially prominent; first segment of abdomen transversely bituberculate towards middle; last segment of abdomen acutely triangular, narrowly rounded at apex, the margins inflexed, emarginate at apex in postero-ventral view; branches of uropod expanded, subequal in length, the endopodite somewhat broader and variably emarginate along the posterior margin; length to 8 mm. (fig. 79) ....**amplicauda** Stimpson

Habitat. Intertidal, usually among and under rocks.

Distribution. Middle California (Monterey Bay, Tomales Bay, *Richardson*); western Aleutians (Kiska, Amchitka, *Richardson*). WASHINGTON: San Juan Islands (Deadman Bay, James Is., Minnesota Reef, Parker's Reef, Turn Is.).

Bibliography. Richardson 1905:288-289, figs. 301-302.

1′. Body oval; thoracic segments and abdomen not tuberculate; last abdominal segment transverse, the posterior margin broadly rounded, not inflexed; exopodite of uropod about two-thirds as long as and a little narrower than endopodite, both exopodite and endopodite evenly and more or less narrowly rounded at apex, not emarginate; length to 12 mm. (figs. 82-83) ....**oregonensis** Dana

Habitat. Under stones intertidally to 10-12 fathoms; also in mud (*Richardson*). None of the Northwestern material was taken below the intertidal level, but a few specimens were collected at underwater lights at Port Angeles and Friday Harbor. Some collections are from localities suggesting fresh or brackish water: Vancouver, B.C. (*Carl*); Nasel River, Wash. (*T. Kincaid*), and Fletcher Lake, Oregon (*T. Kincaid*), and from fresh water above "Spouting Horn," De Poe, Lincoln Co., Oregon (*J. E. Lynch*).

Distribution. Middle California (Monterey Bay) to south-central Alaska and the western Aleutians (*Richardson*). ALASKA: Baranof Is., Ketchikan. BRITISH COLUMBIA: Gulf of Georgia, Grenville Channel and Lowe Is. (*Richardson*); Newcastle Is., Margaret Bay, Taylor Bay, Pilot Bay, Departure Bay (*Fee*); Vancouver (*Carl*). WASHINGTON: Edmonds, Everett, Nasel River, Port Angeles, Puget Sound (*Stimpson*), San Juan Arch. (Deadman Bay, False Bay, Friday Harbor, James Is., Lopez Is., Peavine Pass); Seattle (Alki Pt., Golden Gardens, Carkeek Park); South Bend (in slough); Vashon Is.; Whidbey Is. (Smith Is.); Willapa Bay (Shoalwater Bay—*Stimpson*, Stony Pt.). OREGON: Coos Bay (*G. M. Shearer*), De Poe (Lincoln Co.), Fletcher Lake, Glenada (Lane Co.).

Bibliography. Stimpson 1857a:509 (*Sphaeroma*).—Richardson 1905:288, 296-298, figs. 315-316; 1909:92.—Fee 1926:28-29.—Carl 1937:451.

Dynamene Leach

Last segment of abdomen not perforated immediately before the terminal emargination

1. Anterior margin of head subarcuate, continuous with the side margins of the thorax; frontal lamina with portion behind or above the apical emargination narrower than long; last segment of abdomen about as long as wide, not extending between the base of the uropod and the first abdominal segment

2. Last segment of abdomen smooth, the extreme apex slightly produced and deflexed on either side of the narrow emargination; uropod with exopodite slightly shorter than the endopodite, which extends nearly to the apex of the abdomen; body smooth, broadest across the first abdominal segment; length (of partially contracted specimen) to 3.2 mm. (fig. 84) .... **glabra** Rich.

Habitat. Intertidal.

Distribution. Southern California (*Richardson*) to Oregon. OREGON: Coos Bay (*G. M. Shearer*).

Bibliography. Richardson 1905:299, 301-302, figs. 321-322.

2′. Last segment of abdomen with six longitudinal rows of tubercles, the outer rows basal and consisting of two discrete tubercles the basal one of which is partially enclosed by an emargination of the apical margin of the penultimate abdominal segment, the intermediate rows of four more or less discrete tubercles, the inner rows cariniform with three or four indistinct tubercles, the extreme apex strongly produced, nearly vertically deflexed on either side of the narrow emargination; uropods with exopodite slightly shorter than the endopodite which does not attain the level of the apex of the abdomen; body with sides of thorax nearly parallel; length to 3.3 mm. (fig. 173) .... **sheareri** sp. nov.

Type and three paratypes: Coos Bay, OREGON, in collection of G. M. Shearer, after whom the species is named. From other North American species *sheareri* is distinguished by the six rows of abdominal tubercles.

1′. Anterior margin of head with a transverse subquadrate process, the outline of which is markedly discontinuous with the sides of the thorax; frontal lamina with portion behind or above the apical emargination as broad as or slightly broader than long; last segment of abdomen broader than long and extending between the base of the uropod and the first abdominal segment, the surface of the basal three-fifths with three low longitudinal ridges, a median and two submedian, beyond which the surface is transversely impressed before the tumid apex; last abdominal segment regularly triangularly produced from just behind the base, the sides at the extreme apex deflexed on either side of the narrow emargination; uropods with exopodite slightly shorter than the endopodite, which does not quite attain the level of the apex of the abdomen; body behind the first thoracic segment nearly parallel; length to 6.7 mm. (figs. 85-86) .... **dilatata** Rich.

Distribution. Middle California (Monterey Bay, *Richardson*). OREGON: Coos Bay (*G. M. Shearer*).

Bibliography. Richardson 1905:299, 304, fig. 327.

Cymodoce Leach

Body granulate, finely pubescent; eyes set deeply in emarginations at the extreme sides of the anterior margin of the first thoracic segment; abdomen with an entire basal suture and two incomplete lateral sutures, with four teeth (male) or with only two lateral teeth (female) along the posterior margin of the penultimate abdominal segment; last abdominal segment (male) with two pairs of discal tubercles, the posterior tubercles being the larger, defining a broad median furrow, the basal tubercles slightly lateral to the median teeth of the penultimate abdominal segment, the median furrow with two smaller tubercles opposite the interval between the other tubercles, the apex trilobed, the lateral lobes nearly as long as the median lobe; last abdominal segment (female) with two tubercles, the apex trilobed, the lateral lobes nearly as long as the median lobe; last abdominal segment (female) with two tubercles, the apex trilobed, the lateral lobes much smaller than the median lobe; uropods extending to apex of abdomen, with subequal branches, the exopodite acute at apex, the endopodite obliquely truncate at apex; length to 17.5 mm. (figs. 150-151) .... **japonica** Rich.

This is probably an introduced species in the Pacific Northwest, perhaps brought in with the Japanese oyster. My three males correspond closely with Richardson's descriptions, except that she does not mention the two smaller tubercles in the median furrow of the last abdominal segment, and the basal tubercles of the telson are not quite in line with the median teeth of the penultimate abdominal segment.

Distribution. Sea of Japan (shore to 846 fathoms) (*Richardson*). WASHINGTON: Nahcotta (1922).

Bibliography. Richardson 1906:7-8, fig. 11 (*japonica*); 11-12, fig. 15 (female: *affinis* Rich.); 1909:92.

Suborder Valvifera Sars 1882

Idoteides Leach
Idoteoidea Richardson 1904a:3
Idotheoidea Richardson 1905:3

The Valvifera are primarily a free-living bottom-dwelling marine group. Some of the species of *Idothea* occur in floating vegetation (Tattersall 1929:218), and *Mesidotea entomon* L. occasionally is found in fresh- or brackish-water lakes. One species of *Pentidotea* occurs in fresh water in New Zealand (Van Name 1936:451).

Key to Family and Genera of Valvifera

Body more or less broad, depressed; first antennae with unsegmented flagellum; legs nearly alike, ambulatory, the first three pairs sometimes subcheliform .... IDOTHEIDAE

Second antennae, when present, with multisegmented flagellum

1. Margin of head deeply cleft, explanate, the eyes dorsal; abdomen four-segmented, suture lines at the base of the last segment indicating one or two additional segments; maxillipedal palp five-segmented; thoracic segments two to five with distinct epimera, each extending the full length of the segment; first three pairs of legs subchelate, the propodite dilated; uropod with exopodite minute .... **Mesidotea** Rich.

1′. Margin of head not deeply cleft; legs subsimilar, prehensile, the propodite not dilated

2. Abdomen three-segmented with the lateral sutures of another partially coalesced segment; thoracic segments two to four with distinct

epimera; eyes lateral, the sides of the head below the eyes inflexed; head without a transverse furrow defining a "neck" region

3. Maxillipedal palp five-segmented; head not margined behind the eye (at least in our species); epimera of fifth thoracic segment attaining the posterior margin of the segment; abdomen not emarginate behind or, if so (*resecata*), with acutely prominent posterior angles and with the epimera of the fourth thoracic segment separated from the posterior margin by a broadly arcuate lobe..........**Pentidotea** Rich.

3'. Fifth segment of maxillipedal palp fused with fourth; head margined behind the eyes; epimera of the fifth thoracic segment not attaining the posterior margin of the segment in our species or, if so (*rufescens*), the abdomen emarginate behind with bluntly prominent posterior angles and the epimera of the fourth thoracic segment narrowly separated from the posterior margin................**Idothea** Fab.

2'. Abdomen consisting of a single segment with lateral sutures of another partially coalesced segment; thoracic segments with perfectly coalesced epimera; maxillipedal palp three-segmented; eyes, at least in our species, subdorsal, the margin of the head below the eye entire, not inflexed but explanate and free from the lower surface of the head; head, at least in our species, with a transverse furrow behind defining a distinct "neck" region..............................**Synidotea** Harger

Family IDOTHEIDAE

Mesidotea Rich.

Eyes present; second antennae with segments of peduncle not dilated, the flagellum 8- to 14-segmented; last abdominal segment acutely produced; length to 75 mm. (to 43 mm. in Northwestern material) (fig. 87)..**entomon** L.

Habitat. Marine to 95 meters (*Nierstrasz & Stekhoven*); reported from fresh-water lakes in northern Europe, where they may be glacial relicts; from estuaries and entirely fresh water in Siberia (*Zimmer*); from the brackish Aral Sea; and from fresh-water lakes communicating briefly with the sea in northern Alaska and the Northwest Territories of Canada (*Boone, Johansen*). In Washington Prof. Trevor Kincaid has taken specimens in brackish water at Aberdeen and in the estuary of the Palix River, and tells of finding a specimen under a stone with a fresh-water crayfish (*Astacus*).

Distribution. From the Kara Sea westward and southward to the southern Baltic, Caspian Sea, Aral Sea (*Nierstrasz & Stekhoven*); Labrador, Hudson Bay, Northwest Terr., Yukon Terr., Alaska, Kamchatka, off British Columbia to middle California (*Boone*). BRITISH COLUMBIA (*Boone*). WASHINGTON: Aberdeen, Willapa Harbor (estuary of Palix River). OREGON: Florence.

Bibliography. Richardson 1905:347-350, figs. 374-376; 1909:107.—Boone 1920: 19-22.—Johansen 1922:17.—Zimmer 1927:735.—Nierstrasz & Stekhoven 1930:94, fig. 40.—Van Name 1936:452.

Pentidotea Rich.

1. Abdomen not emarginate at apex; body robust, about three times as long as broad; eyes about twice as broad as long

2. Abdomen behind regularly and broadly rounded, the apex with a small median prominence (typical form) (figs. 88-89) or (var. *exlineae*

nov.) (fig. 162) broadly evenly arcuate; sides of thorax feebly arcuate; epimera of second and third thoracic segments fail by a considerable amount to attain the posterior margin; epimera of fourth segment nearly attain posterior margin; length to 35 mm. (figs. 88-90, 162) .... **wosnesenskii** Br.[32]

The single specimen of var. *exlineae* nov. is labeled: San Juan Is., WASHINGTON, Iceberg Point, VII-6-1936. Harriet Exline, collector. It was taken with the typical form.

Habitat. Surface to 9 fathoms (*Richardson*). This and *Exosphaeroma oregonense* Dana are our commonest intertidal isopods, occurring frequently on rocky beaches.

Distribution. Middle California (Monterey Bay) to southern Alaska, Aleutian Islands, and Sea of Okhotsk (*Richardson*). ALASKA: Baranof Is., Kodiak Is., Salt Water Bay, Wrangell, Yakutat Bay. BRITISH COLUMBIA: Fort Rupert, Gulf of Georgia, Skedegate Bay (Queen Charlotte Is.) (*Miers*); Barclay Sound, Otter Bay (Pender Is.) (*Richardson*); Newcastle Is., Nanoose Bay, Departure Bay, Galiano Is. (*Fee*); Calvert Is. (Safety Cove), Queen Charlotte Is. (Kunghit Is., Larsen Harbor). WASHINGTON: Edmonds, Whidbey Is. (Smith Is.), Nasel River (Cultch Bay), Port Angeles (at underwater light), Puget Sound (*Stimpson*), San Juan Co. (Deadman Bay, East Sound on Orcas Is., False Bay, Friday Harbor, Iceberg Point on Lopez Is., James Is., Minnesota Reef, Orcas Is. (north), Parkers Reef, Sucia Is., Turn Rock, Seattle (Golden Gardens, Carkeek Park), Vashon Is., Willapa Bay (Shoalwater Bay, *Stimpson*). OREGON: Coos Bay (*G. M. Shearer*), Tillamook.

Bibliography. Stimpson 1857:88 (*Idotaea*); 1857a:504 (*Idotaea*).—Miers 1883:25, 40-42 (*Idotea*).—Calman 1898:261 (*Idotea wossnessenskii*).—Richardson 1905:370-373, figs. 402-404; 1909:109.—Fee 1926:30-31.

2′. Abdomen behind with pronounced but rounded posterior angles and an acute narrowly rounded median protuberance

3. Thorax with epimera of segments two and three failing by a considerable amount to attain the posterior margin, of four either attaining or just failing to attain the posterior margin, of five to seven attaining the posterior margin; sides of thorax feebly arcuate; length to 55 mm. (fig. 91) .... **stenops** Benedict

The eyes are not extremely narrow in my specimens, though they are so described by Richardson.

Alaska record in error; See Menzies, 1950 page 173.

Habitat. Intertidal among red or brown algae.

Distribution. Middle California (Monterey Bay, *Richardson* 1905); Alaska (Atka, *Richardson* 1909). OREGON: Coos Bay (*G. M. Shearer*).

Bibliography. Richardson 1905:369, 375-376, figs. 407-408; 1909:109.

3′. Epimera of thoracic segments two to seven attaining posterior margin of segments; sides of thorax subparallel; length to 34 mm. (fig. 92) .... **whitei** Stimpson

Distribution. Middle California (Monterey Bay, *Richardson*). WASHINGTON: Puget Sound (*Richardson*), Seal Rock (in *Laminaria* zone).

Bibliography. Stimpson 1864:155 (*Idothea*).—Miers 1883:25, 42-43, pl. II, fig. 1 (*Idotea*).—Richardson 1899:846-847; 1899a:266; 1905:369, 373-374, figs. 405-406.

[32] Named in honor of Ilya Gavrilovich Vosnesensky (1816-1871), a Russian zoologist, who between 1839 and 1848 made extensive collections in eastern Siberia, Alaska, and middle California. See Essig (1931:777-789) for a portrait and an extensive account of his life and work.

1'. Abdomen broadly emarginate at apex with acutely produced posterior angles, body narrow, elongate, about 4½ times as long as wide; eyes very little wider than long; margin of head behind and below the eye somewhat protuberant; epimera of thoracic segments two to four failing by a considerable amount to attain the posterior margin, an arcuate lobe separating the fourth epimeron from the posterior margin; length to 55 mm. (fig. 93)..........................**resecata** Stimpson

Habitat. Surface to 10 fathoms in beds of algae and eel grass; when intertidal it frequently occurs in beds of eel grass and other vegetation, although Richardson records it likewise from among rocks.

Distribution. Southern California (San Pedro) to British Columbia (*Richardson* 1905). BRITISH COLUMBIA: Fort Rupert, Barclay Sound, Otter Bay (Pender Is.) (*Richardson*); Newcastle Is., Nanoose Bay, Departure Bay, Galiano Is. (*Fee*). WASHINGTON: Bay Center, Dallas Bank (Jefferson Co.), Edmonds, Kitsap Co. (Foulweather Bluff and southeast, President Point), Nahcotta, Port Townsend (type locality), Quilcene, San Juan Co. (Brown Is., Deer Harbor, Doe Bay, East Sound, Friday Harbor, James Is., Stuart Is.), Seabeck.

Bibliography. Stimpson 1857:88 (*Idotaea*); 1857a:504-505, pl. XXII, fig. 7 (*Idotaea*).—Miers 1883:43, 45-46 (*Idotea*).—Calman 1898:261 (*Idotea*).—Walker 1898:279 (*Idotea*).—Richardson 1899:844; 1899a:263-264; 1905:369-370, figs. 400-401.—Fee 1926:31.

Idothea Fab. 1799

(*Idotea* Fab. 1796 preoccupied;[33] *Idotaea* auct.)

1. Abdomen produced at middle of apex

2. Epimera of only thoracic segment seven attaining posterior margin of the segment; body linear, subparallel; abdomen acutely produced, the posterior angles subrectangular, narrowly rounded; length to 42 mm...**fewkesi** Rich.

Distribution. Southern California (*Richardson*) to British Columbia. BRITISH COLUMBIA: Nanoose Bay (shoreline to five fathoms) (*Fee*). WASHINGTON: Bay Center, Port Angeles (at underwater light). OREGON: Coos Bay (*G. M. Shearer*).

Bibliography. Richardson 1905:356, 359-360, figs. 387-388; 1910:107.—Fee 1926:29-30.

2'. Epimera of both thoracic segments six and seven attaining posterior margins of the segments; body less linear

3. Thoracic segment five with margin of epimeron continuous with margin of segment and not attaining its posterior margin; abdomen at middle obtusely produced, somewhat tuberculate, the margin between the median tubercle and the subrectangular narrowly rounded posterior angles more or less evanescently bisinuate; length to 20 mm. (fig. 94)...**urotoma** Stimpson

Habitat. Intertidal.

Distribution. WASHINGTON: Puget Sound (*Stimpson*), San Juan Is. (False Bay), Waaddah Is.

Bibliography. Stimpson 1864:155.—Miers 1883:34 (*Idotea*).—Richardson 1899:844, 845 (*Idotea*); 1899a:264 (*Idotea*); 1905:356, 358-359, fig. 386.

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[33] Cf. Dahl 1916:23; Rathbun 1904:171.

3'. Thoracic segment five with margin of epimeron projecting beyond the lateral margin of the segment itself and not quite attaining the posterior margin of the segment, abdomen prominently produced at middle, the posterior angles broadly rounded; length to 42 mm. (figs. 95-96) .... **ochotensis** Br.

= I.(P.) montereyensis not of Brandt or Richardson see: Menzies 1950 p. ~~185~~ 185, P.16

Habitat. Surface to 18 fathoms (*Richardson*).

Distribution. Middle California (San Francisco Bay) to southern Alaska, Bering Sea, Kamchatka, Hokkaido (*Boone*). BRITISH COLUMBIA: Port Renfrew (*Richardson*), Vancouver Is. (*Boone*). WASHINGTON: Seabeck, West Seattle.

Bibliography. Miers 1883:25, 32-34, pl. I, figs. 8-10 (part) (*Idotea*).—Richardson 1905:356, 366-367, figs. 396-397.—Collinge 1916.—Boone 1920:24-25.

1'. Abdomen emarginate at apex, the posterior angles prominent, blunt, narrowly rounded; epimera of thoracic segments five, six, and seven attaining posterior margin of segment, that of the fourth segment separated from the posterior margin by a very narrow lobe; margin of head below and behind eyes somewhat protuberant; length to 25 mm. (fig. 12) .... **rufescens** Fee

Habitat. Four to 10 fathoms, in beds of algae. What appear to be immature specimens of this species were taken in eel grass near Everett.

Distribution. BRITISH COLUMBIA: Gabriola Pass (*Fee*). WASHINGTON: Dallas Bank (Clallam Co.), Everett, New Dungeness Spit (Clallam Co.), Port Angeles (at underwater light), Whidbey Is. (Partridge Bay).

Bibliography. Fee 1926:30, fig. 12.

Synidotea Harger

1. Abdomen subtruncate to emarginate behind; head with a median pair of tubercles (sometimes obsolescent) behind the medianly notched anterior margin and an additional lateral tubercle towards either side between the eye and the anterior margin
2. Frontal tubercles small, not overhanging the frontal notch
3. Head behind the frontal tubercles with neither transverse ridge nor tubercles; apex of abdomen emarginate .... **"bicuspida Owen"**

Under this name Walker lists a single specimen from Puget Sound without further notation. Since Benedict has shown that Miers confused the Californian *consolidata* Stimpson with this Bering Sea and Arctic species, the identity of the Puget Sound form remains in doubt.

Bibliography. Miers 1883:66 (*Edotea*).—Benedict 1897:391-393, figs. 1-3.—Walker 1898:279 (*Edotia*).—Richardson 1905:376, 383-386, figs. 420-424.

3'. Head behind the frontal tubercles and the thorax transversely ridged but not distinctly tuberculate

4. Body more robust, more arcuate at sides, nearly two-fifths (37-39%) as wide as long; the eyes when viewed from above either failing to intersect or just barely intersecting the margins of the head; thoracic segments with the lateral margins of the first two broadly arcuate, of the last five nearly straight; abdomen nine-tenths as wide at base as long, the sides more or less feebly but somewhat variably curving into the not or very slightly prominent subtruncate to moderately emarginate apex; length to 21 mm. (fig. 152) .... **nebulosa** Benedict

curved like a bow, arched

The material that I have assembled under this designation is somewhat variable but, in my judgment, hardly variable enough to indicate more than a single species. Puget Sound specimens exhibit a distinctly emarginate abdominal apex, and some specimens have a trace of a produced abdominal apex as figured by Benedict (1897:393, fig. 3) for *consolidata* Stimpson. Many of the specimens have the sides of the abdomen not at all subsinuate, but feebly arcuate throughout. Several larger specimens in an extensive and in this respect largely typical series taken off the south end of San Juan Is. lack any trace of frontal tubercles. In comparison with a series of specimens in my collection from Tanaga Is. in the Aleutians, Puget Sound specimens usually have the anterior margin of the head more acutely notched, the sides of the abdomen less distinctly subsinuate, and its apex more emarginate, but the degree of emargination exhibited by Puget Sound material is within the range of variation exhibited by the Tanaga Is. series.

Habitat. Intertidal to 30 fathoms.

Distribution. Kamchatka, Aleutian Islands (*Richardson*). WASHINGTON: Kitsap Co. (Apple Tree Point, 15 fathoms), Neah Bay (15-30 fathoms), San Juan Is. (between Eagle and Cattle Points, 12 fathoms; Friday Harbor, intertidal), Whidbey Is. (Partridge Bay, 7 fathoms).

Bibliography. Benedict 1897:391, 394-395, fig. 5.—Richardson 1905:376, 381-382, figs. 416-417.

4′. Body more slender, scarcely arcuate at sides, three-tenths as wide as long; the eyes intersecting the margins of the head when viewed from above; lateral margins of thoracic segments one and two subangulately arcuate, of segment three strongly arcuate, of segments four and five broadly arcuate, of segments six and seven nearly straight; abdomen about three-fourths as wide at the base as long, the sides arcuate, the apex subtruncate or very slightly emarginate; length 8.5 to 11.5 mm. (fig. 97) .... **angulata** Benedict

Habitat. 31 (*Richardson*) to 63 fathoms.

Distribution. WASHINGTON: off Destruction Is., off Cape Johnson, off Cape Flattery (*Richardson*); off Foulweather Bluff (Kitsap Co., 2 specimens, 117 meters).

Bibliography. Benedict 1897:391, 395-396, fig. 6.—Richardson 1899:847, 848; 1899a:268; 1905:376, 382, figs. 418, 419.

2′. Frontal tubercles prominent, overhanging the well-developed frontal notch; lateral tubercles prominent; behind the frontal tubercles are a pair of tubercles larger and farther apart than the frontal pair; "neck" with a well-defined median tubercle; eyes protuberant, overhanging the lateral margin of head; thoracic segments each with a median and a pair of lateral tubercles, each lateral tubercle less than midway between the median tubercle and the lateral margin

5. Lateral tubercles of head inwardly curved; flagellum of second antenna with seven or eight segments; lateral margin of thoracic segment one narrowly arcuate, of two subtruncately arcuate, of three to seven nearly straight; abdomen nearly as broad at base as long, the sides curving into the feebly emarginate apex; length to 12.5 mm. (fig. 98) .... **ritteri** Rich.

Habitat. Intertidal.

Distribution. Middle California (San Francisco, *Richardson*). OREGON: Coos Bay (*G. M. Shearer*).

Bibliography. Richardson 1905:377-378, figs. 409-411.

5′. Lateral tubercles of head straight, divergent; flagellum of second antenna with 11 to 13 segments; lateral margins of thoracic segments one and two narrowly arcuate, of three strongly arcuate, of four broadly arcuate, of five subtruncate, of six and seven nearly straight; abdomen about six-sevenths (86%) as broad at base as long, the sides feebly arcuate, the apex very slightly produced and deeply emarginate; length 7.5 to 10.5 mm. (figs. 168-169)............... ....**pettiboneae** sp. nov.

Holotype (9 mm. long) and three paratypes: off Neah Bay, WASHINGTON. 15 to 30 fathoms. VII-6-1940. M. Pettibone, collector. I take pleasure in naming this complicated little species after its collector. The largest of the specimens has the left abdominal cusp abnormally aborted.

This species is apparently most closely related to *Synidotea ritteri* Rich., from which it is distinguished by the characteristics cited above. In the structure of the abdominal apex it seems to approach *consolidata* Stimpson, from which, however, it is distinguished by most of the characteristics that distinguish that species from *ritteri.*

1′. Abdomen narrowly rounded at apex, towards which the sides are somewhat sinuate; head with a prominent tubercle in front of each eye, two longitudinally arranged median tubercles, and a tubercle on either side between the longitudinal series and the eye; median tubercles on the neck and on each of the thoracic segments and two on the abdomen; eyes protuberant, overhanging the lateral margin of the head; lateral margins of thoracic segments one to four strongly arcuate, of five to seven feebly arcuate to nearly straight; abdomen at base four-fifths as wide as long (fig. 99).............**nodulosa** Krøyer

Distribution. North Atlantic (*Richardson*). BRITISH COLUMBIA: Dixon Entrance in Queen Charlotte Islands, 111 fathoms (*Harger, Smith*).

Bibliography. Harger 1880:351-352, pl. VI, figs. 33-35.—Smith 1880:218.—Miers 1883:66-68 (*Edotea*).—Benedict 1897:391, 398-399.—Richardson 1899: 847, 849; 1905:376, 388-389, figs. 429-430.

Suborder **Epicaridea** Latreille 1831

Epicarida G. O. Sars 1882
Bopyrida G. O. Sars 1899, p. x
Bopyroidea Richardson 1902:299

The members of the suborder Epicaridea are ectoparasitic on Crustacea. The females in particular exhibit varying degrees of parasitic degeneration, the Cryptoniscidae consisting in the adult stage of little more than an unsegmented sac filled with eggs.

The eggs hatch into a free-swimming twelve-legged epicarid larva with seven distinct thoracic and six abdominal segments. This stage parasitizes a copepod, where it transforms into a fourteen-legged microniscus larva. Eventually the microniscus again becomes free-swimming, and as a fourteen-legged cryptoniscian larva makes its way to the final host.

The classical investigations on the group were made by the distinguished French naturalists, A. Girard and J. Bonnier, in the latter part of the last century. These investigators, however, assumed that each species of epicarid parasite was restricted to a single species of host and mistook the stage in the copepod for a separate adult, misconceptions that were rectified by G. O. Sars (1899).

According to the classification of Tattersall (1929) the group may be divided into two tribes: (1) the Bopyrina, in which the sexes are separate, both passing beyond the cryptoniscian stage, and the brood pouch consists of distinct oöstegites; parasitic variously on Mysidacea, Euphausiacea, and Decapoda (including fresh-water shrimps); and (2) the Cryptoniscina, in which the animal functions as a male in the cryptoniscian stage, later metamorphosing into a highly degenerate female in which the brood pouch no longer consists of distinct oöstegites; parasitic variously on Ostracoda, balanid and rhizocephalan Cirripedia, Mysidacea, Amphipoda, and Isopoda (in the brood pouches of Munnopsidae, of *Idothea,* and of *Bopyrus*).

Stebbing (1893:402-403) strikingly describes the occurrence of "*Cryptoniscus planarioides,* Fritz Müller . . . on *Peltogaster purpureus* (F. Müller) . . . on a Pagurid, in Southern Brazil. . . . If the eggs and young did not betray the crustacean character, the female would almost rather be taken for a flat-worm . . . than for an Isopod. The *Peltogaster,* it must be understood, is a strangely metamorphosed Cirripede, which pushes roots into the body of its Pagurid host. Then comes the *Cryptoniscus,* penetrates the parasite, and draws nourishment to itself through these piratical roots. . . . Under this infliction the body of the Cirripede, cheated of its nutriment, dies and falls away, and yet its roots remain and flourish for the benefit of an alien digestive apparatus. Crustaceans of three distinct orders are thus brought together, and, as it were, jumbled up into a sort of compound animal, so that when the Pagurid [which itself occupies the shell of a departed mollusk] devours a shrimp, its gastronomic exertions are supplying food through the remnants of a shapeless Cirripede to a degraded Isopod."

This suborder has been little studied in North America, especially in the Pacific Northwest, where our knowledge is confined to those species that produce a conspicuous swelling of the cephalothorax under the branchiostegites (branchial) or at the base of the ventral surface of the abdomen (abdominal) of macruran hosts. Open this swelling and the female is revealed, her marsupium usually filled with eggs. Look carefully at her posterior end, and the tiny typically isopodan male is found. Sufficiently diligent search among our other Crustacea should add materially to the species in our list.

Key to Family and Genera of the Tribe Bopyrina

Body of female distinctly segmented, more or less asymmetrical; male with head not fused with first thoracic segment; parasites of Decapoda .... **BOPYRIDAE**

1. Female with neither side swollen; all legs present on both sides; abdomen usually six-segmented; male with first abdominal segment not or only slightly more prominent than the others
2. Abdominal segments without branched lateral elongations in female
3. Abdominal segments of female with lateral lamellar extensions; branchial parasites of Anomura
4. Uropods in female with two branches; abdomen in male with segments fused; branchial parasites of *Munida*.................... **Munidion** Hansen

4'. Uropods in female with a single branch; abdomen in male with distinct segments; branchial parasites of *Paguras, Galacantha, Munida, Petrolisthes*..**Pseudione** Kossman

3'. Abdominal segments of female with lateral lamellar extensions rudimentary or absent

5. Female pleopods evident, biramous, the uropods uniramous

6. First abdominal segment with two dorsal papillae; female pleopods with the branches similar, narrow, elongate; female thoracic segments with posterior lobes not produced; male abdomen distinctly segmented, the first five segments with elongate appendages, the uropods uniramous; abdominal parasites of *Upogebia*........................ ....**Phyllodurus** Stimpson

6'. First abdominal segment without papillae; female pleopods with exopodite narrow and elongate, the endopodite oval and small; female thoracic segments with posterior lateral lobes produced; male abdomen with segments fused, narrow, tapering, without appendages; branchial parasites of shrimps (*Crago, Argis,* rarely *Spirontocaris*) ....**Argeia** Dana

5'. Pleopods and uropods wanting in both sexes; male abdomen with segments fused; branchial parasites of shrimps (*Pandalus, Pandalopsis, Spirontocaris*)...**Bopyroides** Stimpson

2'. All six abdominal segments with lateral parts elongate in both sexes, branched in female; male abdomen with segments fused (in our species); branchial parasites of *Callianassa*........................**Ione** Latr.

1'. Female with one side greatly swollen and much longer than the other side, only one leg present on larger side; abdomen five-segmented; male abdomen with segments fused, conspicuously swollen at base, the swelling representing the first segment; abdominal parasites of shrimps (*Pandalus, Spirontocaris*)...........................**Phryxus** Rathke

Family Bopyridae

Munidion Hansen

Length of female 9 mm., of male 4 mm. (figs. 100-102)....**parvum** Rich.

Host. Branchial parasite of *Munida quadrispina* Benedict.

Distribution. BRITISH COLUMBIA: Departure Bay (*Fee*). WASHINGTON: Juan de Fuca Strait (*Richardson*).

Bibliography. Richardson 1904:81-82, figs. 75-89; 1905:518-520, figs. 563-566. —Fee 1926:37-38.
76-79

Pseudione Kossman

Lateral parts or pleural lamellae of female elongate and covering to a great extent the pleopods; distal segment of first lamella of marsupium produced posteriorly in a lobe

1. Endopodite of pleopods much larger than exopodite, elongate, pointed, the surface roughened by irregularly transverse rugae; pleural plates of last three segments of thorax not developed as lamellae; first incubatory lamellae with distal segment produced in a small and inwardly curved lobe; length, female 12 mm. (figs. 103-104)........... ....**giardi** Calman

Host. Branchial parasite of *Pagurus ochotensis* Br.

Distribution. WASHINGTON: Puget Sound (*Calman*).

Bibliography. Calman 1898:271-281, pl. XXXIV, fig. 5.—Richardson 1899: 868-869; 1899a:337; 1904a:78; 1905:523-527, fig. 569.

1'. Endopodite of pleopods a little larger than exopodite, triangular or ovate, the surface smooth; pleural plates of last three segments of thorax developed as lamellae; first incubatory lamellae with the distal segment produced in a lobe which is large and directed straight backward; length, female 11 mm.; male 4.8 mm. (figs. 105-106)........ ....**galacanthae** Hansen

Hosts. Branchial parasite of *Galacantha diomediae* var. *parvispina* Faxon (Gulf of California) and *Munida quadrispina* Benedict (Pacific Northwest).

Distribution. Mexico (Gulf of California, *Richardson*). WASHINGTON: Flattery Rocks (*Richardson*), San Juan Co. (Lopez, Rocky Bay). BRITISH COLUMBIA: Ruxton Pass (*Fee*).

Bibliography. Richardson 1904a:78; 1905:523, 527-528, fig. 570.—Fee 1926:38.

Phyllodurus Stimpson

Length, female 14 to 17 mm.; male 6 to 9 mm. (figs. 108-109)............. ....**abdominalis** Stimpson

Host. Abdominal parasite of *Upogebia pugettensis* Lockington.

Distribution. Middle California (San Francisco Bay, *Richardson*; Tomales Bay, *Stimpson*). BRITISH COLUMBIA: Departure Bay (*Fee*). WASHINGTON: Puget Sound (*Stimpson, Calman*).

Bibliography. Stimpson 1857a:511-513.—Calman 1898:282.—Richardson 1899: 868; 1899a:337; 1904a:78; 1905:540-544, figs. 582-585.—Fee 1926:39.

Argeia Dana

Thoracic processes present on all the segments; head large; endopodites of all pleopods present; incubatory lamellae not completely covering the marsupium; length, female 8 to 11 mm.; male 5.5 mm. (figs. 110-112)..**pugettensis** Dana

Hosts. Branchial parasites of *Crago, Argis* (*Nectocrangon*), and (rarely) *Spirontocaris*. This species has not previously been recorded from *Spirontocaris*, but I have a single specimen so associated from the San Juan Islands. Mr. Shearer informs me that at Coos Bay, Oregon, in the summer of 1941 nearly half the specimens of *Crago nigricauda* Stimpson were parasitized by this species, whereas in the following summer only three out of forty specimens carried the parasites.

Distribution. Southern California to Bering Sea and Japan (*Richardson*). BRITISH COLUMBIA: off Cape Beale on *C. munita* Dana; Gulf of Georgia on *C. alascensis* Lockington, *C. franciscorum angustimana* Rathbun, and *C. alba* Holmes; off Nanaimo on *C. alba*, all from *Richardson*; Departure Bay on *C. munita* and *C. stylirostris* Holmes (*Fee*). WASHINGTON: Puget Sound (*Dana*); off Grays Harbor on *A. alascensis* Kingsley and *C. communis* Rathbun; off Destruction Is. on *A. alascensis*; Juan du Fuca Straits on *C. franciscorum angustimana* and *C. communis*; near Port Townsend on *C. alascensis* and *C. communis*; Puget Sound on *C. munita*, all from *Richardson*; San Juan Co. (Brown Is. and North Pass on *C. munita*; Lopez Is. on *Spirontocaris suckleyi* Stimpson; Peavine Pass on *C. munitella* Walker and *A. pugettensis* Dana; Shipman Bay near East Sound on *C. alascensis*). OREGON: off Columbia River on *C. alascensis* and var. *elongata* Rathbun and *C. communis*; off Tillamook Rock on *C. nigromaculata* Lockington, all from *Richardson*; Coos Bay on *C. nigricauda* Stimpson (*G. M. Shearer*).

Bibliography. Dana 1853:804, pl. LIII, fig. 7.—Stimpson 1857a:511.—Calman 1898:281 (*Argeia* sp.).—*Richardson* 1899:868; 1899a:337; 1905:544-550, figs. 586-597; 1909:122.—Fee 1926:40.

Bopyroides Stimpson

Length, female 7 mm.; male 3 mm. (figs. 116-119)....**hippolytes Krøyer**

Hosts. Branchial parasites of *Pandalus, Pandalopsis,* and *Spirontocaris.*

Distribution. Circumpolar to British Isles (*Sars*), Massachusetts, Oregon, and Japan (*Richardson*). BRITISH COLUMBIA: off Fort Rupert on *S. herdmani* Walker and *Pandalus jordani* Rathbun and off Nanaimo (*Richardson*); Cowichan Gap on *S. brevirostris* Dana (*Fee*). WASHINGTON: Juan de Fuca Strait on *S. suckleyi* Holmes and *Pandalopsis dispar* Rathbun, Port Townsend on *S. suckleyi,* Puget Sound on *S. brevirostris,* all from *Richardson*; Crane Is. (San Juan Co.) on *S. spina* Sowerby; Maury Is. (King Co.) on *Spirontocaris* sp. OREGON: Heceta Bank on *S. bispinosa* Holmes (*Richardson*).

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Ione Latr.

Lateral parts (pleural lamellae) of the abdominal segments in female twice as long as the uropods; basal segment of legs with an elevated eminence the margin of which is irregular; abdominal segments in male completely fused; length, female 6.7-18 mm.; male 4.5-7 mm. figs. 113-115)..............................(*brevicauda* Bonnier) **cornuta** Bate

Host. Branchial parasite of *Callianassa.*

Distribution. California (*Bonnier*). BRITISH COLUMBIA: Victoria on *C. gigas* Dana (*longimana* Stimpson) (*Bate*); Gulf of Georgia (*Bonnier*); Boundary Bay on *C. gigas* (*Fee*).

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Phryxus Rathke

Length, female 5-9 mm.; male 2-3 mm. (figs. 120-123)...**abdominalis** Krøyer

Hosts. Abdominal parasites of *Pandalus* and *Spirontocaris.*

Distribution. Circumpolar to British Isles (*Sars*), Massachusetts, northern California, and Philippine Islands (*Richardson*). BRITISH COLUMBIA: Nanaimo on *S. bispinosa* Holmes, and Queen Charlotte Sound on *S. macrophthalma* Rathbun (*Richardson*); Departure Bay, Ruxton Pass, Cowichan Gap, and Nanoose Bay on *S. barbata* Rathbun and *S. prionata* Stimpson (*Fee*). WASHINGTON: off Yahwhitt Head on *S. macrophthalma*; Juan de Fuca Strait on *S. townsendi* Rathbun and *S. tridens* Rathbun; Port Townsend on *S. tridens*; Admiralty Inlet on *S. tridens* and *S. groenlandica* Fab., all from *Richardson*; San Juan Co. (Friday Harbor on *S. groenlandica,* Griffin Bay on *S. suckleyi* Stimpson, Peavine Pass on *S. prionata,* Wasp Passage on *S tridens*); Seattle (Carkeek Park on *S. sitchensis* Br. and Alki Pt. on *S. abdominalis* Krøyer).

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EXPLANATION OF PLATE I

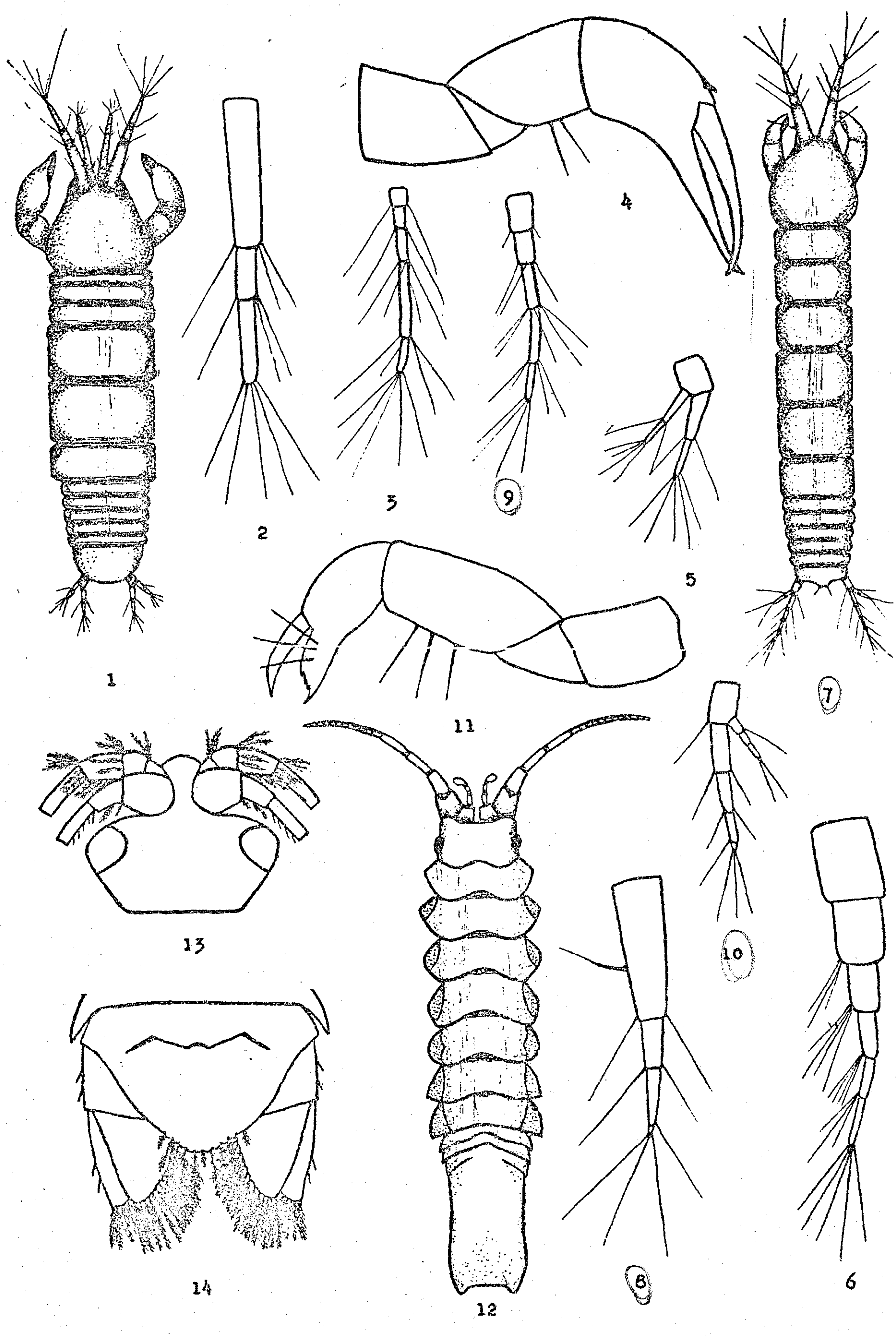
(Figs. 1-14 from Fee)

Paratanais nanaimoensis Fee (figs. 1-6)
1. Female
2. First antenna (female)
3. Second antenna (female)
4. Gnathopod
5. Uropod
6. Second antenna (male)

Heterotanais melacephala Fee (figs. 7-11)
7. Female
8. First antenna
9. Second antenna
10. Uropod
11. Gnathopod

Idothea rufescens Fee (fig. 12)

Cirolana vancouverensis Fee (figs. 13-14)
13. Head (dorsal view)
14. Last abdominal segment and uropods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EXPLANATION OF PLATE II

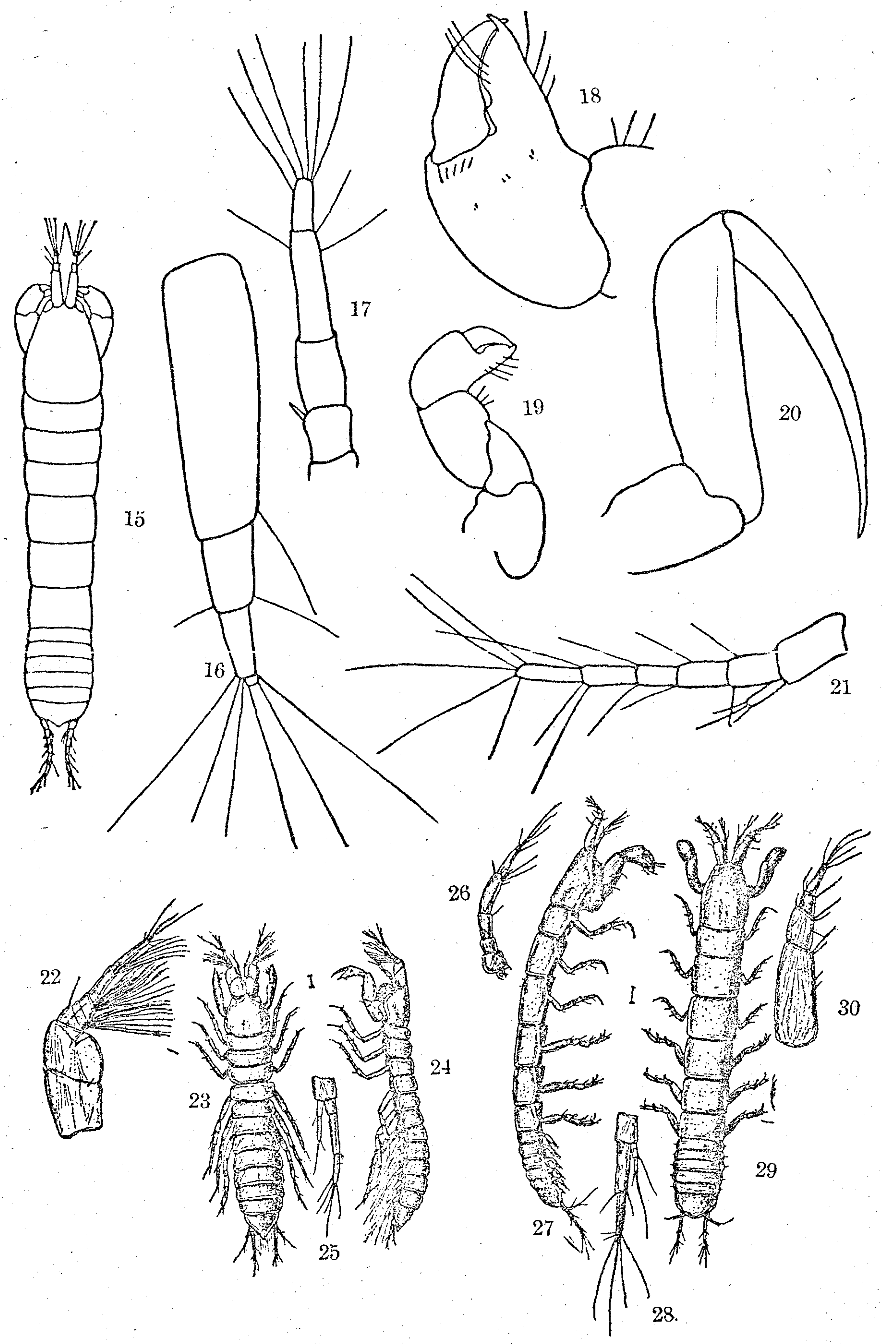
(Figs. 15-30 from Richardson 1905; 15-21 after Moore; 22-30 after Sars)

Leptochelia dubia Krøyer (female) (figs. 15-21)

15. Dorsal view
16. Second antenna, ×77
17. First antenna, ×77
18. Chela, ×77
19. Cheliped, ×33
20. Distal end of second leg, ×77
21. Uropod, ×77

Leptognathia longiremis Lilljeborg (figs. 22-30)

22. First antenna (male)
23. Male
24. Male (lateral view)
25. Uropod (male)
26. Second antenna (female)
27. Female (lateral view)
28. Uropod (female)
29. Female
30. First antenna (female)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EXPLANATION OF PLATE III

(Figs. 31-41 from Richardson 1905; 33 after Smith; 35 after Walker; 37, 38, and 40 after Sars)

Asellus tomalensis Harford (figs. 31-32)
  31. Dorsal view, ×9
  32. Leg of first pair, ×20½

Asellus communis Say (fig. 33)

Jaeropsis lobata Rich., ×20 (fig. 34)

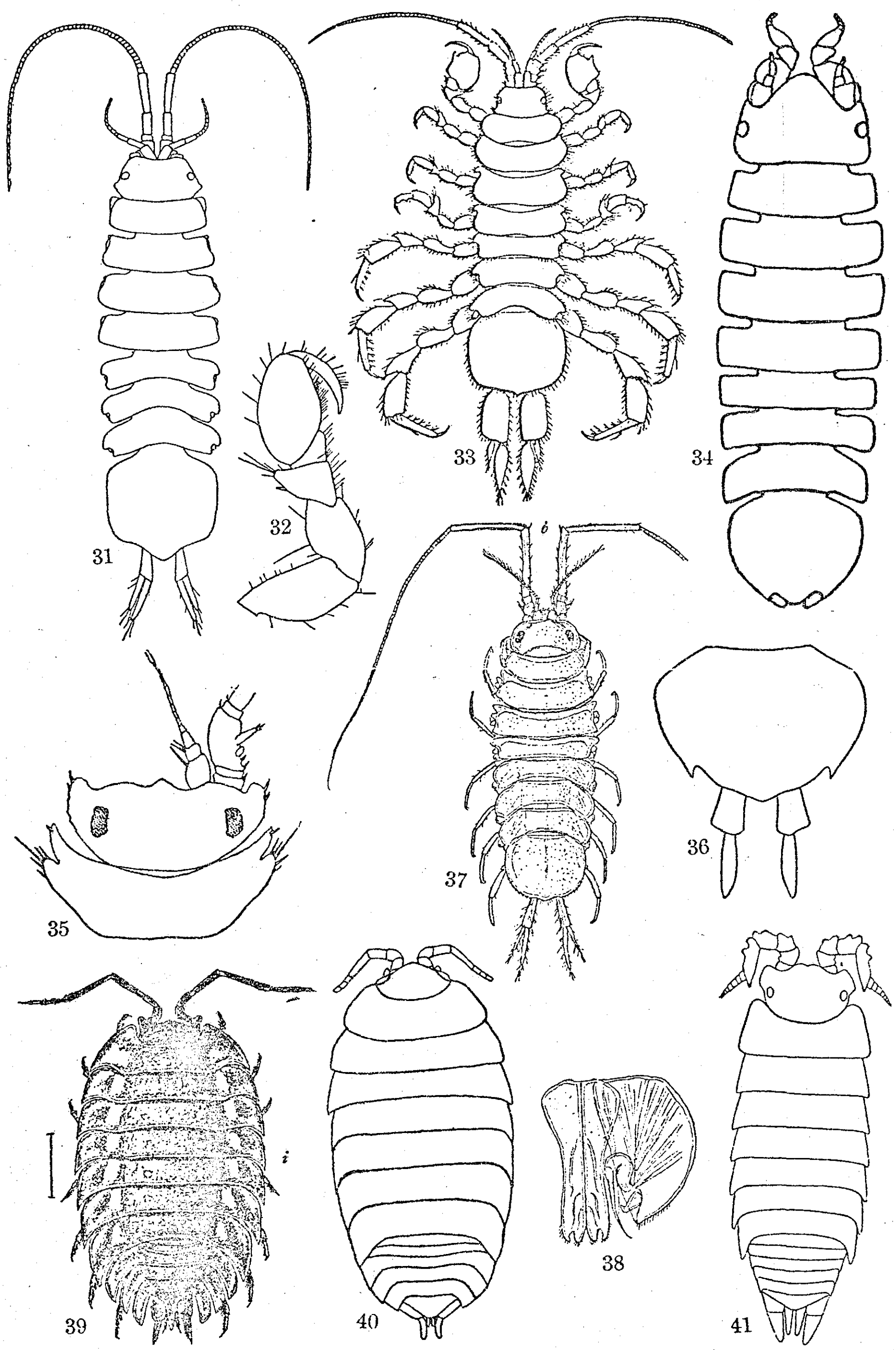
Janira occidentalis Walker (figs. 35-36)
  35. Head and first thoracic segment
  36. Abdomen with uropods

Janira maculosa Leach (figs. 37-38)
  37. Female
  38. First and second pleopods of male

Oniscus asellus L. (fig. 39)

Alloniscus perconvexus Dana (fig. 40)

Detonella papillicornis Rich., ×15 (fig. 41)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EXPLANATION OF PLATE IV

(Figs. 42-50 from Richardson 1905 after Sars)

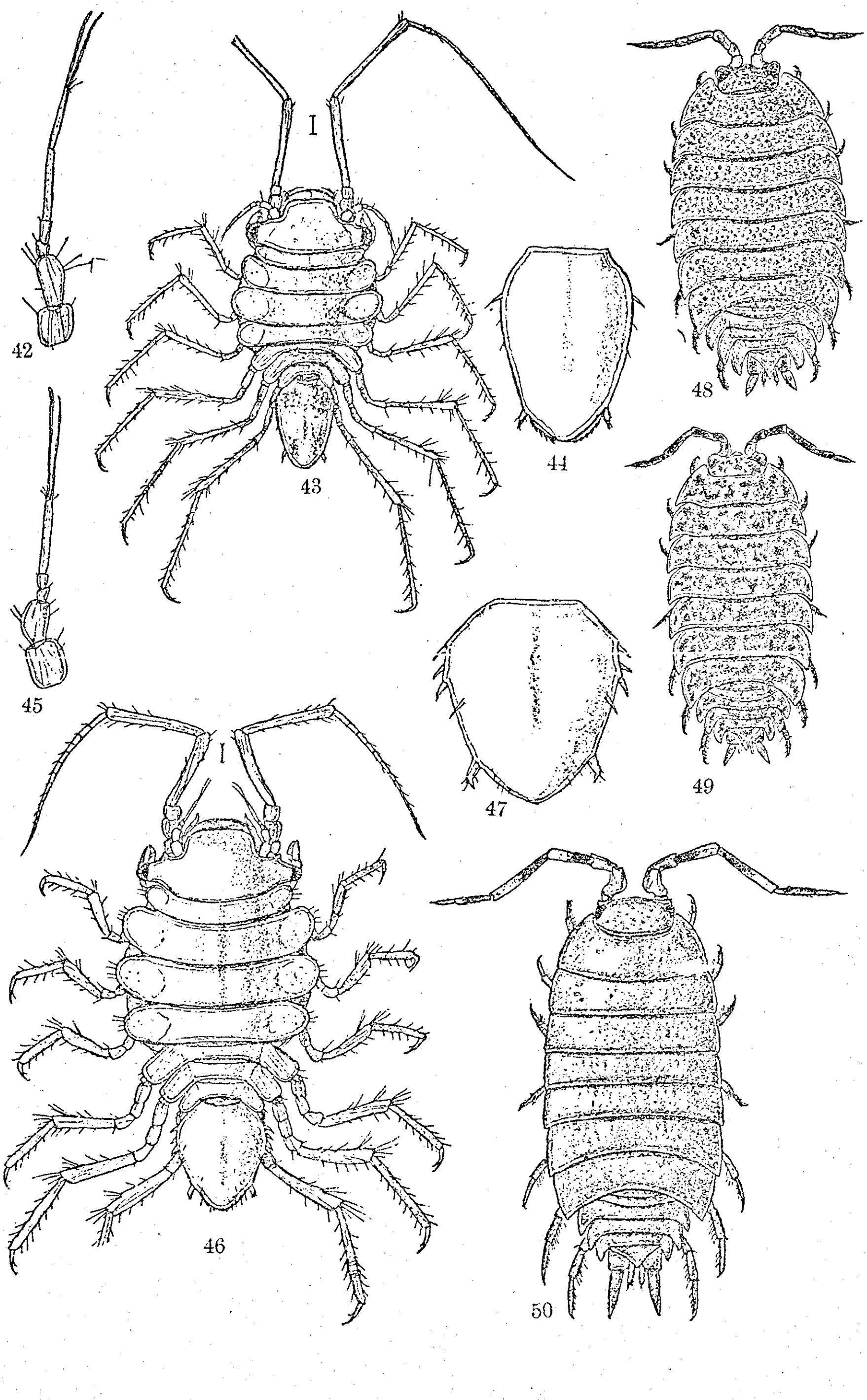
Muna minuta Hansen (figs. 42-44)
- 42. First antenna
- 43. Female
- 44. Abdomen and uropods

Muna kroyeri Goodsir (figs. 45-47)
- 45. First antenna
- 46. Female
- 47. Abdomen with uropods (female)

Porcellio scaber Latr. (fig. 48)

Porcellio scaber var. *marmorata* Br. and Ratz. (fig. 49)

Porcellionides pruinosus Br. (fig. 50)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EXPLANATION OF PLATE V

(Figs. 51-64 from Richardson 1905, 51-56 after Sars, 57 after Stoller, 58-61 after Hansen)

Trachelipus rathkei Br. (figs. 51-52)
 51. Male
 52. Female

Cylisticus convexus DeG. (figs. 53-54)
 53. Male
 54. Lateral view of male

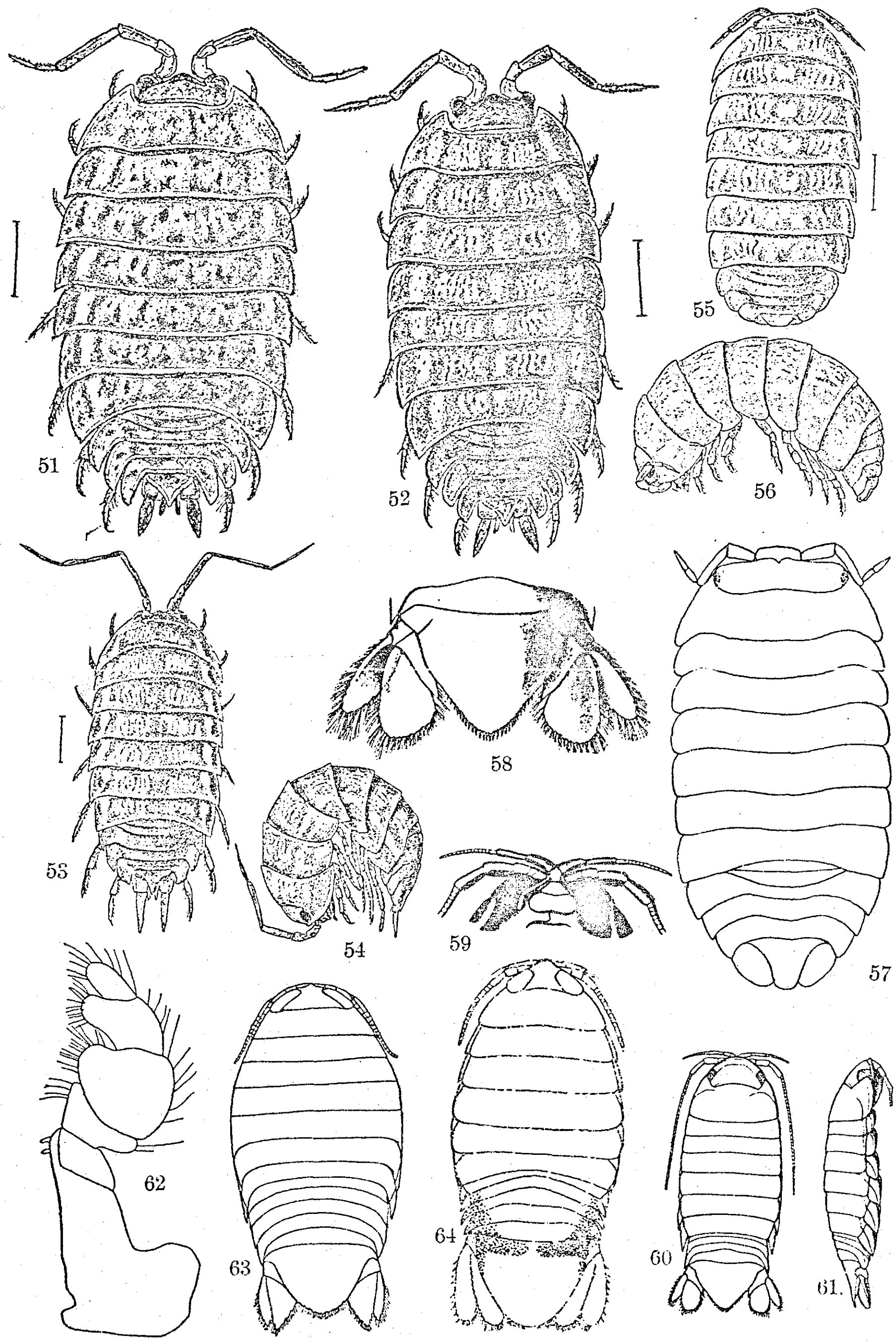
Armadillidium vulgare Latr. (figs. 55-56)
 55. Female
 56. Lateral view of female

Armadillidium nasatum B.-L. (fig. 57)

Cirolana harfordi Lock. (figs. 58-62)
 58. Posterior end of abdomen
 59. Anterior portion of head
 60. Female
 61. Lateral view of female
 62. Maxilliped

Aega symmetrica Rich., ×2⅘ (fig. 63)

Rocinela belliceps Stimp. (fig. 64)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EXPLANATION OF PLATE VI

(Figs. 65-83 from Richardson 1905, 78 after Schioedte and Meinert, 79-80 after Stimpson, 81 after Harger, 82-83 after Dana)

Aega symmetrica Rich. (fig. 65)
65. Posterior end of abdomen, $\times 6\frac{1}{2}$

Rocinela belliceps Stimp. (figs. 66-69)
66. Anterior end, $\times 2\frac{1}{3}$
67. Maxilliped, $\times 27\frac{1}{3}$
68. Third leg, $\times 7$
69. Uropod, $\times 6\frac{1}{2}$

Rocinela propodialis Rich. (figs. 70-73)
70. Anterior end, $\times 2\frac{1}{3}$
71. Third leg, $\times 7$
72. Abdomen, $\times 2\frac{1}{3}$
73. Uropod, $\times 6\frac{1}{2}$

Rocinela angustata Rich. (figs. 74-77)
74. Anterior end, $\times 2\frac{1}{5}$
75. Third leg, $\times 7$
76. Uropod, $\times 6\frac{1}{2}$
77. Male

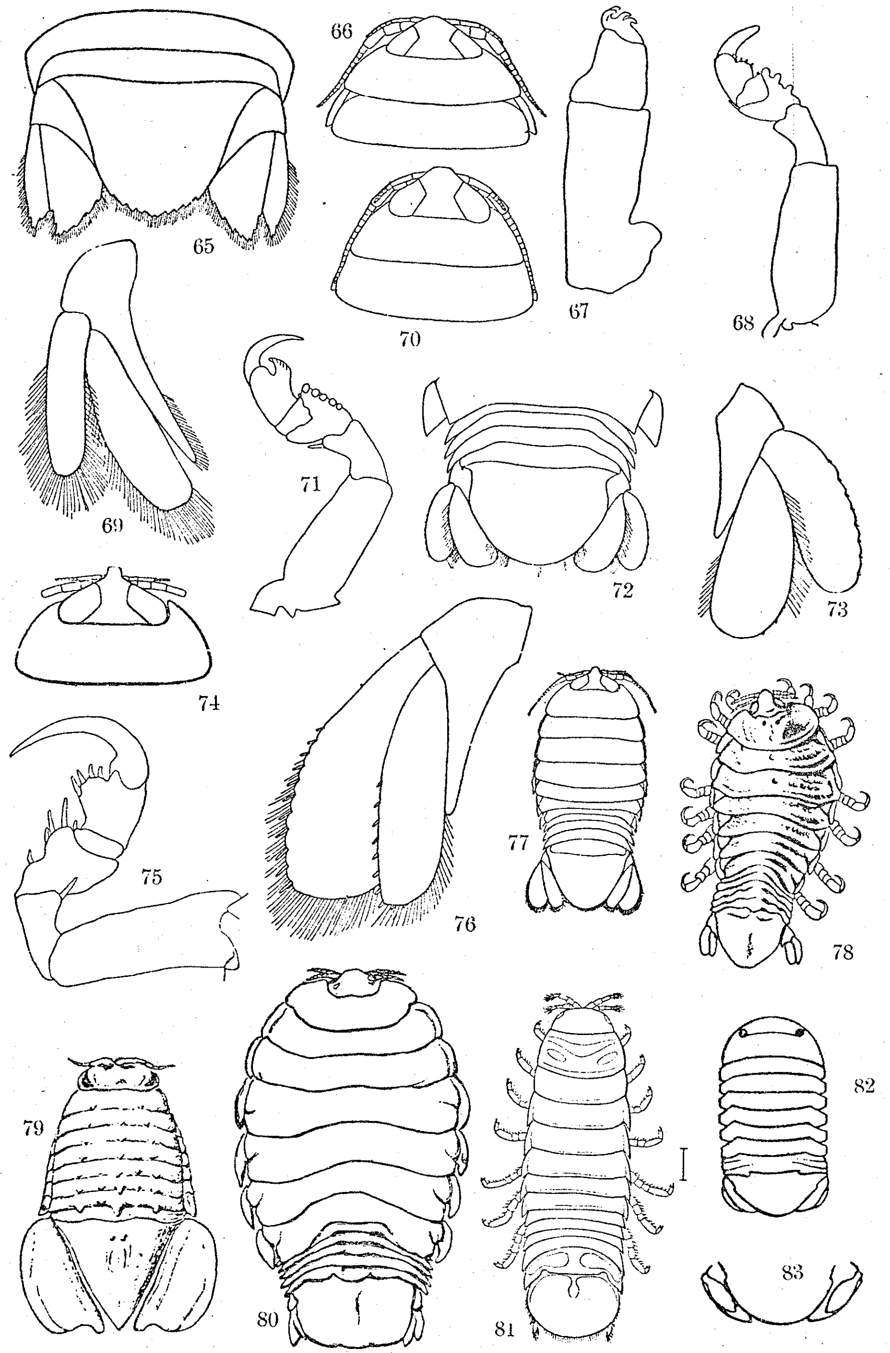
Livoneca californica Schioedte and Meinert, female (fig. 78)

Exosphaeroma amplicauda Stimp., $\times 8$ (fig. 79)

Livoneca vulgaris Stimp. (fig. 80)

Limnoria lignorum Rathke (fig. 81)

Exosphaeroma oregonensis Dana (figs. 82-83)
82. Dorsal view
83. Abdomen (ventral side)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EXPLANATION OF PLATE VII

(Figs. 84-94 from Richardson 1905, 87 after Gerstaecker, 91 after Benedict)

Dynamene glabrata Rich. (fig. 84)
84. Posterior end, ×13⅓

Dynamene dilatata Rich. (figs. 85-86)
85. Anterior end, ×13⅓
86. Dorsal view, ×10⅔

Mesidotea entomon L. (fig. 87)

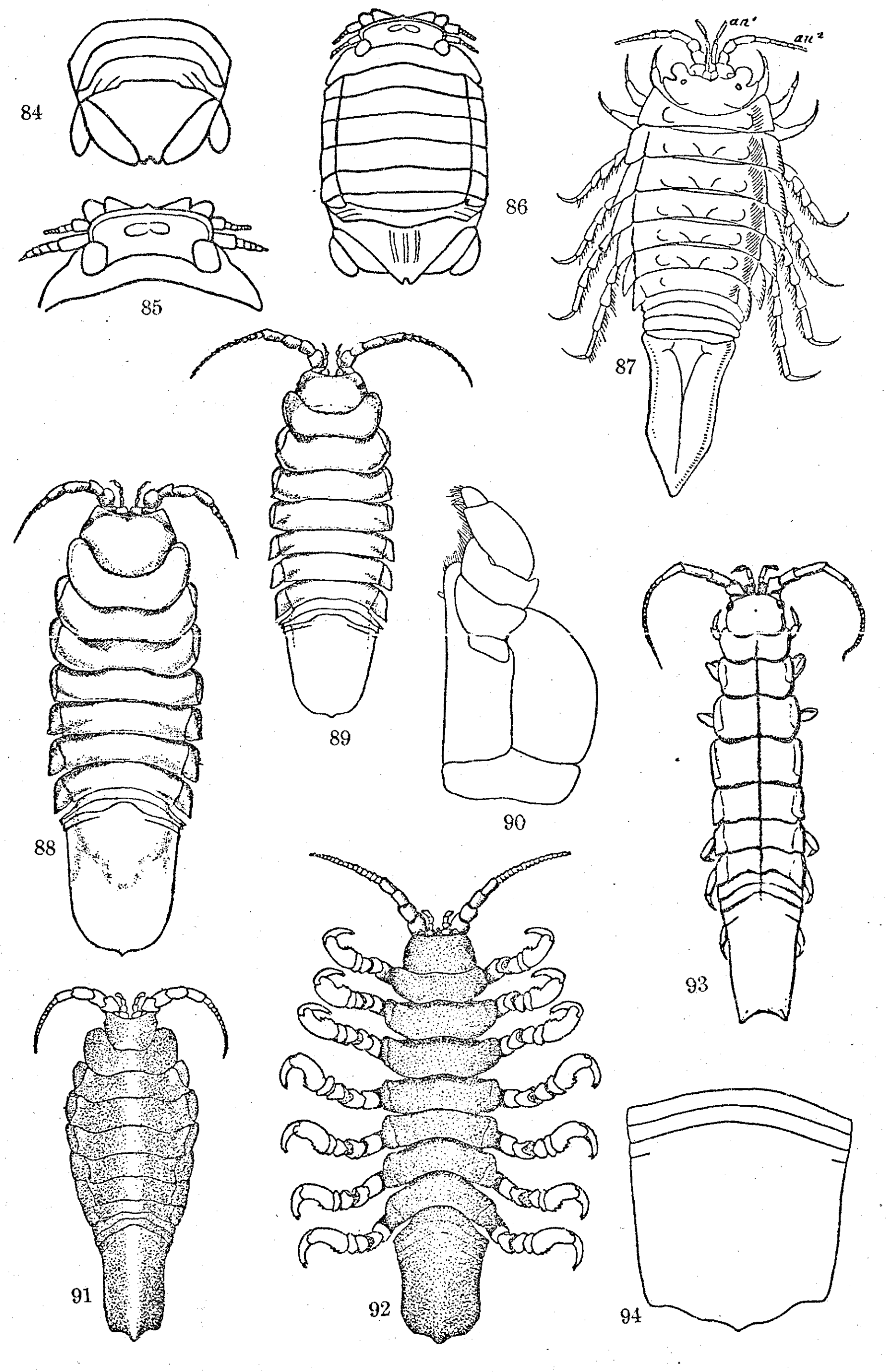
Pentidotea wosnesenskii Br. (figs. 88-90)
88. Male
89. Female
90. Maxilliped, ×15⅓

Pentidotea stenops Ben. (fig. 91)

Pentidotea whitei Stimp., ×1½ (fig. 92)

Pentidotea resecata Stimp., ×1⅓ (fig. 93)

Idothea urotoma Stimp., abdomen, ×6½ (fig. 94)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EXPLANATION OF PLATE VIII

(Figs. 95-105 from Richardson 1905, 97 after Benedict, 99 after Harger, 103-104 after Calman, 105 after Hansen)

Idothea ochotensis Br. (figs. 95-96)
- 95. Dorsal view
- 96. Maxilliped, ×15⅓

Synidotea angulata Ben., ×4 (fig. 97)

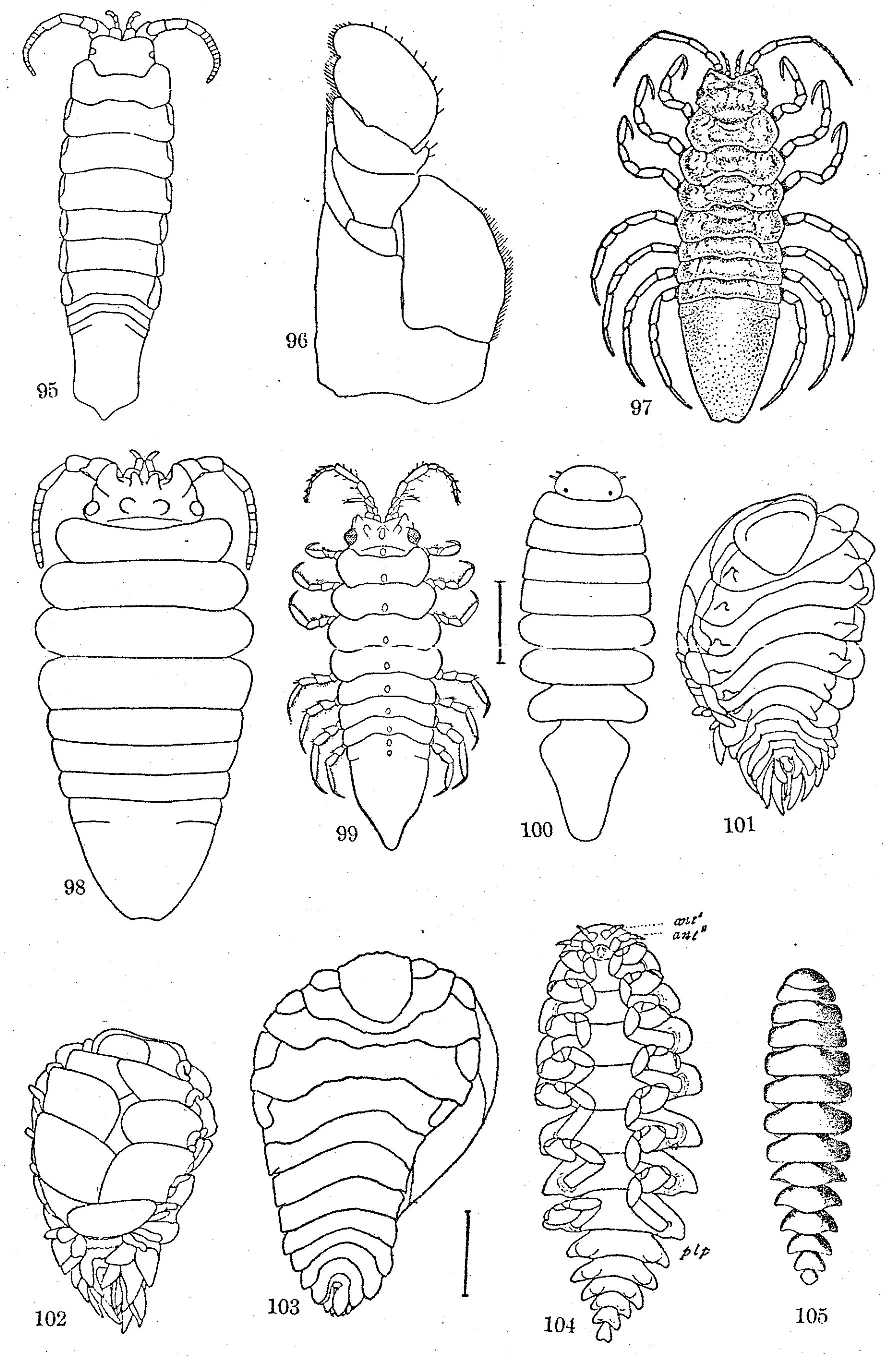
Synidotea ritteri Rich., ×10 (fig. 98)

Synidotea nodulosa Krøyer, ×4 (fig. 99)

Munidion parvum Rich. (figs. 100-102)
- 100. Male, ×23
- 101. Female (dorsal view), ×8
- 102. Female (ventral view), ×8

Pseudione giardi Calman (figs. 103-104)
- 103. Female (dorsal view)
- 104. Male (ventral view)

Pseudione gelacanthae Hansen (fig. 105)
- 105. Male (dorsal view)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EXPLANATION OF PLATE IX

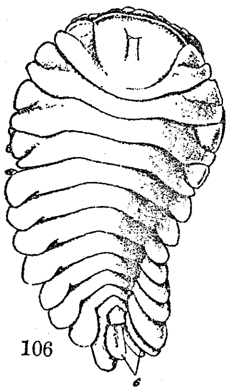
(Figs. 106-115 from Richardson 1905, 106-107 after Hansen, 113-115 after Bonnier)

Pseudione galacanthae Hansen (figs. 106-107)
106. Female (dorsal view)
107. Female (ventral view)

Phyllodurus abdominalis Stimp. (figs. 108-109)
108. Female (dorsal view)
109. Male

Argeia pugettensis Dana (figs. 110-112)
110. Female (dorsal view), ×14½
111. Female (ventral view), ×14½
112. Male, ×22

Ione cornuta Bate (figs. 113-115)
113. Female (dorsal view)
114. Female (ventral view)
115. Male (dorsal view)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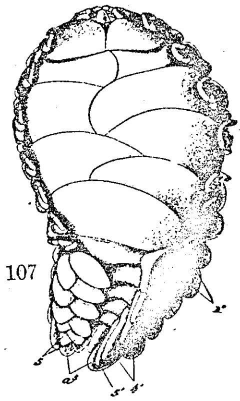
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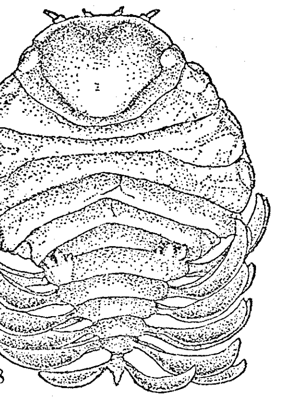
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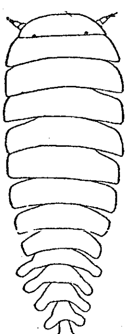
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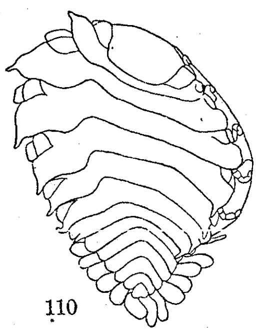
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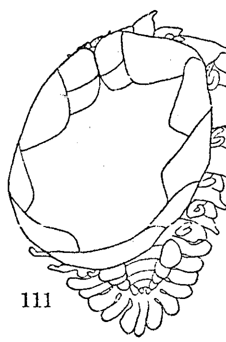
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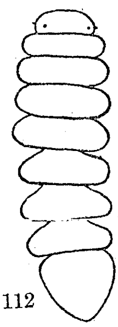
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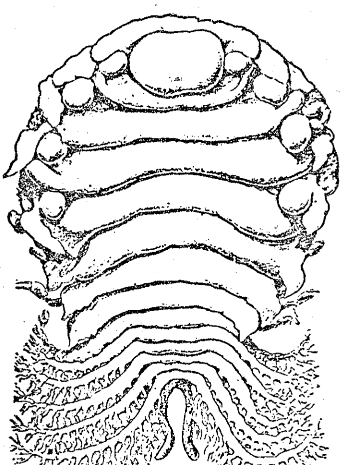
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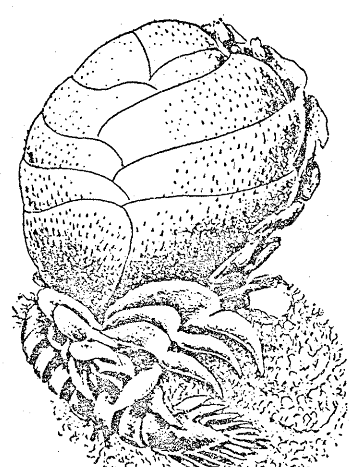
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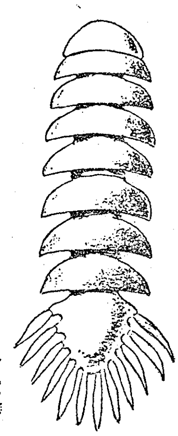
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EXPLANATION OF PLATE X

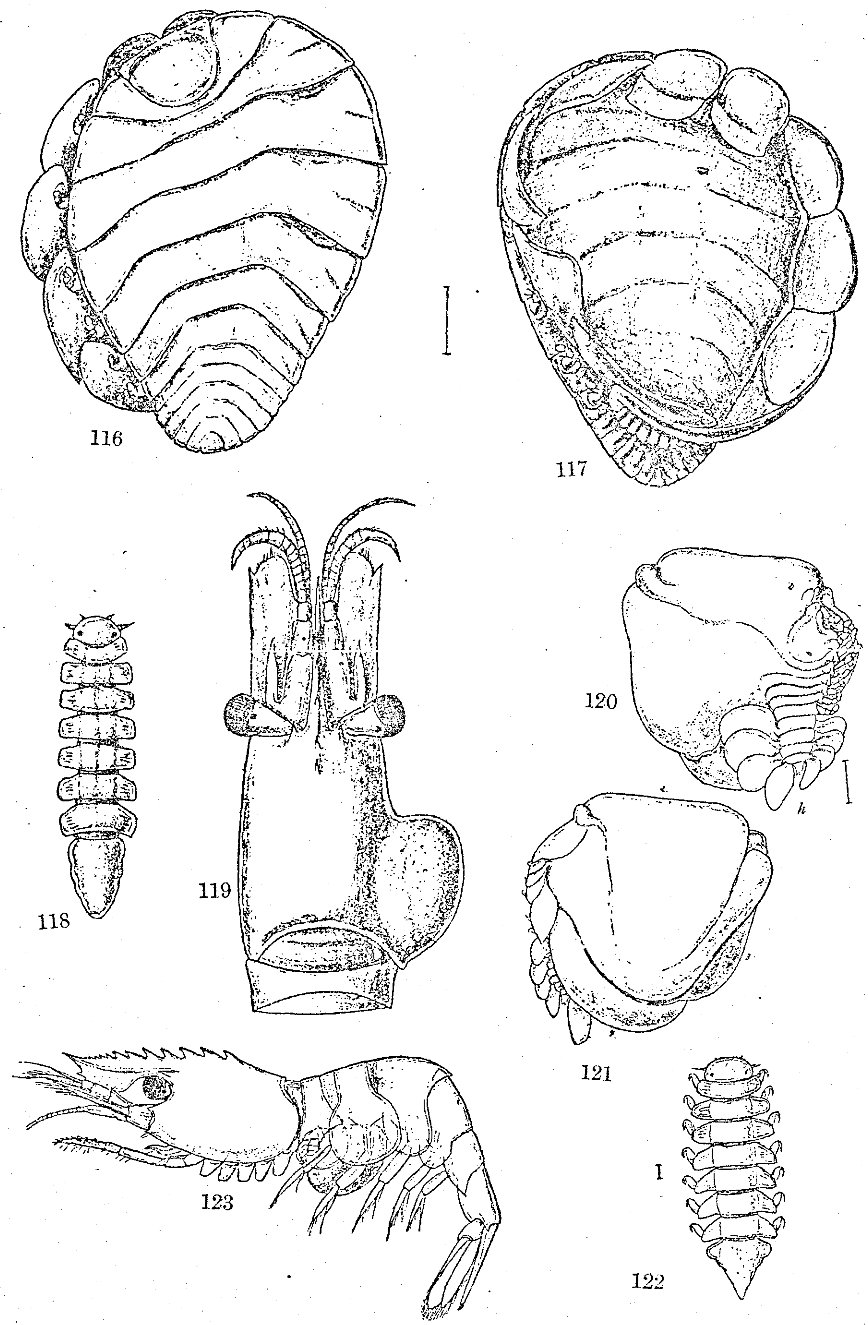
(Figs. 116-123 from Richardson 1905 after Sars)

Bopyroides hippolytes Krøyer (figs. 116-119)

116. Female (dorsal view)
117. Female (ventral view)
118. Male (dorsal view)
119. Anterior portion of specimen of *Spirontocaris polaris* infested with parasite

Phryxus abdominalis Krøyer (figs. 120-123)

120. Female (dorsal view)
121. Female (ventral view)
122. Male (dorsal view)
123. Specimen of *Spirontocaris lilljeborgii* infested with parasite



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EXPLANATION OF PLATE XI

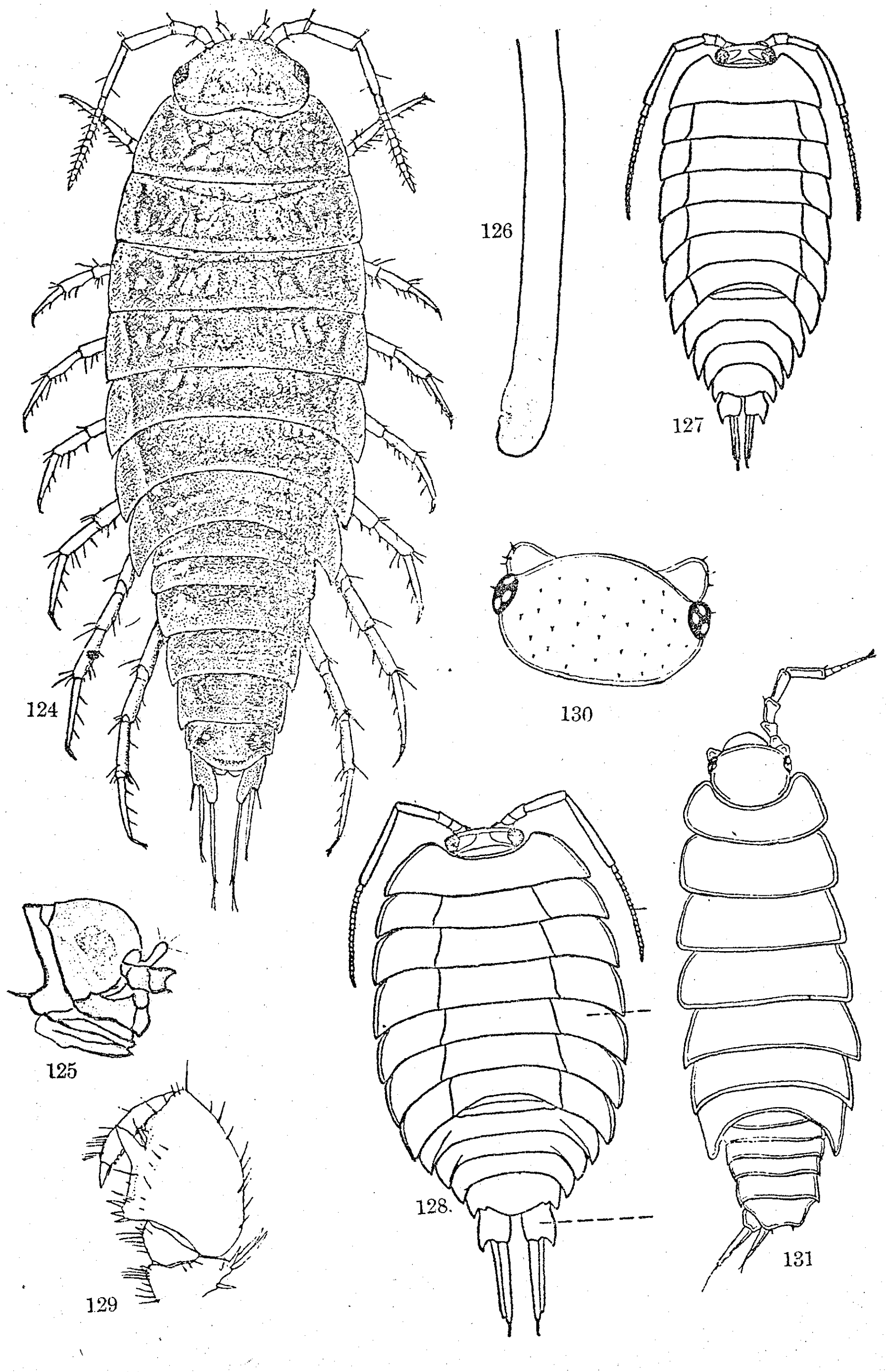
(Figs. 124-126 from Walker 1927, 127-128 from Miller 1938, 129 from Van Name 1936 after Racovitza, 130-131 from Blake 1931)

Ligidium gracile Dana (figs. 124-126)
124. Female
125. Lateral view of head
126. Male gonostyle

Ligia pallasii Br. (figs. 127-128)
127. Female
128. Male

Asellus communis Say (fig. 129)
129. Distal end of first leg of male

Trichoniscus demivirgo Blake (figs. 130-131)
130. Dorsal view of head
131. Female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EXPLANATION OF PLATE XII

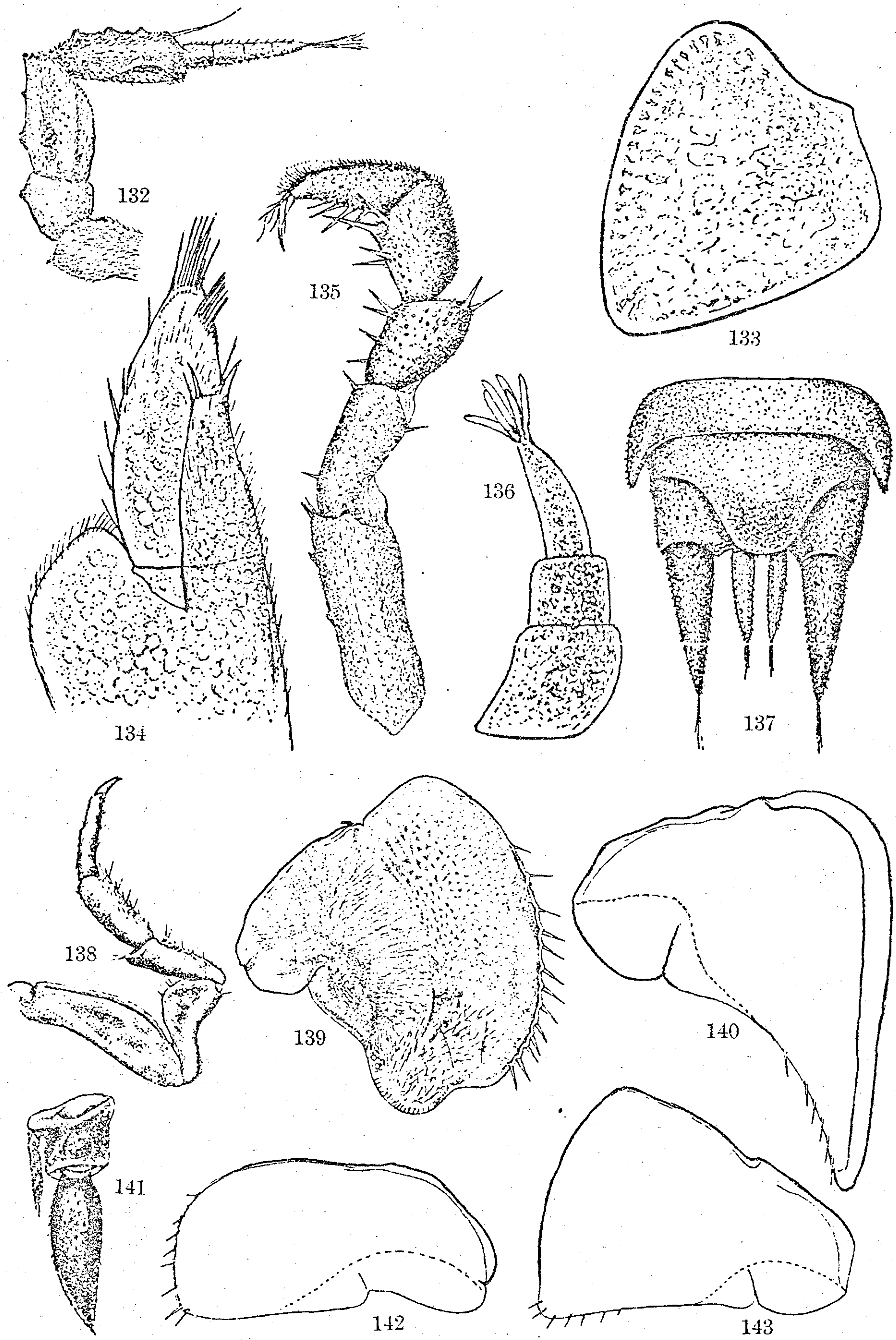
(Figs. 132-143 from Arcangeli 1932)

Oregoniscus nearticus Arcangeli (female) (figs. 132-137)

132. Second antenna (dorsal view)
133. Exopodite of left first pleopod (anterolateral view)
134. Distal portion of left maxilliped
135. Right seventh leg (anterolateral view)
136. First antenna (dorsal view)
137. Posterior end of abdomen

Porcellio scaber ssp. *niger* Say (*americanus* Arcangeli) (figs. 138-143)

138. Left seventh leg of male (anterolateral view)
139. Exopodite of right first pleopod of male (anterolateral view)
140. Exopodite of left second pleopod of male
141. Left uropod of male (dorsal view)
142. Exopodite of left first pleopod of female
143. Exopodite of left second pleopod of female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EXPLANATION OF PLATE XIII

(Figs. 144-148 from Lohmander, 149 from Richardson 1905, 150-151 from Richardson 1906, 152 from Richardson 1905 after Benedict, 153-154 from Holmes and Gay, 155-156 from Stafford, 157 from Van Name 1936 adapted from Patience)

Detonella papillicornis Rich. (figs. 144-148)
144. Second antenna of male
145. Second antenna of female
146. First antenna
147. Penis
148. First pleopod of male

Aega symmetrica Rich., maxilliped (fig. 149)

Cymodoce japonica Rich. (figs. 150-151)
150. Abdomen of female
151. Abdomen and last thoracic segment of male

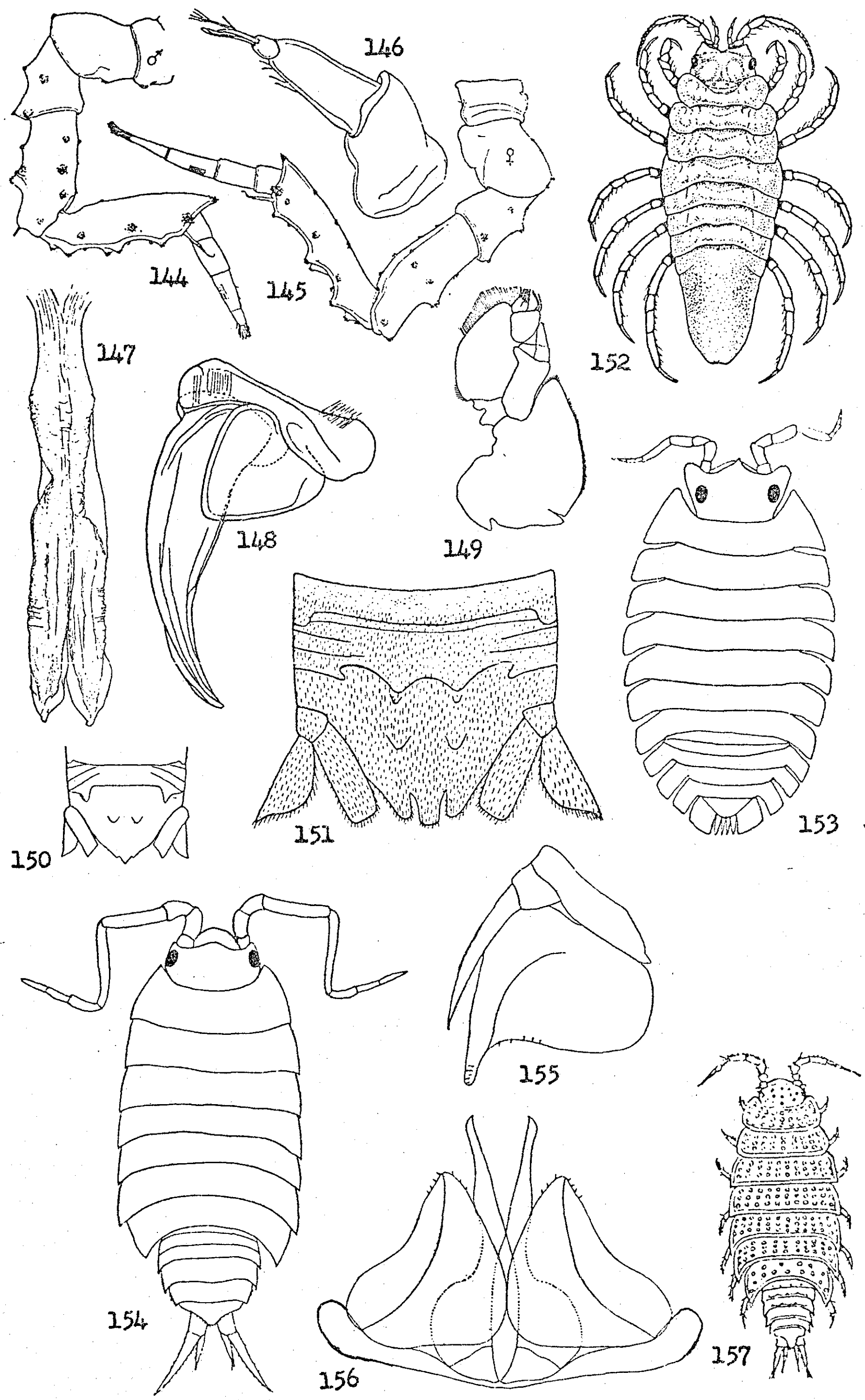
Synidotea nebulosa Ben. (fig. 152)

Armadilloniscus tuberculatus Holmes and Gay (fig. 153)

Philoscia richardsonae Holmes and Gay (fig. 154)

Alloniscus perconvexus Dana (figs. 155-156)
155. Second pleopod of male
156. First pleopod of male

Cordioniscus stebbingi Patience (fig. 157)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EXPLANATION OF PLATE XIV

Janira solasteri sp. nov. (figs. 158-160)
158. Dorsal view of right margin of thoracic segments
159. Abdomen
160. Head

Leptochelia filum Stimp. from Seattle, uropod (fig. 161)

Pentidotea wosnesenkii var. *exlineae* nov., abdomen (fig. 162)

Cirolana kincaidi sp. nov., last abdominal segment and uropods (fig. 163)

Rocinela tridens sp. nov., head (fig. 164)

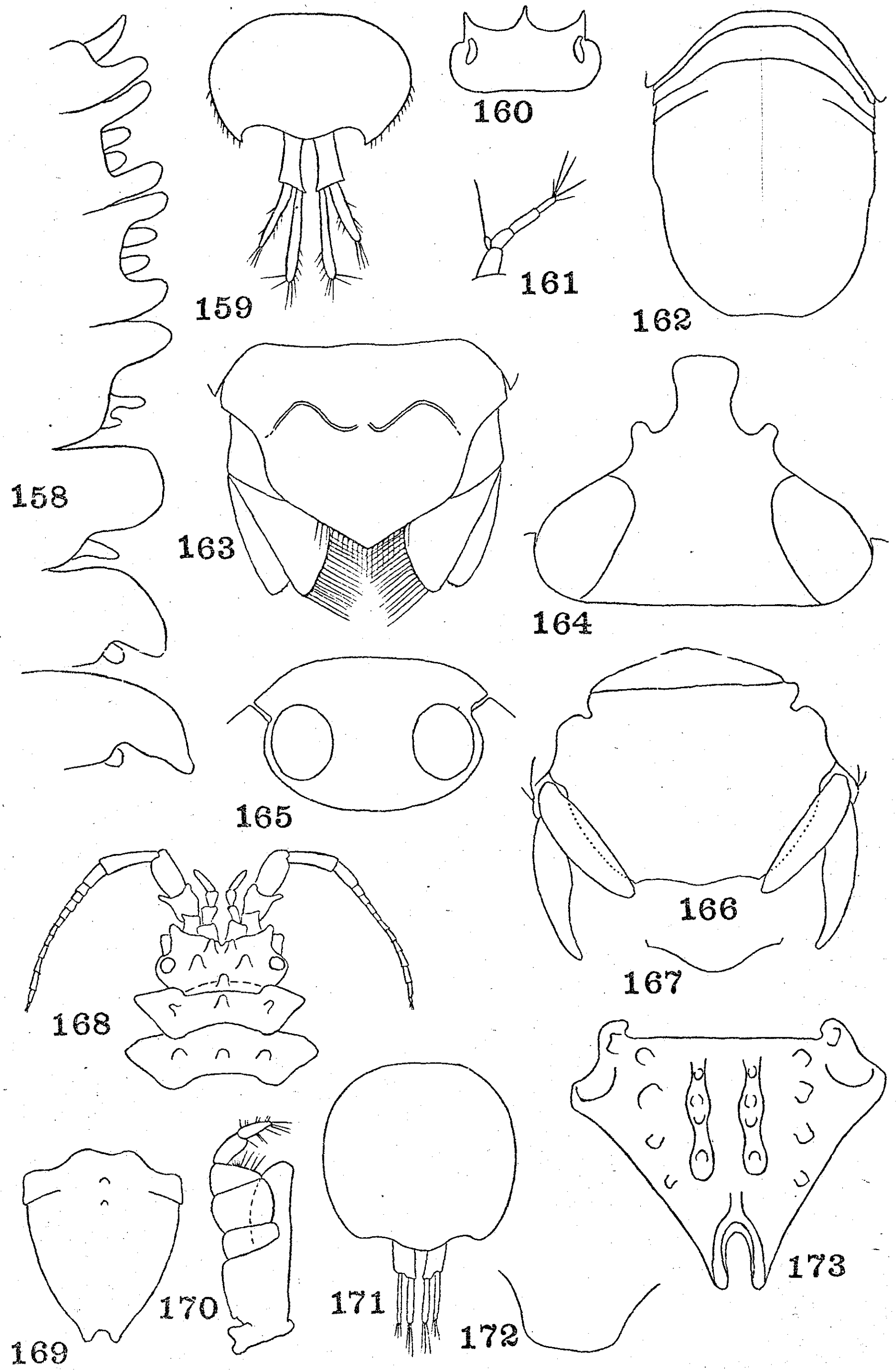
Tecticeps pugettensis sp. nov. (figs. 165-167)
165. Head
166. Last abdominal segment and uropods
167. Anterodorsal view of caudal margin of last abdominal segment

Synidotea pettiboneae sp. nov. (figs. 168-169)
168. Head and first two thoracic segments
169. Abdomen

Ianiropsis pugettensis sp. nov. (figs. 170-171)
170. Maxilliped
171. Abdomen

Detonella papillicornis Rich., caudal margin of telson (fig. 172)

Dynamene sheareri sp. nov., last abdominal segment (fig. 173)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EXPLANATION OF PLATE XV

(Figs. 174-189 from Wächtler, 177 after Meinertz, 179-180 and 185-186 after Verhoeff)

Philoscia muscorum Scop. (figs. 174-180)

174. Head (dorsal view)
175. Head (anterior view)
176. Last thoracic segment and abdomen
177. Antenna
178. Thoracic segments I and II from the right side (rdf, marginal groove)
179. Ischiopodite (isch) and meropodite (me) of seventh leg of male (pr, tooth)
180. Tooth (z) on meropodite of seventh leg of male

Oniscus asellus L. (figs. 181-184)

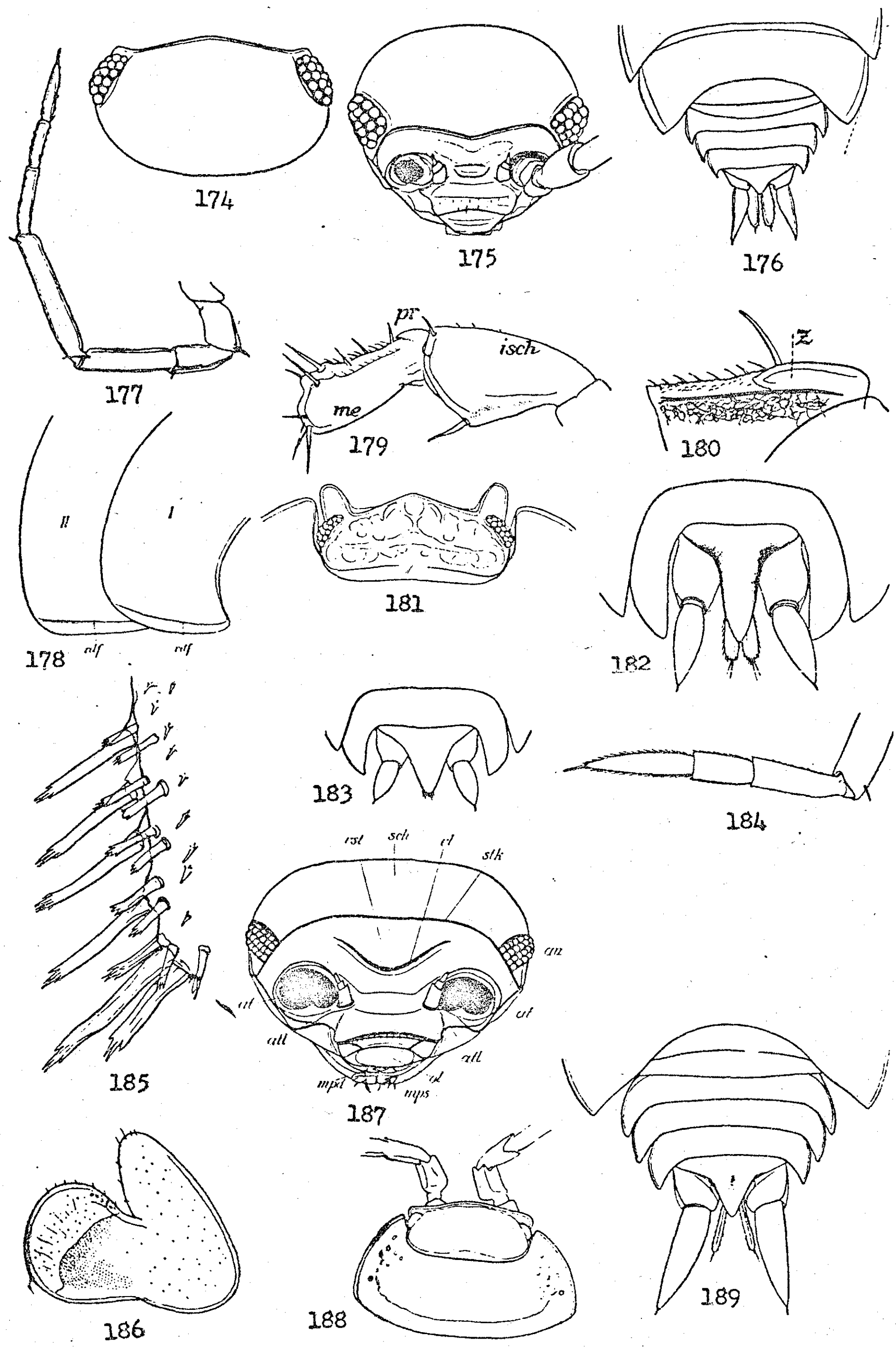
181. Head
182. Posterior end of abdomen
183. Posterior end of a young individual, about 3 mm. long
184. Flagellum

Oniscus asellus asellus L. (figs. 185-186)

185. Setae on carpopodite of first leg of male
186. Exopodite of first pleopod of male

Porcellionides pruinosus Br. (figs. 187-189)

187. Head, anterior view (at, second antenna; atl, first antenna; au, eye; mpd, right maxilla; mps, left maxilla; ol, upper lip; sch, vertex; stk, frontal line; vl, V-shaped carina; vst, head in front of frontal line)
188. Head and first thoracic segment
189. Abdomen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EXPLANATION OF PLATE XVI

(Figs. 190-204 from Wächtler; 190-193 after Graeve; 197, 201, 203, 204 after Meinertz)

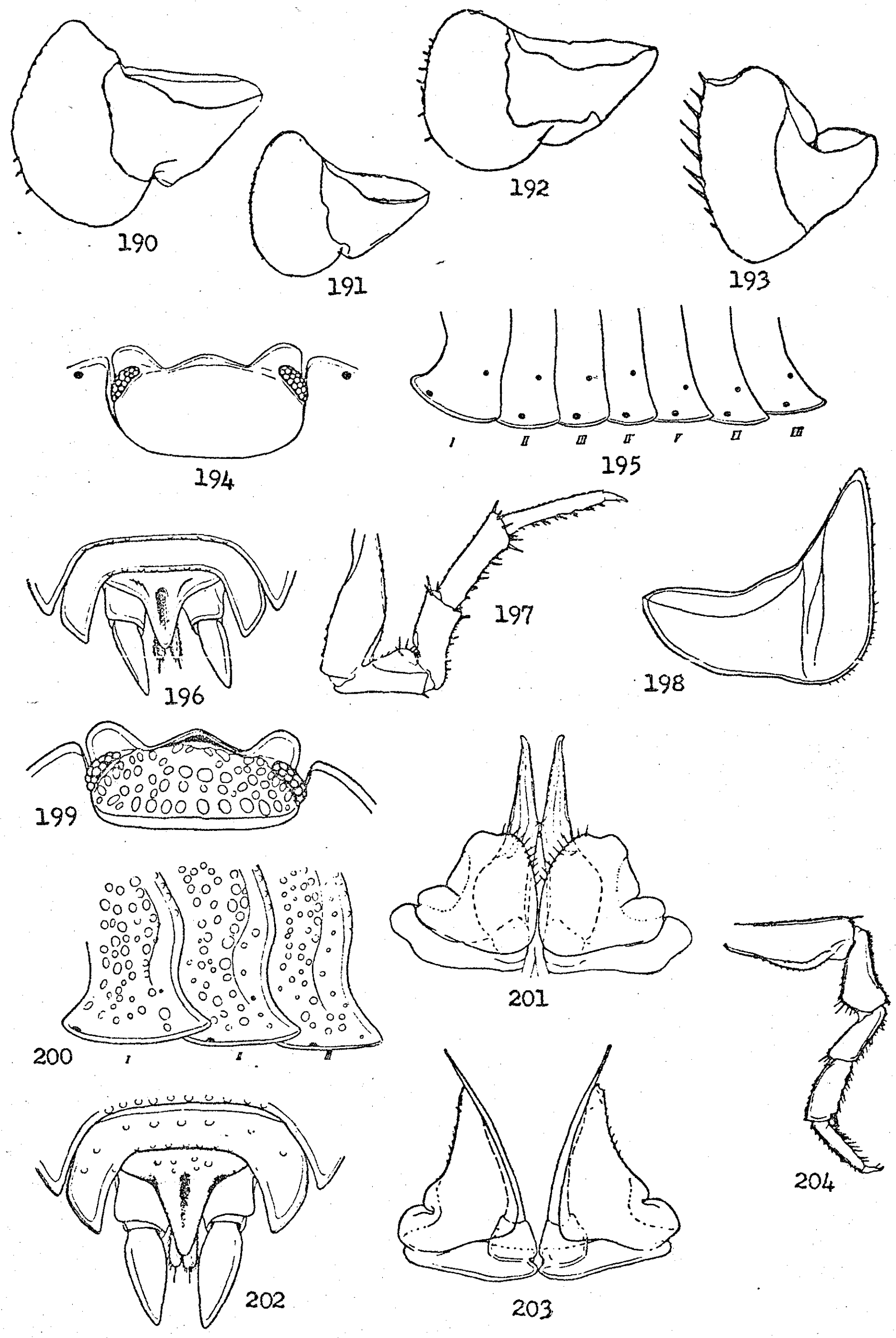
Porcellionides pruinosus Br., exopodite of first pleopod of male to show variation (figs. 190-193)

Porcellio laevis Latr. (figs. 194-198)

194. Head and anterior portion of first thoracic segment
195. Thoracic segments I to VII from the side to show pores (nearer margin) and nodules
196. Posterior end of abdomen
197. Seventh leg of male
198. Exopodite of first pleopod of male

Porcellio scaber Latr. (figs. 199-204)

199. Head
200. Thoracic segments I to III from the side
201. First pleopods of male
202. Posterior end of abdomen
203. Second pleopods of male
204. Seventh leg of male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EXPLANATION OF PLATE XVII

(Figs. 205-217 from Wächtler, 209 and 217 after Verhoeff, 213 after Meinertz)

Porcellio spinicornis Say (figs. 205-209)

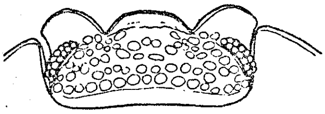
205. Head
206. Thoracic segments I and II from side
207. Posterior end of abdomen
208. Exopodite of first pleopod of male
209. Carpopodite of seventh leg of male

Porcellio dilatatus Br. (figs. 210-213)

210. Head
211. Thoracic segments I to III from side
212. Posterior end of abdomen
213. First pleopods of male

Trachelipus rathkei Br. (figs. 214-218)

214. Head and first thoracic segment
215. Posterior end of abdomen
216. Seventh leg of male showing carpopodite (c), ischiopodite (i), and meropodite (m)
217. Exopodite of first pleopod of male



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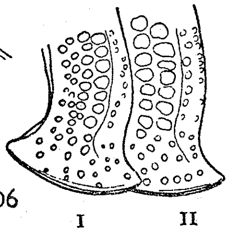

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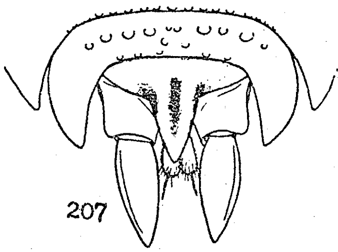

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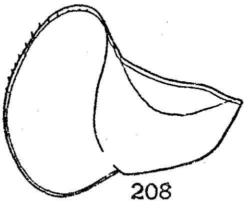

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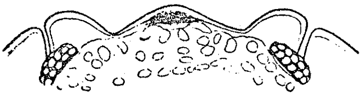

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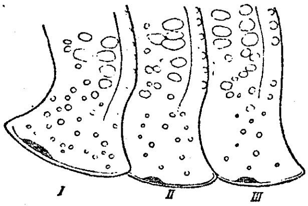

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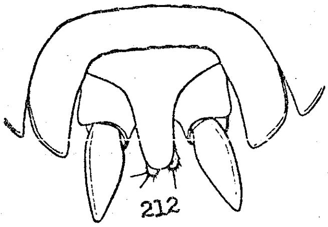

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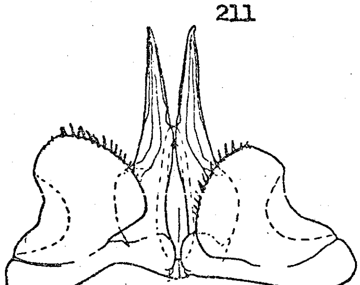

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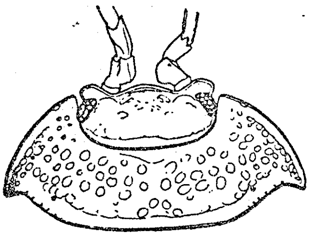

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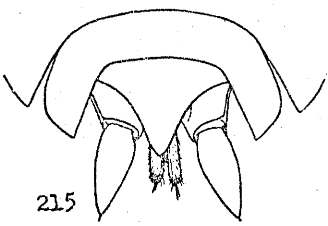

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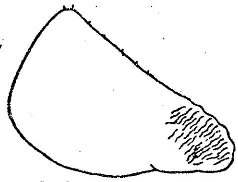

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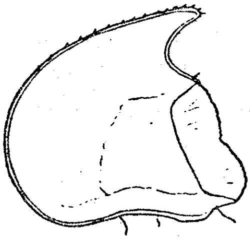

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EXPLANATION OF PLATE XVIII

(Figs. 219-234 from Wächtler; 220, 221, 223, and 231 after Verhoeff; 226 after Meinertz)

Cylisticus convexus DeG. (figs. 219-223)

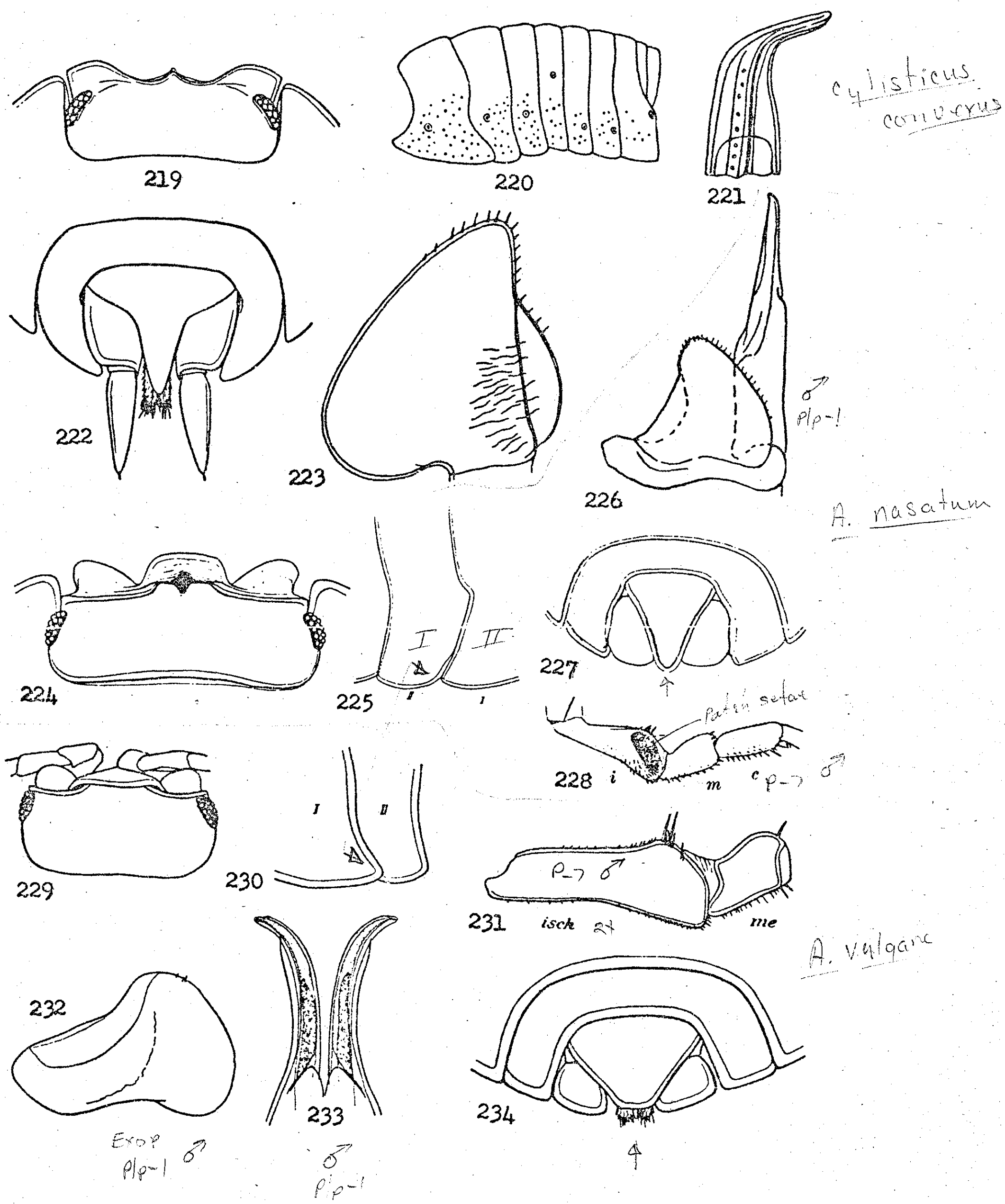
219. Head
220. Thoracic segments I to VII from side
221. Apex of endopodite of first pleopod of male
222. Posterior end of abdomen
223. Exopodite of first pleopod of male

Armadillidium nasatum B.-L. (figs. 224-228)

224. Head
225. Thoracic segments I and II from the side
226. First pleopod of male
227. Posterior end of abdomen
228. Ischiopodite (i), meropodite (m), and carpopodite (c) of seventh leg of male

Armadillidium vulgare Latr. (figs. 229-234)

229. Head
230. Thoracic segments I and II
231. Ischiopodite (isch) and meropodite (me) of seventh leg of male
232. Exopodite of first pleopod of male
233. Apices of endopodites of first pleopods of male
234. Posterior end of abdomen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220
221
Cylisticus convexus
222
223
226
♂ Plp-1
A. nasatum
224
I II
225
227
patch setae
228 i m c P-7 ♂
229
I II
230
P-7 ♂
231 isch me
A. vulgare
232
Exop Plp-1 ♂
233
♂ Plp-1
234

male

INDEX OF CRUSTACEAN SCIENTIFIC NAMES

(Subgenus and above)