

STUDIES ON MARINE GAMMARIDEAN AMPHIPODA
OF THE SETO INLAND SEA. I¹⁾

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With 15 Text-figures

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PART I. SYSTEMATIC ACCOUNT

Introduction

Benthic marine gammaridean amphipods form an important component among small crustaceans of littoral sea bottom, and are one of the important members of benthic communities in company with polychaetes and molluscs quantitatively. It is also well known that gammarideans are frequently found in the stomachs of benthos-feeding fishes as prey-animals. Nevertheless, the

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systematic knowledge of the marine gammaridean amphipods on the coast of Japan is very insufficient. The caprellidean and hyperidean amphipods have hitherto been reported by Huzio U^TINOMI (1947) and Haruhiko I^RIE (1959) respectively, and the terrestrial, subterranean, and fresh water gammarideans by W.M. TATTERSALL, Masuzo U^ENO, Kōzō AKATSUKA, Taku KOMAI, and by other several authors. As a matter of fact, the poverty of the systematic knowledge has much interrupted the advance in ecological researches of the littoral area. The gammaridean fauna of the littoral area is rich both in the number of species and in quantity, and as far as I examine, it is reasonable that a fairly good numbers of endemic species were found in the present study, though benthic amphipods have been generally deemed to show a wide range of distribution.

Recently J. L. BARNARD (1959) gave a very interesting figure concerning the number of families, genera, and species of suborder Gammaridea of the world described up to the year 1956 :

Families	57
Genera	605
Species	3146

According to habitat, they are divided as follows :

Marine and brackish species	2376
Stream and lake species	400
Lake Baikal species	232
Terrestrial species	88
Subterranean species	50

About 200 species of gammarideans are now kept in my hand, taken from the coast of Japan. It is interesting to put them in systematic order, but frustrating, especially, when there are no available references in Japan. I have, therefore, requested available copies of benthic amphipods to the colleagues in the foreign countries. However, it seems to be very hard to accomplish the work very soon. I am now examining a large number of specimens from the various localities of the Japanese coast, which are sent to me by several ecologists for identification. On completing the present study it will afford an information to the geographical distribution of the fauna, and will give a basic knowledge to the study of benthic communities being undertaken by some ecologists.

Most of material for the taxonomical study have been taken from the Seto Inland Sea. The species from the Seto Inland Sea were usually found also on all the other Japanese coasts, from the west coast of Kyūshū to Mutsu Bay, the northernmost bay of Honshū. These inland bays belong to "warm temperate" area, so far as the water temperature is concerned. I believe

that almost all the species commonly found in the Japanese inshore waters are represented in this paper.

Material

The sources of material here dealt with are summarised as follows (see Fig. 1):

Area I: Kasaoka Bay, material composed of 284 specimens taken by Ekman-Lenz bottom sampler (0.02 sq. m.) during the periods from Jan. 1953 to Mar. 1956; depth, 2.1-15.5 m; collected by R. KITAMORI & S. KOBAYASHI.

Area II: Fukuyama inlet, 50 specimens from 13 collections carried out seasonally between Mar. 1954 and Jan. 1955; depth, 2.2-4.5 m; collecting gear and members both the same as above.

Area III: Hiuchi Mada, 27 specimens from 10 stations by Okayama-maru (Okayama Pref. Fish. Exper. Stat.), Mar. 22-26, 1954; depth 2.2-25.0 m, both collecting gear and members are the same as above.

Area IV: Mihara Bay, 31368 specimens from 9 seasonal surveys between Feb. 1956 and Mar. 1957; depths of low-water marks to about 25 m, Ekman-Lenz sampler & bottom-layer net (see NAGATA 1960, fig. 1), collected by R. KITAMORI, S. KOBAYASHI, and the writer.

Area V: Estuary of the Ôta, Hiroshima Pref., 399 specimens from 4 seasonal surveys between Mar. 1956 and Oct. 1956; depth 0.4-11.6 m, Ekman-Lenz sampler, collected by R. KITAMORI & S. KOBAYASHI.

Area VI: Hosonosu, north of Hosono Shima, Hiroshima Pref.; 629 specimens from 4 seasonal surveys between Oct. 1956 and Feb. 1957; depth, shallower than 3.0 m; Ekman-Lenz sampler & bottom-layer net, collected by R. KITAMORI, S. KOBAYASHI, and the writer.

Area VII: Inshore waters of Momo Shima, Hiroshima Pref., 766 specimens, Jan. 23, 1957; depth, 1.5-10.5 m, Ekman-Lenz sampler & bottom-layer net, collected by R. KITAMORI & S. KOBAYASHI.

Area VIII: Estuaries of the Kanzaki (Mar. 28 and 31, 1958) and the Yodo (Aug. 29, 1958), Ôsaka Bay, 20 specimens from the polluted water area; depth, shallower than 10 m, Ekman-Lenz, collected by R. KITAMORI & Z. KÔBE.

Area IX-a: Front of Ôno-Branch of our laboratory, Ônoura, Hiroshima Pref., intertidal area, May 27, 1959; 25 specimens found among eelgrass (*Zostera nana*) exposed in low water, collected by K. FUNAE.

Area IX-b: The same area as above, *Zostera* belt near low-water marks, 911 specimens obtained at a depth of 0.5 m in low water, by pushing a coarse net strongly so as to drag the sea-floor; May 11, 1960, collected by K. FUNAE & the writer.

Area IX-c: The same *Zostera* belt as above, July 27 and 28, 1961; 56

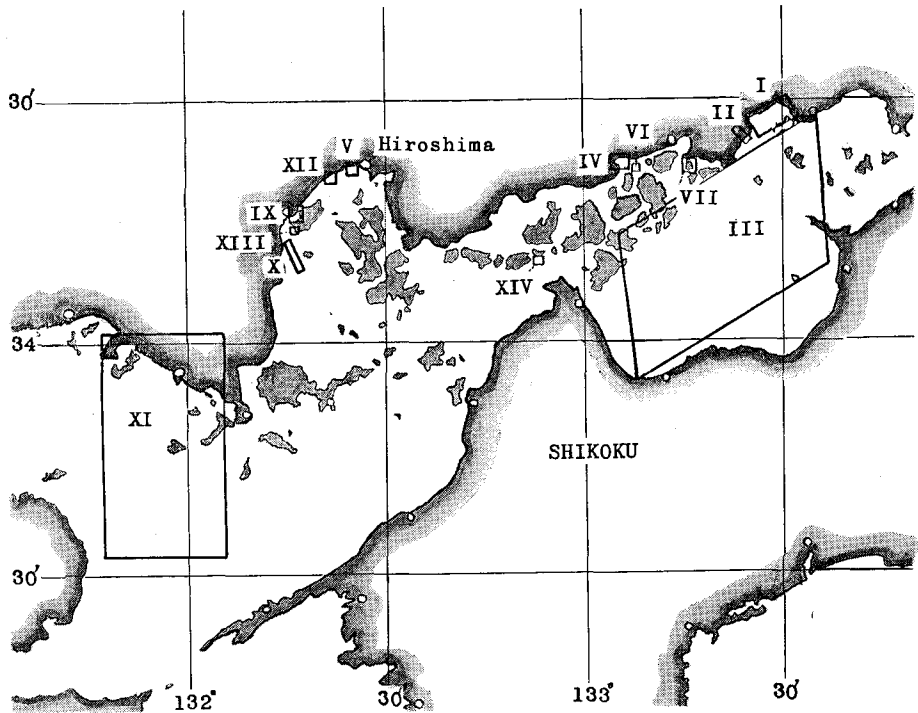


Fig. 1. Map of Seto Inland Sea showing the collecting area of materials dealt with in this paper, excluding "Area VIII".

specimens, collecting method as above, collected by K. FUNAE & the writer.

Area IX-d: The same belt as above, 1671 specimens by nocturnal surveys between Aug. 30 and Oct. 10 in 1962; horizontal-tow by plankton net along the surface waters of 0.8-3.9 m in depth in high water (see Part II).

Area X: Neighbouring waters of Atata Shima, Hiroshima Bay; 328 specimens from 4 collections by bottom-layer net; June 2-3, 1959; 15.0-13.0 m in depth; collected by R. KITAMORI, K. FUNAE, and the writer.

Area XI-a: Eastern area of Suō Nada, 5673 specimens from 14 collections by bottom-layer net, between June 12-16, 1959; depths about 30-60 m; collected by R. KITAMORI (see Fig. 47, and Table 4).

Area XI-b: The second survey of the same area as above, 3689 specimens from 29 collections by bottom-layer net, between Sept. 2-5, 1960; depths ca. 10-60 m; collected by R. KITAMORI (see Fig. 47, and Table 5).

Area XII: Front of the beach of Itsukaichi, Hiroshima Pref., Oct. 19, 1960; 185 specimens found together with the excrements of oyster in the experimental basket suspended from the oyster-raft at a depth about 10 m from the bottom; collected by U. KOBAYASHI.

Area XIII-a: Near Kanematsuhana, south coast of Miyajima, Hiroshima Bay; *Sargassum* zone, 2-4 m in depth; Dec. 8, 1961; 35 specimens found by formalin-washing of algae taken by "ebikogi" net; collected by R. OKAMOTO & K. FUNAE.

Area XIII-b: The same location as above, Jan. 8, 1962; 220 specimens found among algae obtained by the same net as above; collected by R. OKAMOTO & K. FUNAE.

Area XIV: Beach of Okamura-jima, Aki Nada; 61 specimens; May 31, 1962; among algae or under stones near low-water marks; collected by K. FUNAE.

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Historical Review of Systematic Works

Records of the gammaridean group in the systematic works from the coast of Japan have hitherto been only made fragmentally by STEBBING (1888), STEPHENSEN (1932, 1933, 1938, 1944), IWASA (1934, 1939), DAHL (1945), SHIINO (1948), and IRIE (1956). STEBBING described 3 species in "Challenger Report" of 1888; *Ampithoe japonica* was found at "Bay of Kôbe", Seto Inland Sea, and the other two were collected from "Kuroshio" region. STEPHENSEN in his 4 papers mentioned above described 23 species, of which 14 were directly recorded from marine inshore localities of the Japanese coast. IWASA in 1934 and 1939 described 13 species and 2 subspecies of only two families (Talitridae and Hyalidae), two species of which were terrestrial amphipods. DAHL in 1945 reported on 4 species of only Ampeliscidae. In 1948, SHIINO described a new boring amphipod, *Chelura brevicaudata*, and in 1956, IRIE reported on two species, *Erichthonius brasiliensis* and *Corophium acherusicum* belonging to the family Corophiidae.

Following is a list of all the marine and brackish water species from the coast of Japan described by several authors mentioned above;

Anonyx ampulloides BATE, STEBBING (1888).

Orchomene musculosus, n. sp. by STEBBING (1888).

(now falls to) → *Orchomenella chilensis* (HELLER) by K.H. BARNARD (1925 and 1932).

* *Ampithoe japonica*, n. sp. by STEBBING (1888)

→ *A. lacertosa* BATE, herein by the writer.

- Elasmopus japonicus*, n. sp. by STEPHENSEN (1932).
- * *Corophium uenoi*, n. sp. by STEPHENSEN (1932).
- Ceinina japonica*, n. sp. by STEPHENSEN (1933).
- Parhyale kurilensis*, n. sp. by IWASA (1934); IWASA (1939)
→*P. ochotensis* (BRANDT) by GURJANOVA (1951).
- * *Grandidierella japonica*, n. sp. by STEPHENSEN (1938).
- Orchestia platensis* KRØYER; IWASA (1939); STEPHENSEN (1944).
- * *Orchestia platensis japonica* (TATTERSALL); IWASA (1939); STEPHENSEN (1944); was *Talorchestia japonica* in TATTERSALL (1922).
- Orchestia ditmari* DERJAVIN; IWASA (1939); STEPHENSEN (1944)
→*O. ochotensis* BRANDT by BULYCHEVA (1957).
- Orchestia tenuimana*, n. sp. by IWASA (1939); STEPHENSEN (1944)
→*O. pyatakovi* DERJAVIN by BULYCHEVA (1957).
- Talorchestia brito* STEBBING; IWASA (1939); STEPHENSEN (1944).
- * *Hyale novaezealandiae* THOMSON; IWASA (1939)
→*H. grandicornis* (KRØYER) by K.H. BARNARD (1916).
- * *Hyale schmidti* (HELLER); IWASA (1939).
- Hyale dollfusi* CHEVREUX; IWASA (1939); STEPHENSEN (1944).
- Hyale gracilis*, n. sp. by IWASA (1939)
→*H. iwasai* SHOEMAKER on account of "homonym".
- * *Allorchestes malleolus* STEBBING; IWASA (1939)
→*A. angustus* DANA by J.L. BARNARD (1954a).
- Allorchestes malleolus carinatus*, n. subsp. by IWASA (1939)
→*A. angustus carinatus* automatically.
- * *Allorchestes plumicornis* (HELLER); IWASA (1939); STEPHENSEN (1944).
- * *Melita koreana*, n. sp. by STEPHENSEN (1944).
- Anisogammarus (Anisogammarus) dybovski* (DERJAVIN); STEPHENSEN (1944)
→*A. (A.) pugettensis* (DANA) by J.L. BARNARD (1954a).
- Anisogammarus (Eogammarus) kygi* (DERJAVIN); STEPHENSEN (1944).
- * *Anisogammarus (Eogammarus) annandalei* (TATTERSALL); STEPHENSEN (1944);
was *Gammarus* in TATTERSALL (1922).
- * *Ampithoe shimizuensis*, n. sp. by STEPHENSEN (1944)
→*A. valida* SMITH by J.L. BARNARD (1954a).
- * *Ampithoe macrurus*, n. sp. by STEPHENSEN (1944)
→*A. lacertosa* BATE by J.L. BARNARD (1954a).
- Sunamphithoe plumosa*, n. sp. by STEPHENSEN (1944).
- * *Ampelisca bocki*, n. sp. by DAHL (1945).
- * *Ampelisca misakiensis*, n. sp. by DAHL (1945).
- * *Ampelisca* sp. cf. *brevicornis* (COSTA) by DAHL (1945)
→*A. brevicornis* (COSTA) by the writer.
- * *Byblis japonicus*, n. sp. DAHL (1945).

Chelura brevicaudata, n. sp. by SHIINO (1948)

→*Nippocheilura brevicaudata* (SHIINO) by J.L. BARNARD (1959-b).

* *Erichthonius brasiliensis* DANA; IRIE (1956)

→*E. pugnax* DANA, herein by the writer.

* *Corophium acherusicum* COSTA; IRIE (1956).

The species which has been afterwards revised are indicated with a mark of arrow, and those described herein are marked with an asterisk.

Orchomene musculosus mentioned above was at first transferred into the genus *Orchomeneopsis* by STEBBING himself (1906), then fallen to a synonym of *O. chilensis* (HELLER) by K.H. BARNARD (1925), after that, the genus *Orchomeneopsis* was fused under the genus name of *Orchomenella* by K.H. BARNARD (1932), and thus the present name of the species is *Orchomenella chilensis* (HELLER). Concerning *Parhyale kurilensis* designated as a new species by IWASA, SHOEMAKER says in his paper of 1956, "DERJAVIN (1937) made IWASA's species a synonym of BRANDT's species *Allorchestes ochotensis*, which was made the genotype of a new genus *Parallorchestes* by SHOEMAKER (1941). DERJAVIN at the same time transferred BRANDT's species to *Parhyale*, making it *Parhyale ochotensis*." *Melita koreana* is a record from Makinoshima, Fuzan, Korea described by STEPHENSEN, but known also from the Japanese coasts by the writer, and *Anisogammarus (E.) kygi* and *A. (E.) annandalei* are recorded from fresh water localities in his paper of 1944, but the two species are both found also from the brackish waters along the coasts of Japan.

As far as the writer knows, the specific information mentioned above are all of the taxonomic records prior to the writer's work from Japan.

List of the Species Described in This Series of Papers

Lysianassidae

1. *Anonyx nugax pacificus* GURJANOVA
2. *Orchomenella littoralis*, sp. nov.
3. *Lepidepecreum vitjazi* GURJANOVA
4. *Endevoura mirabilis* CHILTON
5. *Aristias pacificus* SCHELLENBERG
6. *Scopelocheirus hopei* (COSTA)
7. *Socarnes vahli* (KRØYER)
8. *Ichnopus taurus* COSTA

Ampeliscidae

9. *Ampelisca brevicornis* (COSTA)
10. *Ampelisca cyclops* WALKER
11. *Ampelisca bocki* DAHL
12. *Ampelisca misakiensis* DAHL
13. *Ampelisca miharaensis* NAGATA
14. *Ampelisca naikaiensis* NAGATA
15. *Byblis japonicus* DAHL

Argissidae

16. *Argissa hamatipes* (NORMAN)
- Haustoriidae
17. *Urothoe pulchella* (COSTA)
- Phoxocephalidae
18. *Paraphoxus oculus* (SARS)
 19. *Leptophoxus falcatus* SARS
 20. *Harpinia miharaensis* NAGATA
- Amphilochidae
21. *Gitanopsis vilordes* J. L. BARNARD
- Leucothoidae
22. *Leucothoe incisa* ROBERTSON
 23. *Leucothoe alata* J. L. BARNARD
- Stenothoidae
24. *Stenothoe gallensis* WALKER
- Liljeborgiidae
25. *Liljeborgia japonica*, sp. nov.
 26. *Liljeborgia serrata*, sp. nov.
 27. *Idunella chilensis* CHILTON
 28. *Idunella curvidactyla*, sp. nov.
- Oedicerotidae
29. *Pontocrates altamarinus* (BATE & WESTWOOD)
 30. *Bathymedon longimanus* (BOECK)
 31. *Monoculodes limnophilus japonicus*, subsp. nov.
- Synopiidae
32. *Synopia ultramarina* DANA
- Tironidae
33. *Syrrhoites pacificus*, sp. nov.
- Calliopiidae
34. *Leptamphopus novaezealandiae* (THOMSON)
- Pleustidae
35. *Pleustes panopla* (KRÖYER)
 36. *Parapleustes bicuspides*, sp. nov.
- Atylidae
37. *Atylus japonicus* NAGATA
- Melphidippidae
38. *Melphidippa borealis* BOECK
 39. *Melphidippa globosa*, sp. nov.
 40. *Melphidippella sinuata*, sp. nov.
 41. *Melphisana japonica*, sp. nov.
- Pontogeneiidae
42. *Pontogeneia rostrata* GURJANOVA
- Cammaridae
43. *Anisogammarus (Eogammarus) annandalei* (TATTERSALL)
 44. *Melita koreana* STEPHENSEN
 45. *Melita denticulata*, sp. nov.

46. *Melita tuberculata*, sp. nov.
47. *Melita japonica*, sp. nov.
48. *Maera serratipalma*, sp. nov.
49. *Maerella tenuimana* (BATE)
50. *Ceradocus* (*Denticeradocus*) *capensis* SHEARD
51. *Eriopisa elongata* (BRUZELIUS)
52. *Eriopisella sechellensis* (CHEVREUX)
53. *Megaluropus agilis* HOECK

Dexaminidae

54. *Paradexamine flindersi* (STEBBING)
55. *Paradexamine barnardi* SHEARD

Talitridae

56. *Orchestia platensis japonica* (TATTERSALL)

Hyalidae

57. *Hyale grandicornis* (KRØYER)
58. *Hyale schmidti* (HELLER)
59. *Allorchestes angustus* DANA
60. *Allorchestes plumicornis* (HELLER)

Aoridae

61. *Aora typica* KRØYER
62. *Aoroides columbiae* WALKER
63. *Aoroides secunda* CURJANOVA

Photidae

64. *Photis reinhardi* KRØYER
65. *Photis longicaudata* (BATE & WESTWOOD)
66. *Eurystheus japonicus* NAGATA
67. *Eurystheus utinomii* NAGATA
68. *Podoceropsis nitida* (STIMPSON)

Ampithoidae

69. *Ampithoe lacertosa* BATE
70. *Ampithoe valida* SMITH
71. *Ampithoe ramondi* AUDOUIN
72. *Ampithoe orientalis* DANA

Ischyroceridae

73. *Jassa falcata* (MONTAGU)
74. *Microjassa cumbrensis* (STEBBING & ROBERTSON)

Corophiidae

75. *Corophium volutator* (PALLAS)
76. *Corophium acherusicum* COSTA
77. *Corophium crassicorne* Bruzelius
78. *Corophium uenoi* STEPHENSEN
79. *Corophium insidiosum* CRAWFORD
80. *Corophium kitamorii* sp. nov.
81. *Erichthonius pugnax* DANA
82. *Crandidierella japonica* STEPHENSEN
83. *Cerapus tubularis* SAY
84. *Unciolella lunata* CHEVREUX

Podoceridae

85. *Podocerus inconspicuus* (STEBBING)

Types are preserved in my hand for the present (KN No.).

Systematics

Key to the families described in this paper

1. Antenna 1, peduncular article 1 stout, with accessory flagellum; mandible with cutting edge almost smooth, with palp; article 3 of gnathopod 2 elongate.....Lysianassidae
1. These characters not combined..... 2
2. Head tapering, truncate; eyes externally simple, with 2-4 corneal lenses; antenna 1 without accessory flagellum; telson more or less cleft.....Ampeliscidae
2. These characters not combined..... 3
3. Coxal paltes 1-3 decreasing gradually in size.....Argissidae
3. Coxal plates 1-3 not decreasing in size..... 4
4. Antenna 1 with accessory flagellum; mandible with palp normal; peraeopods 3-5 adapted for burrowing by expansion of joints and armature of many spines and setae 5
4. These characters not combined 6
5. Peraeopod 4 not greatly longer than peraeopod 5Haustoriidae
5. Peraeopod 4 greatly longer than peraeopod 5.....Phoxocephalidae
6. Upper lip incised; maxillipeds normal; uropod 3 biramous; telson elongate, tapering, entire.....Amphilochidae
6. These characters not combined..... 7
7. Antenna 1 without accessory flagellum; maxillipeds more or less abnormal; telson entire..... 8
7. These characters not combined..... 9
8. Gnathopod 1 chelate; uropod 3 biramousLeucothoidae
8. Gnathopod 1 not chelate; uropod 3 with a single 2-jointed ramusStenothoidae
9. Mandible with molar weak or wanting; maxillipeds, inner plate small; gnathopods 1 and 2 strongly subchelate; telson more or less dividedLiljeborgiidae
9. These characters not combined..... 10
10. Head produced into a deflexed rostrum, or front of head bent down at right angles to dorsal line; eyes, when present, dorsally contiguous or confluent 11
10. These characters not combined 13
11. Antenna 1 without accessory flagellum; article 3 of mandibular palp large; peraeopod 5 much longer than peraeopod 4; telson entireOedicerotidae
11. Antenna 1 with accessory flagellum; article 3 of mandibular palp small; peraeopod 5 not much longer than peraeopod 4; telson cleft 12
12. Peraeopods 1 and 2 with articles 4 and 5 dilatedSynopiidae
12. Peraeopods 1 and 2 with articles 4 and 5 narrowTironidae
13. Coxal plate 4 usually excavated behind; peraeopods 1 and 2 not glandular; telson variable; animal usually not domicolous..... 14
13. Coxal plate 4 usually not excavated behind; peraeopods 1 and 2 frequently glandular; telson entire; animal usually domicolous 22
14. Mandible with palp 15
14. Mandible without palp 20
15. Telson entire 16
15. Telson eleft..... 17

16. Rostrum weak; mandible with molar well developedCalliopiidae
 16. Rostrum usually well marked; mandible, molar feeblePleustidae
 17. Pleon segments 5 and 6 coalescedAtylidae
 17. Pleon segments 5 and 6 not coalesced 18
 18. Antenna 1 without accessory flagellumPontogeneiidae
 18. Antenna 1 with accessory flagellum 19
 19. Peraeopods and uropods long and very slenderMelphidippidae
 19. Peraeopods and uropods not very slenderGammaridae
 20. Uropod 3, both rami well developedDexaminidae
 20. Uropod 3, one ramus wanting or very small 21
 21. Antenna 1 shorter than peduncle of antenna 2Talitridae
 21. Antenna 1 longer than peduncle of antenna 2Hyalidae
 22. Uropods 2 and 3, one or other wanting or rudimentaryPodoceridae
 22. Uropods 2 and 3 developed 23
 23. Pleon usually depressed; uropod 3 uniramousCorophiidae
 23. Pleon compressed; uropod 3 biramous 24
 24. Uropod 3 not uncinatate 25
 24. Uropod 3, outer ramus uncinatate 26
 25. Gnathopod 1 larger than gnathopod 2Aoridae
 25. Gnathopod 1 not larger than gnathopod 2Photidae
 26. Lower lip with principal lobes notchedAmpithoidae
 26. Lower lip with principal lobes not notchedIschyroceridae

Family LYSIANASSIDAE

Key to the species of Lysianassidae

1. Peraeopod 1 powerful, chelate*Endeavoura mirabilis*
 1. Peraeopod 1 normal, simple 2
 2. Coxa 1, lower front angle concealed*Aristias pacificus*
 2. Coxa 1, lower front angle not concealed 3
 3. Branchial vesicles pleated on both or one side 4
 3. Branchial vesicles simple 6
 4. Gnathopod 1 subchelate*Anonyx nugax pacificus*
 4. Gnathopod 1 simple 5
 5. Epimeral plate 3, lower hind corner rounded*Socarnes vahli*
 5. Epimeral plate 3, lower hind corner toothed*Ichnopus taurus*
 6. Mandibular palp attached not behind the molar*Scopelocheirus hopei*
 6. Mandibular palp attached behind the molar 7
 7. Pleon segment 4 with a triangular dorsal carina prominently projected
*Lepidepcreum vitjazi*
 7. Pleon segment 4 without such a projection*Orchomenella littoralis*

Anonyx nugax pacificus GURJANOVA

Anonyx nugax pacificus GURJANOVA 1962, p. 219, figs, 68a-b.

Anonyx ampulloides, (non BATE), NAGATA 1960, p. 166, pl. 13, figs. 1-6.

Material examined: Area IV (484 specimens), VI (2), XI-b (1); up to 14.9 mm in length; depths of 3-52 m. Nearly all of them were obtained from

Sts. 6-8 of Mihara Bay, deeper than 10 m in depth.

Remarks: As I have mentioned in my preceding paper, I felt it difficult to identify the specimens with certainty either as *A. nugax* or as *A. ampulloides*, because of having no opportunity actually comparing the specimens of the two species; *A. ampulloides* was recorded at 34°58'N, 139°29'E, off the Pacific coast of Japan by "Challenger" Expedition. According to GURJANOVA's key of the genus *Anonyx* (1962, p. 211), the present specimens fall into the present subspecies, therefore the specimens reported under the name *A. ampulloides* in my preceding paper should be attributed to this subspecies of *A. nugax*. The subspecies is particularly distinguished from BATE's *ampulloides* by the shape and color of eyes, and the structure of male uropod 2.

This subspecies is also known by me from the other coasts of Japan, e.g. the shallower waters of Mutsu Bay, and the Japanese coast of Japan Sea; they are both the same form as that of Seto Inland Sea in characters. The present specimens are, however, not entirely agreed with GURJANOVA's figures of the species taken from the Japan Sea. Mandibular palp normal in shape; its article 2 not so stout. Front lower corner of the first pleonal epimeron not so strongly produced but rather similar to that of his figure of *A. nugax nugax* (1962, fig. 67a). Lower hind corner of the third pleonal epimeron with the tooth of variable shape, usually acutely produced in the smaller specimens 6-8 mm long, while produced to a short, broad tooth in the larger ones of 12-14 mm long. Peraeopod 3, article 4 surely stout and similar proportion of length to its article 5, but in peraeopod 4, article 4 not so short in proportion to its article 3. Peduncular article 5 of antenna 2 usually subequal in length to article 4, but rather longer in the larger of 13 mm long. Eyes flask-shaped, but the lower posterior corner usually less produced backwards, rather similar to that of the specimens of this subspecies from Okhotsk Sea figured by GURJANOVA (1962, fig. 69). The most remarkable character of the present specimens is that article 5 of gnathopod 1 is fairly long, comparing with its article 6 (see NAGATA 1960, pl. 13, fig. 3).

Distribution: Japan Sea and Okhotsk Sea.

Orchomenella littoralis, sp. nov.

Orchomenella sp., NAGATA 1960, p. 167, pl. 13, figs. 7-18.

Material examined: Areas I (2), IV (258), V (70), VI (20), VII (66), IX-b (7), IX-c (4), XI-a (2), XI-b (6), XIII-b (2). Total: 437 specimens, up to 6.5 mm in length; from depths of low-water mark to 56 m.

Description: Lateral lobes of head in female triangularly produced, in male rather more narrowly produced. Eyse oval, slightly widened below, moderate in size, and its facets of light red reticulated with milk-like white

in fresh, composed of about 10-11 in number, but entirely vanishing away and imperceptible in spirits. Coxa 1 of nearly uniform width bearing 3-4 setae in a oblique row on the surface of inside; coxa 4 of a harmonious boot-like shape, right-angularly excavated behind, the excavation relatively shallow comparing to the total depth of the coxa, the lower hind lobe relatively long, narrowing towards the apex; coxa 5 of equal breadth and depth, produced downwards behind; coxae 6-7 like in those of *O. lepidula* (GURJANOVA 1962, fig. 44b). Pleonal epimera 1-3 with the posterior margin minutely serrate, in the first and third epimera only in the lower half of the margin. Pleon segment 4 in female with a wide, shallow dorsal depression, in male narrowly and steeply depressed (in female of 6.2 mm long, rather resembles the outline of figure (pl. 13, fig. 16) shown as a male of 4.7 mm long in my preceding paper, while in male of 6.5 mm long still more narrow, deep, and steep). Epistome with a broadly rounding lobe projection forwards beyond the upper lip. Antenna 1 in male, the first peduncular article more stouter and somewhat shorter than in female; antenna 2, flagellum in male distally thread-like, reaching the full length of the animal.

Gnathopod 1 short and stout, article 5 subequal or a little shorter than article 6, not produced to a linguiform posterior lobe; article 6 with the anterior and posterior margin nearly parallel each other, the palm nearly transverse and slightly concave, bearing a minutely comb-like margin, and defined by a spiniform angle accompanied with two stout spines at the base; article 7 with an accessory tooth on the inner edge like in *O. nana* (KRØYER) (CHEVREUX & FAGE 1925, p. 71, fig. 62). Gnathopod 2, article 5 about two times as long as article 6, of which the distal end subacutely produced, showing a minute cheliform with the finger. Peraeopods 3-5, article 2 shorter than the rest of the limb, the hind margin minutely serrated; the shape in peraeopod 3 as seen in the figure of my preceding paper, pretty constant through many specimens at my hand, but in peraeopods 4-5 they are somewhat of variable shape, usually similar to those of *O. lepidula* (l.c.). All fingers of peraeopods 1-5 do not show such a strong form as seen in GURJANOVA's figures for *O. intermedia* (GURJANOVA 1962, fig. 45b).

Uropod 2, inner ramus not constricted; uropod 3 with the rami fully longer than the peduncle, inner ramus subequal to the basal article of outer ramus, the second article of the outer ramus short and small, the inner margin of the outer ramus in male lined with many marginal plumose setae. Telson rather slender, more than 1.5 times as long as broad, tapering towards the apex, cleft to three fourths the length, each lobe bearing an apical spine and a lateral spinule. Integument comparatively indurated, partly coloring with light red in fresh, but entirely whitish in spirits.

Holotype: KN No. 3111, male, 4.9 mm. *Type locality*: St. 2, north coast of Momo Shima (Area VII), Jan. 23, 1957; 4 m in depth, *Zostera* belt, Mud, W.T.

9.8°C, Cl. 18.16‰ at bottom-layer respectively.

Remarks: I have thoroughly referred to all of the known species belonging to this genus listed by J.L. BARNARD (1958, p. 96), in which 30 species are reported until the end of 1956 from the world, but no species agreed well with the present new one; particularly among them, *O. nana* (KRØYER) known from the European coasts, Mediterranean, and Ceylon, is the most nearest to the new species. Recently, GURJANOVA in his paper of 1962 described five new species from the north-western parts of the Pacific, in which three species (*O. lepidula*, *O. intermedia*, and *O. minuscula*) are related to the new one. However, the present new species could not still satisfy me in referring it to any of them. This new one is commonly found in the inshore waters of the inland bay along the coasts of Japan, from Mutsu Bay to the west coast of Kyūshū, which belong to "warm temperate" area of Japan. It may be one of the distinctive species representing the endemic feature of these areas.

Lepidepcreum vitjazi GURJANOVA

Lepidepcreum vitjazi GURJANOVA 1962, p. 338, fig. 112.

Material examined: Areas I (1), IV (72), VI (1). All up to 7.4 mm long, from depths of 3-25 m.

Remarks: The specimens are wonderfully well allied to GURJANOVA's description and figures of *L. vitjazi*, except for the following minor details: there is no oblique row of setae on the first coxal plate; marginal setae on article 6 of gnathopod 1 not hooked at apex; there are only five pairs of dorsal spinules on telson; the dorso-posterior end of pleon segment 3 feebly carinate and shows no such an attractive projection as to be upturnedly raised. The shape of dorsal projection on pleon segment 4 rather more resembles that of *L. longicorne* figured by CHEVREUX & FAGE (1925, p. 63, figs. 50-51). The present specimens are closely related to *L. longicorne* (BATE & WESTWOOD), except for the appearance of carinae both on the dorsal line and on the peduncular article 1 of antenna 1; the difference appeared to be not essential in character but to be only a variable character caused by the discrepancy of localities, so I have assigned the specimens to *L. longicorne* in my memorandum for a long time. However, in closer examination of *L. longicorne*, accessory flagellum of antenna 1, strange to say, entirely wanting, and telson strongly tapering towards the apex and more longer, nearly three times as long as broad. The specimens have also a close resemblance with *L. eoum* GURJANOVA (1951, p. 277, figs. 146-147) taken from the shallow waters, 15 m in depth of the Russian coast of the Japan Sea, but the discrepancy of the dorsal appearance can not still satisfy me in referring them to *L. eoum*

Distribution: Bering Sea, near Olyutorskogo, 40 m.

Endevoura mirabilis CHILTON

(Figs. 2-3)

Endevoura mirabilis CHILTON 1921, p. 44, figs. 4 a-q.

Material examined: Areas XI-a (1), XI-b (4). Length, 3.5-10.5 mm, all probably male; depths, 32-56 m.

Remarks: The present specimens somewhat differ from CHILTON's description and figures of *E. mirabilis*. Lateral lobes of head more narrowly produced. Coxa 4 not abruptly upturned at the lower hind corner. Mandibular palp

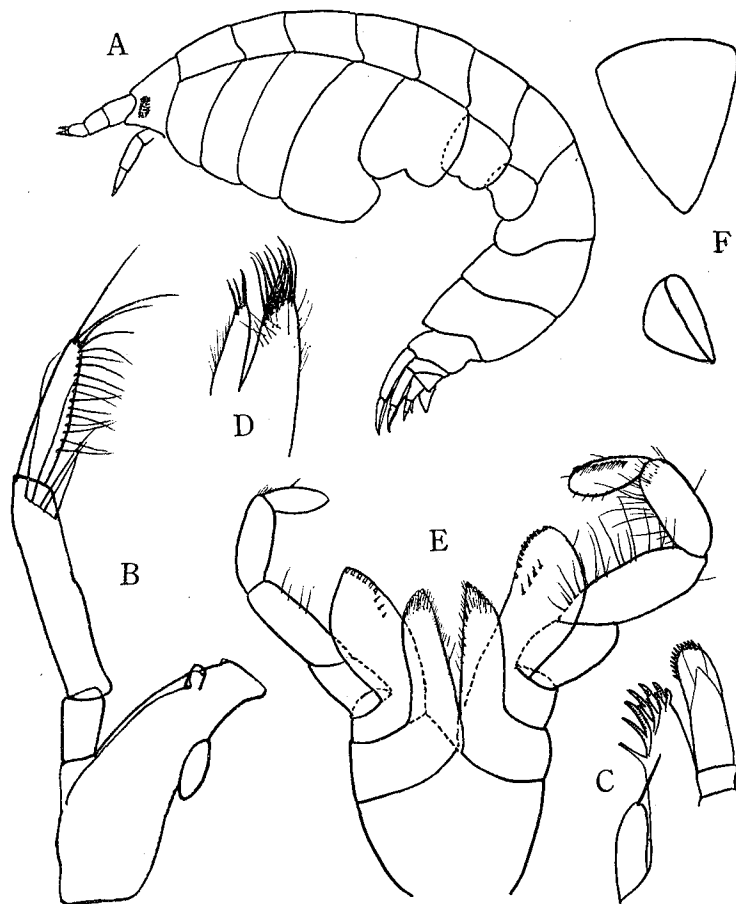


Fig. 2. *Endevoura mirabilis* CHILTON. Male, 10.5 mm : A, lateral view of body. Male, 7.1 mm : B, mandible ; C, maxilla 1 ; D, maxilla 2 ; E, maxillipeds ; F, telson (upper and lateral view).

more elongate, armed with more long setae on articles 2 and 3. Gnathopod 1, articles 5 and 6 combined are much longer than article 2; article 2 proximally broad, with the anterior margin roughly dentate, the denticles become smaller and denser by degrees towards the proximal portion; finger minutely dentate on the middle of the inner edge.

Peraeopod 1 has the most prominent character on the distal portion of the leg; article 6 shows a echelon-formation, the postero-proximal portion produced backwards to the posterior end of article 4, while the postero-distal end projecting forwards and forming a chela with the finger; the palm evenly convex, regularly and minutely dentate, and defined by a stout tooth (sometimes entirely evanescent), accompanied with a pretty distinctive spine.

The third pleonal epimeron with such a minute point at the lower pos-

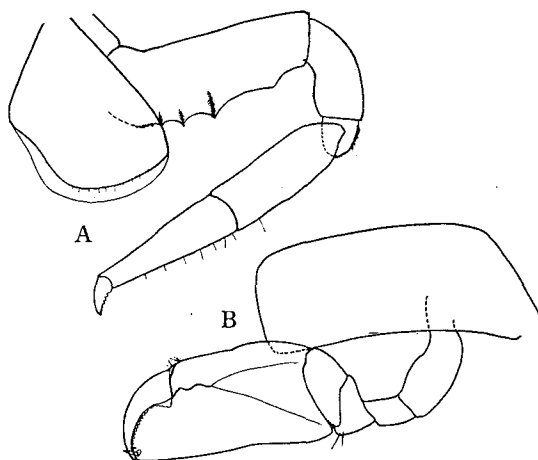


Fig. 3. *Endevoura mirabilis* CHILTON. Male, 7.1 mm : A, gnathopod 1 ; B, peraeopod 1.

terior corner, that it is apt to be overlooked, but the hind margin not serrate below, unlike in CHILTON's figure. Telson tapering, longer than broad, the apex narrowly rounded. Among the differences mentioned above, the shape of article 6 of peraeopod 1 and of telson are truly remarkable. The rounded shape of telson in CHILTON's specimen may have happened to be observed when it was depressed down with a cover-glass. Article 6 of peraeopod 1 is invariable in shape among the specimens at hand, between 3.5-10.5 mm in length. The present specimens are, however, quite well conformed with *mirabilis* in all the other major characters, so that I could not consider the specimens to be essentially distinctive from *E. mirabilis*.

Distribution: Australian seas (east coast of Frinders Island, Bass Strait).

Aristias pacificus SCHELLENBERG

Aristias pacificus SCHELLENBERG 1936, p. 153.

Material examined: Area XI-a, 4 specimens (see Table 4); up to 2.5 mm in length; depths, 20-50 m.

Remarks: The present specimens, though they are all small, appear to agree well with SCHELLENBERG's description. This species has surely some agreements both with *A. tumidus* and *A. neglectus* (SARS 1895, pl. 17, fig. 2 and pl. 18, fig. 1, respectively). In the specimens at hand, coxa 6 has also the lower hind lobes produced below to a long curved process as in *A. falcatus* described and figured by STEPHDENSEN (1923, p. 73, fig. 14), who says in the paper, "the feature is also found among the materials of *A. tumidus* and *A. neglectus*."

Such a "ganz kleinen stumpfen Zahn" as described by SCHELLENBERG for *A. pacificus*, is not found at the lower hind corner of the third pleonal epimeron. Peraeopods 1-5, article 6 produced at the tip to a short tooth-like process, and this character is described also in STEBBING's diagnosis of 1906 for *A. neglectus* (p. 50). Telson cleft to two-thirds the length. The other points like in SCHELLENBERG's description, except in the number of flagellar articles of antennae. However, a little hesitation remains behind for the identification of these specimens, as no figures of this species are given by SCHELLENBERG, and if the more larger specimens be accepted in future, the specific characters will be more confirmed.

Distribution: N.E. of Union Bay, east side of Vancouver Is., 12-16 fm.

Scopelocheirus hopei (COSTA)

Callisoma krøyeri, DELLA VALLE 1893, pl. 26, figs. 1-15; SARS 1895, p. 54, pl. 19, fig. 2.

Scopelocheirus hopei, STEBBING 1906, p. 62; CHEVREUX & FAGE 1925, p. 55, figs. 39-40; GURJANOVA 1951, p. 241, fig. 106.

Material examined: Area XI-b, 2 female specimens; 7.1 and 7.8 mm in length; from depths of 40-52 m.

Remarks: The specimens well agree with this species figured in the references cited above; the shape of coxa 4 especially with that of DELLA VALLE's one. The shape of epistome is used by DAHL (1959, p. 221) as one of the distinctive characters among the genera of the *Scopelocheirus* group; *Scopelocheirus*, *Paracallisoma*, *Aroui*, *Scopelocheiropsis*, and *Bathycallisoma*, but the protruding form of epistome beyond upper lip is not always a proper character for the genus *Scopelocheirus*; it projects really in *S. crenatus* (SARS 1895, pl. 19, fig. 1), but not projects in *S. hopei*, as obviously seen in CHEVREUX & FAGE's figure for this species. It is confirmed also in the present specimens, therefore

a revision may be needed in STEBBING's diagnosis of 1906. The outer plate of maxillipeds in the present specimens also nearly reaching to the end of article 2 of the palp, and article 4 of the palp not so slender as in *S. crenatus*.

Distribution: North Atlantic, North Sea, Skagerrak, Kattegat, Baltic (Great Britain, Norway, Sweden), and Mediterranean.

Socarnes vahli (KRØYER)

Socarnes vahli SARS 1895, p. 44, pl. 16, fig. 2; STEBBING 1906, p. 57; GURJANOVA 1951, p. 226, fig. 91; GURJANOVA 1962, p. 308.

Material examined: Area XIII-b, 3 female specimens; 3.8-11.7 mm in length; from depths of 2-4 m.

Remarks: The specimens agree well with SARS' figures. Eyes reniform, black. Lateral lobes of head with the smooth distal margin. Oral parts entirely like in Sars' figures. Antenna 1, flagellum 4-14 jointed, accessory flagellum with 2-6 joints. Antenna 2, peduncular article 5 shorter than article 4; flagellum with 3-13 joints. Gnathopod 1, finger simple, and smooth at the base. Third pleonal epimeron with the postero-lateral corner rounding, rather similar to that of CHEVREUX & FAGE's figure of *S. erythrophthalmus* ROBERTSON (1925, fig. 34). Telson scarcely reaching to the distal end of peduncle of uropod 3. Branchial vesicles pleated on both sides.

These specimens are undoubtedly assigned to the present species. It is noteworthy that such a boreo-arctic form is found in Seto Inland Sea.

Distribution: In North Atlantic it descends southerly to the south end of Greenland, and Iceland; in the North Pacific it extends, through Okhotsk Sea and Bering Sea, south to Japan Sea (3-5 to 240 m in depth).

Ichnopus taurus COSTA

Ichnopus, taurus, DELLA VALLE 1893, pl. 3, fig. 1, pl. 27, figs. 1-22; WALKER 1904, p. 238, pl. 1, fig. 3; STEBBING 1906, p. 53; K. H. BARNARD 1916, p. 123; CHEVREUX & FAGE 1925, p. 48, fig. 30.

Ichnopus spinicornis, SARS 1895, pl. 15; STEBBING 1906, p. 52; CHEVREUX & FAGE 1925, p. 47, figs. 28-29; GURJANOVA 1951, p. 220, fig. 86.

Ichnopus serricus WALKER 1909, p. 328, pl. 43, fig. 1.

Material examined: One male specimen, 8.4 mm long from the stomach of benthos-feeding fish caught in the area of Bungo Suidō (about 40-60 m), Jan. 20, 1960.

Remarks: Though found from the stomach of fish, the specimen is not so damaged and fully available for identification. It agrees well with SARS' figures for *I. spinicornis*, except for gnathopod 1 and peraeopod 3.

Antenna 1, the distal dentiform process of peduncle presents only on the

first article. Gnathopod 1 much shorter than gnathopod 2, while the finger with the expanded base, at which is armed with spines of variable size like in CHEVREUX & FAGE's figure for *I. taurus*. Article 2 of peraeopod 3 with the hind margin more deeply serrated than in the figure given by WALKER for *I. serricurus*. The closer examination of the present specimen makes me approve of K. R. BARNARD's opinion that the above-mentioned three species are together conspecific.

Distribution: Faroes, Norwegian coast, coasts of Ireland and France, and Mediterranean; South Africa, Seychelles, Ceylon, and Java Sea.

Family AMPELISCIDAE

Key to the species of Ampeliscidae

- | | |
|---|------------------------------|
| 1. Peraeopod 5, finger spiniform | <i>Byblis japonicus</i> |
| 1. Peraeopod 5, finger lanceolate | 2 |
| 2. Corneal lenses of two pairs | 3 |
| 2. Corneal lenses of one pair only | 6 |
| 3. Third pleonal epimeron bisinuate..... | <i>Ampelisca brevicornis</i> |
| 3. Third pleonal epimeron not bisinuate..... | 4 |
| 4. Antenna 1, peduncular article 2 subequal to article 1 in length..... | <i>Ampelisca bocki</i> |
| 4. Antenna 1, peduncular article 2 clearly longer than article 1..... | 5 |
| 5. Antenna 1 in female not very much shorter than antenna 2 | <i>Ampelisca miharaensis</i> |
| 5. Antenna 1 in female very much shorter than antenna 2 | <i>Ampelisca naikaiensis</i> |
| 6. Head produced into a broad rostrum..... | <i>Ampelisca cyclops</i> |
| 6. Head produced into a narrow rostrum | <i>Ampelisca misakiensis</i> |

Ampelisca brevicornis (COSTA)

(Fig. 4, 1)

Ampelisca brevicornis, WALKER 1904, p. 253; STEBBING 1906, p. 100; CHEVREUX 1911, 180; STEPHENSEN 1915, p. 43; K. H. BARNARD 1916, p. 132; CHEVREUX & FAGE 1925, p. 77, figs. 67-68; SCHELLENBERG 1928, p. 634; K. H. BARNARD 1932, p. 84; PIRLOT 1936, p. 277; K. H. BARNARD 1937, p. 148; SCHELLENBERG 1942, p. 146, fig. 119; REID 1951, p. 206, figs. 10-15 (with vars.); NAGATA 1959, p. 265, fig. 2; NAGATA 1960, p. 167.

Ampelisca sp. cf. *brevicornis*, DAHL 1945, p. 9, fig. 7.

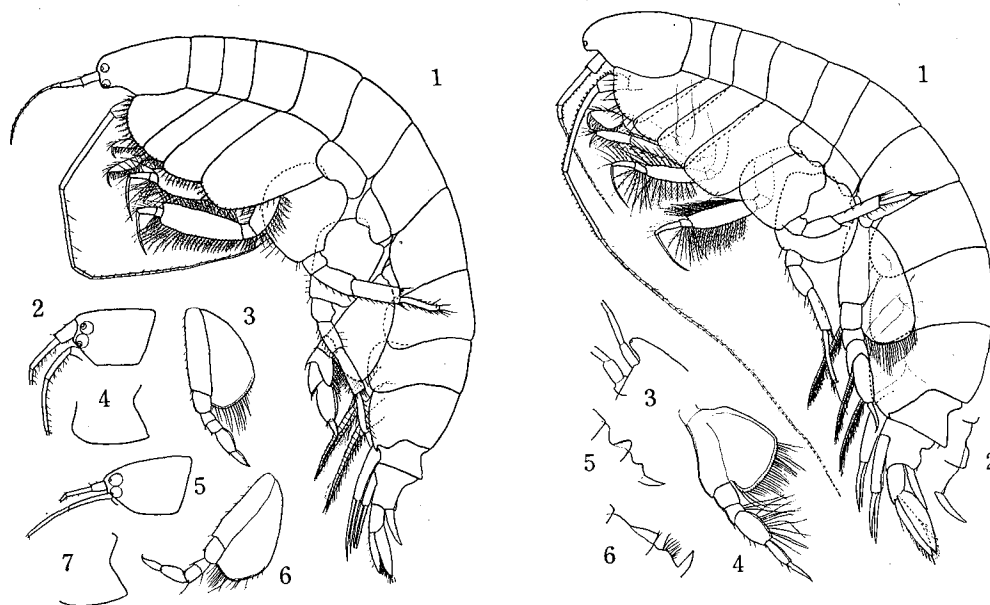
Ampelisca laevigata, SARS 1895, p. 169, pl. 59, fig. 1.

Material examined: Areas I (30), III (9), IV (105), V (84), X (250), XI-a (2117), XI-b (2162). Total: 4575 specimens, up to 12.0 mm in length; from depths of 5-53 m.

Remarks: The specimens at hand do not necessarily agree in details with DAHL's description for the material from Japan, and it is unable to find any qualitative differences between Japanese and European forms, except that the rami of uropod 3 more broader and the apices more rounded as seen in DAHL's

figure. This species is very common on the littoral sea bottom as seen in Tables 4 and 5, and often found in the stomachs of various benthos-feeding fishes taken from all over the areas of Seto Inland Sea.

Distribution: Northerly from Lofoten Is., along European coasts, to the West and South Africa; into Mediterranean, through Red Sea, Gulf of Aden, the coast of East Africa, to Ceylon, Java Sea, and Japan.



(Fig. 4)

(Fig. 5)

Fig. 4. *Ampelisca brevicornis* (COSTA) : 1. *Ampelisca miharaensis* NAGATA : 2-4. *Ampelisca naikaiensis* NAGATA : 5-7. (1, lateral view ; 2, 5, head and peduncle of antennae ; 3, 6, fifth peraeopod ; 4, 7, third pleonal epimeron).

Fig. 5. *Ampelisca cyclops* WALKER : 1, lateral view of male ; 2, female dorsal profile of urosome. *Ampelisca misakiensis* DAHL : 3, front of head ; 4, fifth peraeopod ; 5, 6, male and female dorsal profile of urosome respectively.

Ampelisca cyclops WALKER

(Fig. 5, 1-2)

Ampelisca cyclops WALKER 1904, p. 253, pl. 2, fig. 14 ; STEBBING 1906, p. 722 ; PILOT 1936, p. 280 ; K. H. BARNARD 1937, p. 149.
Ampelisca iyoensis NAGATA 1959, p. 274, figs. 9-11.

Material examined: Areas IV (2), XI-a (6), XI-b (31); up to 12.8 mm in length; from depths of 10-53 m.

Remarks: WALKER described the female specimens of this species from

Ceylon, and my female specimens well agree with WALKER's ones, except for the minor details. WALKER says that the head has "2 large confluent crimson spots" at the anterior edge, therefore the corneal lenses are probably not one but two; in the present specimens the pigments of the spots soon fade out in spirits, but the lenses are usually outlined by red pigments for a long time. Antenna 1, the peduncle has the ratio of raticle 2 to article 1 considerably variable in length; in female about 1.5-2.0, in male 2.0 or more. Antenna 2, the peduncular article 4 in both sexes fully longer than article 5. The difference of dorsal profile of pleon segment 4 in both sexes is figured here. And now, I am unable to distinguish qualitatively the present specimens from WALKER's material from Ceylon. It is pretty sure that *A. iyoensis* designated by myself in 1959 is a synonym of *A. cyclops* WALKER.

Distribution: Gulf of Oman, Ceylon, East Indies, and Japan.

Ampelisca bocki DAHL

Ampelisca bocki DAHL 1945, p. 2, figs. 1-3; NAGATA 1959, p. 274.

Material examined: Areas I (2), III (1), IV (18), V (9), X (1), XI-a (269), XI-b (428). Total: 728 specimens, up to 11.0 mm in length; from depths of 10-56 m.

Remarks: This species is found by DAHL from Kōbe Bay, 12-15 m in depth, and is widely distributed on the littoral sea floor of the southern coasts of Japan as well as Seto Inland Sea.

Distribution: Known only from Japan.

Ampelisca misakiensis DAHL

(Fig. 5, 3-6)

Ampelisca misakiensis DAHL 1945, p. 6, figs. 5-6.

Material examined: Areas IV (14), XI-a (127), XI-b (275). Total: 416 specimens, up to 8.2 mm in length; from depths of 30-56 m.

Remarks: Only one female specimen of this species has been reported by DAHL from depths of 30-50 m, Misaki, Kanagawa Pref., and the difference of dorsal profile of urosome in both sexes is figured here.

Distribution: Known only from Japan.

Ampelisca miharaensis NAGATA

(Fig. 4, 2-4)

Ampelisca miharaensis NAGATA 1959, p. 266, figs. 3-5; NAGATA 1960, p. 168.

Material examined: Areas IV (4073), VI (8), VII (1), IX-d (1), XI-a (132),

XI-b (83). Total: 4298 specimens, up to 9.9 mm in length; from depths of 2 to 47 m.

Remarks: The enormous number of material from Mihara Bay (Area IV) are obtained at Sts. 6-8, which are deeper than 10 m in depth.

Distribution: Known only from Japan; Ariake Sea, and Nakaumi (Shimane Pref.) in other localities than the Seto Inland Sea.

Ampelisca naikaiensis NAGATA

(Fig. 4, 5-7)

Ampelisca naikaiensis NAGATA 1959, p. 270, figs. 6-8; NAGATA 1960, p. 168.

Material examined: Areas I (1), III (2), IV (70), XI-a (309), XI-b (141). Total: 523 specimens, up to 8.9 mm in length; from depths of 4-56 m; nearly all of the specimens from the soft bottom deeper than 10 m in depth.

Distribution: Known only from Japan; on the other coasts of Japan, found in Ariake Sea, and Tomioka Bay.

Byblis japonicus DAHL

(Fig. 6)

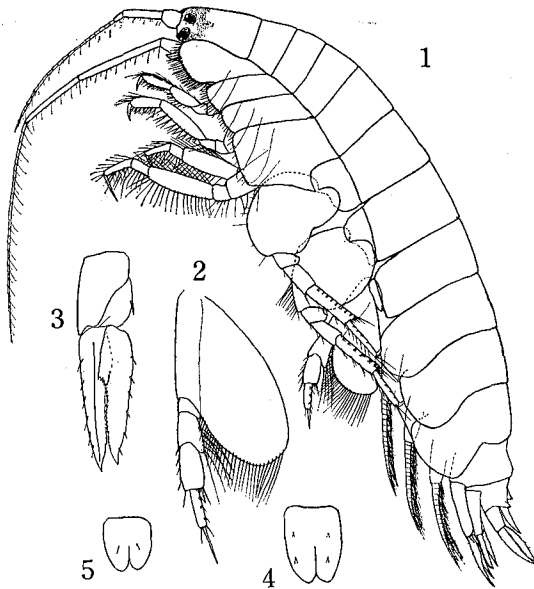


Fig. 6. *Byblis japonicus* DAHL: 1, lateral view; 2, fifth pereopod; 3, third uropod; 4, 5, telson of male and female respectively.

Byblis japonicus DAHL 1945, p. 14, figs. 8-10; NAGATA 1960, p. 168, pl. 13, figs. 19-23.

Material examined: Areas I (24), II (2), III (10), IV (3302), V (42), VI (45), VII (18), IX-b (6), IX-c (37), IX-d (21), XI-a (451), XI-b (263), XIII-b (1). Total: 4222 specimens, up to 10.0 mm in length; depths of *Zostera* belt near low-water marks to 56 m.

Remarks: This species is found by DAHL from depths 200-400 m off the coast of Misaki, Kanagawa Pref., and is also known by me from the inshore waters of several localities; Tōkyō Bay, Maizuru Bay, and the west coast of Kyūshū. It is one of the most popular inhabitants on a littoral sea bottom, at least, in the southern coast of Japan, together with the species of the genus *Ampelisca* (see Tables 4 and 5).

This species also appears very often from the stomachs of benthos-feeding fishes caught in Seto Inland Sea.

Distribution: Only known from Japan.

Family ARGISSIDAE

Argissa hamatipes (NORMAN)

(Fig. 7)

Argissa hamatipes, SARS 1895, pl. 48; WALKER 1904, p. 246; STEBBING 1906, p. 277; SCHELLENBERG 1927, p. 686, fig. 76; SHOEMAKER 1930, p. 255, figs. 15-16; GURJANOVA 1951, p. 327, fig. 193; STEPHENSEN 1940, p. 41; J. L. BARNARD 1962, p. 151; GURJANOVA 1962, p. 392.

Argissa stebbingi, STEBBING 1906, p. 277; CHEVREUX & FAGE 1925, p. 90, figs. 81-82; REID 1951, p. 220.

Material examined: Area XI-a, 3 female specimens; 4.0-5.0 mm in length; from depths of 39-49 m.

Remarks: The specimens are rather nearer to *A. stebbingi* form. Eyes truly with the typical structure of *A. hamatipes*. A vertical crest which separates both antennae in front of head, forms a thin plate of truncate shape above the epistome, and a emargination on either end of it, as just seen in SHOEMAKER's figure for *A. hamatipes* (l.c.), but the epistome triangularly more produced and reaching fully beyond the end of the second peduncular article of antenna 2. Coxa 1 postero-proximally expanded. Third pleonal epimeron like in SARS' figure. Mandibular palp proportionally longer than in *hamatipes* form, the third article twice as long as the second. The fifth peduncular article of antenna 2 obviously longer than article 3 as shown in *stebbingi* form. Outer ramus of uropod 3 without the minute second article, but somewhat constricted on one side near the acute apex as figured here. The other characters fully coincide with both *hamatipes* and *stebbingi*.

The above distinctive characters which have separated *stebbingi* from *hamatipes* seem to be pretty well represented also in SHOEMAKER's material of *hamatipes* from Gulf of St. Lawrence. As SHOEMAKER suggested in the paper of 1930, I am now unable to see any specific difference between these two species. The wanting of eyes of *stebbingi* in BONNIER's original description is probably no essential peculiarity; CHEVREUX & FAGE described the presence of eyes comprised of 4-8 facets in the specimens of *stebbingi*. In addition, WALKER reported the occurrence of *A. hamatipes* from Ceylon, and J. L. BARNARD says that *A. hamatipes* predominately inhabits in the shallow area of Southern California, though the species has been recorded from relatively deep cold temperate waters. Therefore, *A. hamatipes* shows a very wide distribution, from Arctic to tropical sea, and I believe that the two species are essentially conspecific.

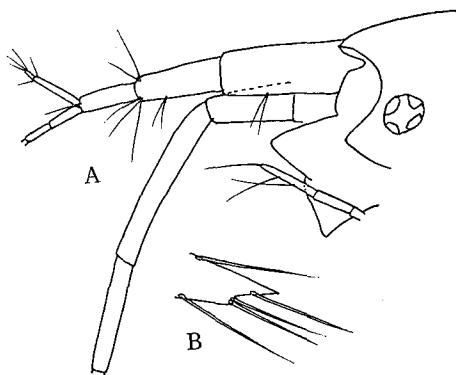


Fig. 7. *Argissa hamatipes* (NORMAN). Female, 4 mm : A, front of head and peduncular articles of antennae ; B, apex of outer ramus of uropod 3.

Distribution: From Baffin Bay through Gulf of St. Lawrence to Casco Bay, Maine; northerly from Kola Bay through Norwegian coast, Iceland, Shetland Scotland, Azores, Bay of Biscay, southerly to the west coast of tropical Africa; Bering Sea, Okhotsk Sea, Japan Sea, Southern California, and Ceylon.

Family HAUSTORIIDAE

Urothoe pulchella (COSTA)

Urothoe pulchella, STEBBING 1906, p. 130; CHEVREUX & FAGE 1925, p. 99, fig. 92; K. H. BARNARD 1916, p. 143; K. H. BARNARD 1955, p. 83, fig. 41-a.

Material examined: Area XI-b, 4 female specimens, 2.8-5.3 mm in length; from depths of 54-56 m.

Remarks: The specimens agree pretty well with the figures of this species given by CHDREUX & FAGE, except for gnathopod 1. A narrow shape of article 6 of gnathopod 1 is rather similar to that of *U. grimaldi* (CHEVREUX & FAGE 1925, p. 99, fig. 93). On the other hand, I have also some specimens assigned by myself to *U. grimaldi* from Tomioka Bay, the west coast of Kyūshū; the shape of the article 6 is, on the contrary, similar to that of *U. pulchella*. The specimens of *grimaldi* are, however, clearly distinguished from the present specimens of *pulchella* by the proportional lengths of peduncular articles of antenna 1, by the typical shape of peraeopod 3, and the relative lengths between articles 5 and 6 of peraeopod 4. In the specimens of *pulchella*, peraeopod 3 has also clear article 7 of the slender form not cultriform, and the front edge entirely smooth or much minutely crenulate.

The present specimens are also related to *U. orientalis* GURJANOVA (1951, p. 354, figs. 211, A-B) in the article 6 of gnathopod 1, but seem to be different from the latter in the structure of peraeopod 3, in the more broader article 5 of gnathopod 2, and in the size of eyes, which is large in his specimen, and similar both in male and in female.

Distribution: Scotland, west coast of France, Senegal, and Mediterranean.

Family PHOXOCEPHALIDAE

Key to the species of Phoxocephalidae

1. Eyes present.....*Paraphoxus oculatus*
1. Eyes absent 2
 2. Hooded rostrum deflexed at apex*Leptophoxus falcatus*
 2. Hooded rostrum not deflexed at apex*Harpinia miharaensis*

Paraphoxus oculatus (SARS)

Paraphoxus oculatus, SARS 1895, p. 149, pl. 51; STEBBING 1906, p. 137; STEPHENSEN 1925, p. 162; STEPHENSEN 1938a, p. 150; STEPHENSEN 1940, p. 20; GURJANOVA 1951, p. 364, fig. 215; J. L. BARNARD 1960a, p. 240, figs. 27-28.

Paraphoxus maculatus, CHEVREUX 1900, p. 34, pl. 5, fig. 5; STEBBING 1906, p. 138; CHEVREUX 1911, p. 187, pl. 10, figs. 12-13; CHEVREUX & FAGE 1925, p. 103, fig. 97.

Material examined: Areas IV (96), XI-b (1); 1.9-5.0 mm in length; from 10-56 m in depth.

Distribution: "West of Greenland to 71°N, the Kara Sea (97°N), along the Norwegian Coast, Iceland, East Greenland, around the British Isles, into Mediterranean eastward to Tunisia, at South Africa, Japan, and in the eastern Pacific." (J. L. BARNARD 1960a, p. 243).

Leptopoxus falcatus Sars

Leptopoxus falcatus, Sars 1895, p. 147, pl. 50; STEBBING 1906, p. 136; STEPHENSEN 1925, p. 161; STEPHENSEN 1938a, p. 150; J. L. BARNARD 1960a, p. 308.

Material examined: One male specimen, 2.5 mm long from Area IV; two specimens from the stomachs of fishes caught off the coast of Kōchi, Tosa Bay (June 6, 1958). Depth: 10-60 m.

Distribution: "Greenland, east and west coasts; Norway; North Sea; Skagerrak. Depth: 56 to 2258 m." (J. L. BARNARD 1960a, p. 308).

Harpinia miharaensis NAGATA

Harpinia miharaensis NAGATA 1960, p. 169, pls. 13-14, figs. 24-36.

Material examined: Areas I (1), IV (15), VI (12), XI-a (1), XI-b (1). Total: 30 specimens, up to 3.0 mm in length; from depths of 2-52 m.

Distribution: Known only from Japan. No specimens have been found in the area other than the Seto Inland Sea.

Family AMPHILOCHIDAE

Gitanopsis vilordes J. L. BARNARD

Gitanopsis vilordes J. L. BARNARD 1962, p. 131, fig. 6.

Material examined: Area IX-d, 10 specimens, up to 2.5 mm in length; from the surface water in high tide, at low-water mark.

Remarks: In gnathopod 2 of the present specimens, the stout spine were not seen at the postero-distal end of article 2, and also on the anterior margin of article 6. Otherwise they call for no remarks.

Distribution: Lower California, intertidal and subtidal.

Family LEUCOTHOIDAE

Key to the species of Leucothoidae

Third pleonal epimeron, the lower hind corner toothed.....*Leucothoe incisa*
Third pleonal epimeron, the lower hind corner rounded.....*Leucothoe alata*

Leucothoe incisa ROBERTSON

(Fig. 8)

Leucothoe incisa, STEBBING 1897, p. 35, pl. 10; STEBBING 1906, p. 167; CHEVREUX & FAGE 1925, p. 123, figs. 117, 120.

Material examined: Area VII, 3 specimens, 3.0-4.3 mm in length; 4.0 m in depth (St. 2), *Zostera* belt, mud; W.T. 9.8°C; Cl 18.16‰, Jan. 23, 1957.

Remarks: The only peculiar feature is that the third pleonal epimeron bears the double teeth at the lower hind corner, the lower one smaller, and the sinus above the large one not so deep as seen in European form. Otherwise, the specimens hold well with the characters hitherto been described.

Distribution: Scotland, Atlantic coast of France, Mediterranean, and ? West Africa.



Fig. 8. *Leucothoe incisa* ROBERTSON.
Sex ?, 3 mm : Lower posterior
corner of third pleonal epimeron.

Leucothoe alata J. L. BARNARD

(Figs. 9, 10)

Leucothoe alata J. L. BARNARD 1959c, p. 19, pl. 1.

Leucothoe minima (?), J. L. BARNARD 1952, p. 9, pl. 1.

Material examined: Areas XIII-a (3), XIII-b (1); up to 12.3 mm in length; depths of 2-4 m.

Remarks: The specimens comparatively well agree with J. L. BARNARD's description and figures, except for the following points: Article 4 in peraeopods 1-5 somewhat more robust and well developed. Coxa 1 not so broad at the antero-distal corner; coxa 4 in lateral view is poor in my drawing, and the actual shape is nearly straight or rather slightly concave at the frontal margin. Gnathopod 1, article 2 stout and robust, much expanded proximally in the larger specimens (11.0-12.3 mm long); article 6 not narrow at the proximal portion, but tapering towards the distal end. Uropod 3 with the peduncle much powerful, about 1.5 times as long as the rami. Telson more shorter and broader. Maxilla 2 in my specimens is typical as seen in Sars' figure of *L. spinicarpa* (1895, pl. 100); it may be unusual form in BARNARD's specimen.

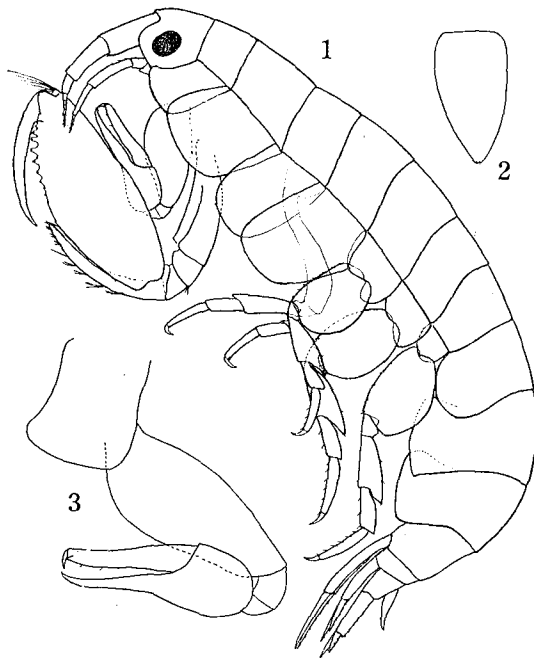


Fig. 9. *Leucothoe alata* J. L. BARNARD: 1, lateral view; 2, telson; 3, first gnathopod.

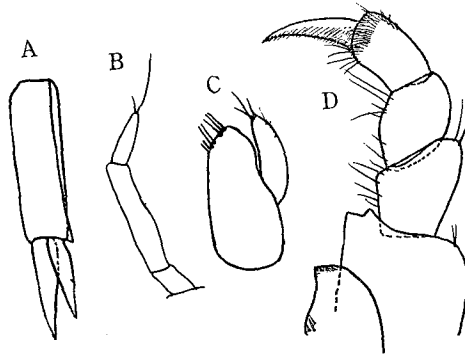


Fig. 10. *Leucothoe alata* J. L. BARNARD. Female ovig., 11 mm: A, uropod 3; B, mandibular palp; C, maxilla 2; D, maxilliped.

Unfortunately, I could not refer to SCHELLENBERG's description and figures of *L. minima* known from the tropical coast of West Africa. This species is also found by me from Tomioka Bay, the west coast of Kyūshū.

Distribution: California (Morro Bay and Newport Bay).

Family STENOTHOIDAE

Stenothoe gallensis WALKER

Stenothoe gallensis WALKER 1904, p. 261, pl. 3, fig. 19; WALKER 1909, p. 331; K. H. BARNARD 1916, p. 154; SCHELLENBERG 1928, p. 640; K. H. BARNARD 1937, p. 153; REID 1951, p. 228, fig. 27; J. L. BARNARD 1955, p. 3, fig. 1.
Stenothoe crenulata CHEVREUX 1907, p. 471, figs. 1-3.

Material examined: Areas IX-d (7), XII (19); up to 4.7 mm in length. Both collections taken from the surface water at depths of 3-10 m.

The specimens agree quite well with J. L. BARNARD's figures drawn from Hawaiian materials.

Distribution: Caribbean Sea (Puerto Rico), West and South Africa, Mediterranean, Red Sea, Zanzibar, Seychelles, Ceylon, and Pacific (Gambier Archipelago and Hawaiian Is.).

Family LILJEBORGIIDAE

Key to the species of Liljeborgiidae

1. Gnathopod 2 larger than gnathopod 1 2
1. Gnathopod 2 smaller than gnathopod 1 3
 2. Peraeopod 5, article 2 weakly serrate behind *Liljeborgia japonica*
 2. Peraeopod 5, article 2 deeply serrate behind *Liljeborgia serrata*
3. Gnathopod 1, finger in male abruptly curved *Idunella curvidactyla*
3. Gnathopod 1, finger in male evenly curved *Idunella chilkinsis*

Liljeborgia japonica, sp. nov.

(Figs. 11, 12)

Material examined: Areas IV (1), IX-b (1), X (16), XI-a (33), XI-b (1), XIII-a (2). Total: 54 specimens, 3.5-10.0 mm long; 2-53 m in depth.

Description: Pleon segments 1 and 2 each produced to three adpressed dorsal teeth, the middle one largest. Pleon segments 4 and 5 each with a small tooth, that of pleon segment 5 very small and often evanescent. Pleon segment 6 with one pair of dorso-lateral spine. Lateral lobes of head somewhat narrowly produced, its apex subacute. Eyes and antennae like in *L. pallida* figured by SARS (1895, pl. 187). Coxae 1-3 each with a minute tooth at the lower hind corner; coxa 4 with 2-4 minute teeth on the hind margin; the anterior lower margin of coxae 2-4 and the lower hind corner of coxae 5-6 also each with a minute notch or tooth; all the tooth or notch usually accompanied by a minute seta. Third pleonal epimeron with a small sinus above the lower hind corner tooth.

The inner plate of maxilla 1 with one or two setae, the second article of

maxillipedal palp relatively elongate, otherwise the oral parts nearly like in Sars' figures of *L. pallida*. Gnathopod 1: article 2 proximally wider; article 6 long and slender, more than twice as long as broad; the palm, along the most outside edge, with a row of spinules hooking at the tip; the median side bearing the edge lined with spine-like setae armed with 2 minute accessory teeth at the middle; article 7 with the inner edge entirely smooth.

Gnathopod 2: the palm roughly dentate near the hinge of the finger; the palm in male lined with many long setae throughout the margin; finger with

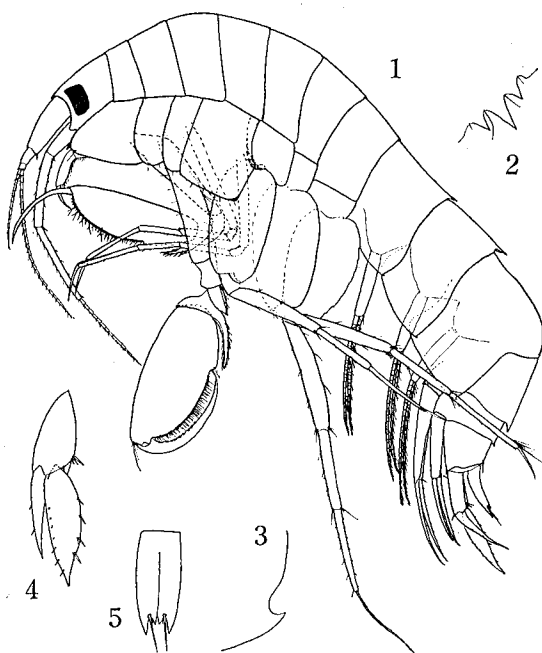


Fig. 11. *Liljeborgia japonica*, sp. nov. : 1, lateral view ; 2, upper view of dorsal teeth on first pleonal segment ; 3, lower hind corner of third pleonal epimeron ; 4, male third uropod ; 5, telson.

5-8 flattened teeth on the proximal half. Peraeopods 1 and 2 very slender and delicate, finger more than one half the length of article 6. Peraeopod 5: article 2 distally narrow; article 5 subequal to or shorter than article 4, in male the article 5 rather longer; finger normally longer than article 6, but often broken off. Uropod 3: inner ramus longer than the outer, in male much wider than in female. Telson more than twice as long as broad, the apices bidentate, the outer point much longer than the inner, each of the notches with a strong spine. Color tinted with pale pink, particularly on peraeon segments 2-4 and pleon segments 1-3.

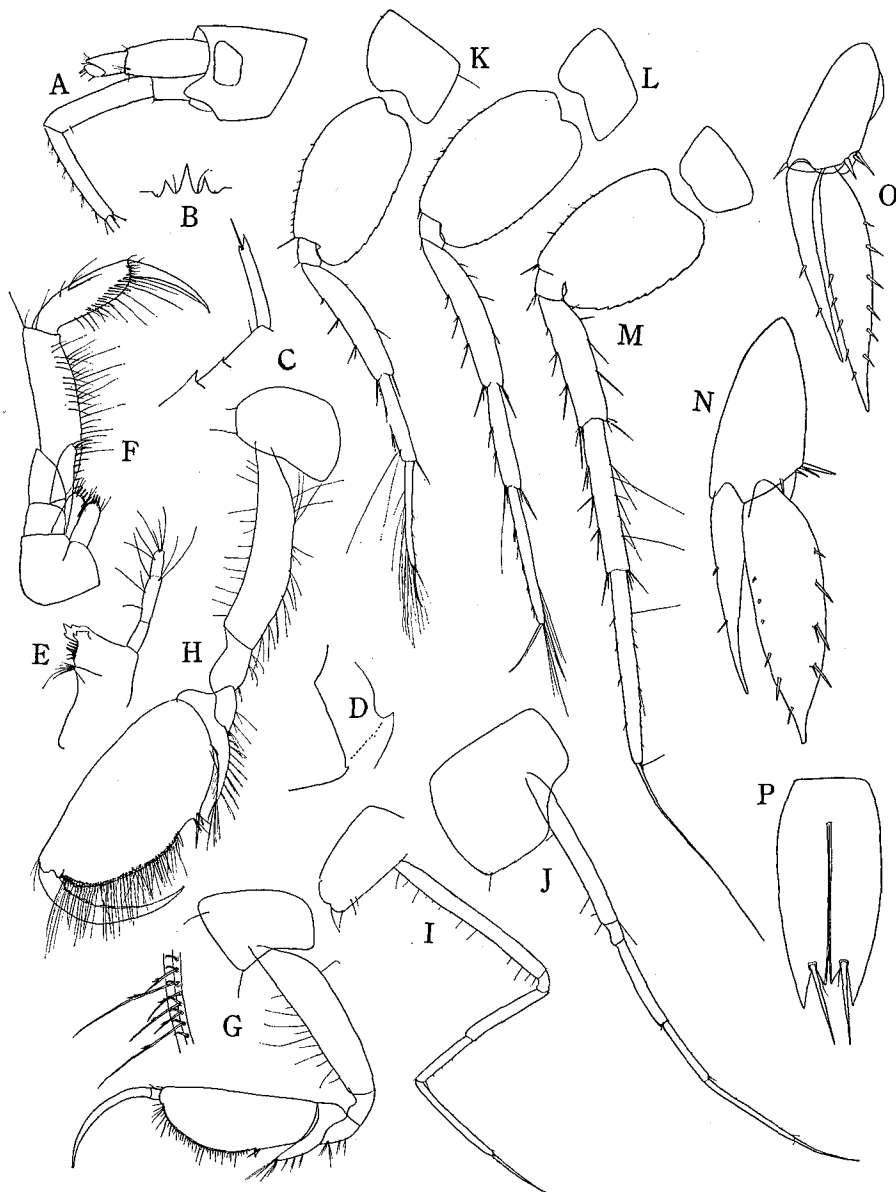


Fig. 12. *Liljeborgia japonica*, sp. nov. Male, 8 mm : A, head and peduncular articles of antennae ; B, dorsal teeth of pleon segment 1 from upper view ; C, lateral view of pleon segments 4-6 and telson ; D, third pleonal epimeron ; E, Mandible ; F, maxilliped ; G, gnathopod 1, with palmar armature magnified ; H, gnathopod 2 ; I, J, K, L, M, peraeopods 1, 2, 3, 4, 5 ; N, uropod 3 ; P, telson. Female, ovig., 7 mm : O, uropod 3. G-M : the same proportion of magnification.

Holotype: KN No. 3104, male, 8.8 mm. *Type locality*: St. 7 in Area XI-a, 47-51 m, sandy mud, June 13, 1959.

Remarks: The new species is in general appearance too much closely related to *L. brevicornis* which is figured by Sars for *L. pallida*, except for the dorsal dentation; each of pleon segments 1 and 2 in the latter has only a dorsal tooth. In discussing *L. aequabilis* which is also much closely allied to *L. brevicornis*, STEBBING says on the value for specific distinction attributed to the difference of dorsal dentation, "the question exercised a soporific influence on my mind" (1910, p. 588). This question has also much annoyed me for a long time in identifying the present Japanese form.

If this Japanese form was not designated as a new species, it would have been assigned to any of the known ones having a close resemblance to *L. brevicornis*: *L. aequabilis* STEBBING, *L. proxima* CHEVREUX, *L. octodentata* SCHELLENBERG, and *L. brevicornis* (BRUZELIUS). *L. octodentata* is found from the neighboring waters of Falkland Is., and it is geographically far distant from Japan. *L. proxima* identified by SCHELLENBERG (1938, p. 31, fig. 15) from Marshall Is. shows a fairly divergence from a typical form of *proxima* designated as a new one by CHEVREUX (1907, p. 475, figs. 4-5) from Gambier Archipelago, South Pacific. K. H. BARNARD suggests in his paper of 1916 (p. 167) that his South African specimen referred to *L. proxima* may possibly be a synonym of *L. aequabilis*.

In my specimens, gnathopod 2 is never excavated on the palm unlike in *L. aequabilis* (STEBBING 1910, p. 558; K. H. BARNARD 1930, p. 364; HURLEY 1954, p. 786). CHILTON's material referred to *L. brevicornis* from South Australia (Bass Strait) (CHILTON 1921, p. 64) is undoubtedly the same species as *L. aequabilis* by STEBBING. PIRLOT's specimens of *aequabilis* from Sulu Sea, Philippines (PIRLOT 1936, p. 301) bear four setae on the inner plate of maxilla 1, and show a considerable difference from the typical form of *aequabilis*. It is strange that Australian *aequabilis* by STEBBING and CHILTON is somewhat different from New Zealand one by K. H. BARNARD and HURLEY. The dorsal teeth is absent in the former, whereas, in the latter K. H. BARNARD discerns three minute denticles only on pleon segments 1 and 2, and in HURLEY materials it is arranged as 3, 3, 0, 1, 1 in order of pleon segments 1-5. As far as the arrangement of dorsal teeth is concerned, the present new one is certainly allied to *L. aequabilis* described by HURLEY.

After a long period of consideration about a question which annoyed me much, I made up my mind to accept the importance of the specific value of dorsal dentation for avoiding a confusion in the identification of the species in this genus.

SCHELLENBERG says in his paper of 1931 (p. 129, as to *L. octodentata*), "Die abweichende Bezahnung des I und II Metasomsegmentes kommt im Habitus

nicht zum Ausdruck. Die dorsale Bezählung ist schon bei dem 2.5 mm langen Exemplar deutlich ausgebildet." In the materials at my hand, the dorsal dentation on pleon segments can be distinctly discerned even in small specimen of 3.5 in length. According to the pleonal tooth formulas given by J. L. BARNARD (1962, p. 86, table 1) to 26 species hitherto been reported of the genus, the species bearing the arrangement of the dorsal teeth number as 3, 3, 0, 1, 1 in order of pleon segments 1 to 5, are limited to the following seven ones:

<i>L. kinahani</i> (BATE) 1862	<i>L. macrodon</i> SCHELLENBERG 1931
<i>L. aequabilis</i> STEBBING 1888	<i>L. longicornis</i> (SCHELLENBERG) 1931
<i>L. mixta</i> SCHELLENBERG 1925	<i>L. akaroika</i> HURLEY 1954
<i>L. octodentata</i> SCHELLENBERG 1931	

The present new one is distinguished from any of the above species by the following characters: The male gnathopod 2 is densely lined along its palm by long setae; the inner edge of finger of gnathopod 1 is entirely smooth in all of the specimens ranging from 3.5 to 10.0 mm in length; and peraeopod 5 has much long finger. It should be noted that the new species agrees with *L. barhami* HURLEY (1954, p. 798, figs. 184-201) in having no teeth on the finger of gathopod 1, and agrees with *L. macronyx* (SARS) (SARS 1895, pl. 188, fig. 2; STEBBING 1906, p. 231) in having a long and slender finger of peraeopods 1 and 2, and also with *L. proxima* CHEVREUX (l.c.) in having a very long finger in peraeopod 5.

Liljeborgia serrata, sp. nov.

(Fig. 13)

Material examined: Areas IV (19), VI (5), XI-a (10), XI-b (2). Total: 36 specimens, 4.2-13.0 mm, from depths of 5-53 m.

Description: Pleon segments 1 and 2 each with three adpressed dorsal teeth, the middle one the largest. Pleon segments 4 and 5 dorsally elivating and carinate, each produced to an acute tooth on the posterior end. Pleon segment 6 with one pair of dorso-lateral spines, and the hinder end produced backwards to the rounding lateral lobes. Pleon segment 3 dorsally unarmed, the epimeron with a tooth at the posterior lower corner, sinuated above, the hind margin slightly convex. Coxae like in the preceding species, except that coxa 7 is lined with many minute notches on the hind margin. Lateral lobes of head more broadly produced than in the preceding species, its apex rounding. The shape of eyes and antennae like in the preceding one. The first article of mandibular palp rather longer than the second; the outer lobes of lower lip with a minute spine at apex: the inner plate of maxilla 1 with one or two long setae; otherwise, the oral parts like in *L. pallida* figured by SARS.

Gnathopod 1, article 6 not so slender as that of the preceding species, article 7 with 5 flattened teeth. Gnathopod 2 with the palm of article 6 finely dentate, lined with many blunt small denticles partly or through the length; finger with 9 teeth along the proximal two thirds; gnathopods 1-2 otherwise like those of the preceding one. Peraeopods 1-2 also like in the preceding one. Peraeopods 3 and 4: article 2 oblong oval, the hind margin nearly straight and distinctly serrated, the lower edge of the hind lobe truncated; article 4 the largest of the last four articles; finger normal. Peraeopod 5: article 2 more expanded, rounding oval, the hind margin deeply serrate, the lower edge truncated; article 4 subequal in length to article 5 in female, in male article 5 rather longer than article 4; finger stiliform, about five sixths as

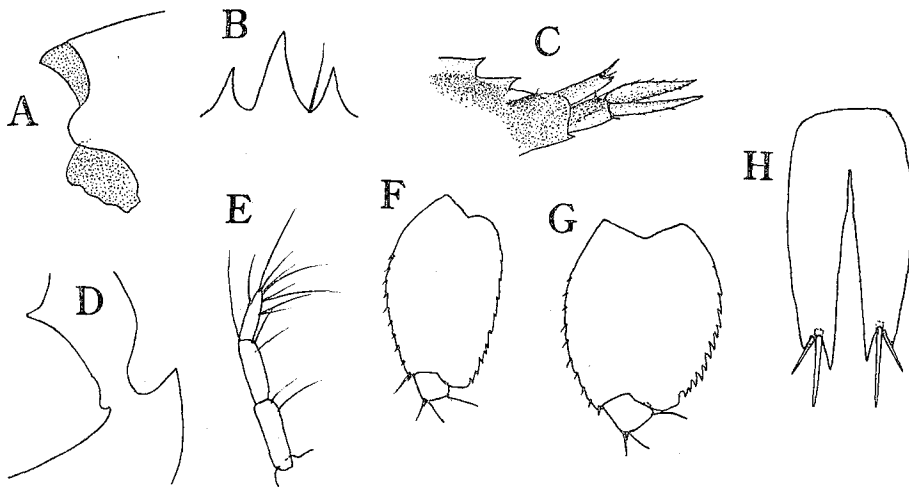


Fig. 13. *Liljeborgia serrata*, sp. nov. Female, ovig., holotype, 13 mm : A, lateral lobe of head. Female, ovig., 10 mm : B, upper view of dorsal teeth on pleon segment 1 ; C, lateral view of pleon segments 4-6, telson, and uropod 3 ; D, third pleonal epimeron, with the corner magnified ; E, mandibular palp ; F, G, article 2 of peraeopods 3 and 5 ; H, telson.

long as article 6 (often broken off). Uropod 3, inner ramus subequal in length to and wider than the outer. Telson, the apices with the inner point longer than the outer contrary to those of the preceding species, each notch with two or three spines. Color reddish, particularly with transverse bands of deep red.

Holotype: KN No. 3006, female, ovig., 13.0 mm. *Type locality*: St. 8 in Area IV, 20-25 m, sandy mud, June 15, 1956.

Remarks: The new species appears to show no prominent sexual differences, and is fairly related to *L. macrodon* SCHELLENBERG (1931, p. 133, fig. 71), which is found from the neighbouring waters of Magellan Strait, South America, but is here distinguished from the latter by the following differences;

The oral parts in *macrodon* are said to be similar to *L. pallida*, except for upper lip, but in my specimens the first article of mandibular palp is usually broader and longer than the second, and the outer lobes of lower lip has a minute spine at each apex, just as seen in that of *Paradexamine barnardi* herein described. The posterior end of pleon segment 6 in *macrodon* is acutiform. The apices of telson in *macrodon* is contrary to those of the present new species, i.e. the outer point longer than the inner. As far as gnathopod 2 described and figured by SCHELLENBERG is concerned, the shape of article 2 in *macrodon* appears to show a sexual difference although there is a disparity in the size of the specimens, moreover, the armature of the palm and palmar angle are somewhat different in minor details; in the new one the palm finely dentate, and the palmar angle has a short spine at the concavity and has long and short two spines at the median side a little backwards; the shape of article 6 of gnathopods 1 and 2 also seems to somewhat differ from the new species.

Peraeopods 3 and 4, the posterior edge of article 2 in the new one is not so deeply serrate as that of peraeopod 5. The new species also somewhat differs from *macrodon* both in the proportional lengths between article 4 and article 5 of peraeopod 5, and in the length of finger of peraeopod 5. Both species are, however, essentially very near to each other, and I am not quite certain whether the present new species is entirely distinctive from *L. macrodon* or not. But no specimens of *L. macrodon* have been found from any other localities than Magellan sea-area, and so I would like to designate the Japanese specimens as a distinct species from the SCHELLENBERG's species recorded in the locality far distant from Japan.

Idunella chilensis CHILTON

Idunella chilensis CHILTON 1921a, p. 525, fig. 1.

Material examined: Areas XI-a (3), XI-b (1); 5.6-5.9 mm in length; from depths of 10-53 m.

Remarks: In the specimens at my hand, antenna 1 in female a little shorter than antenna 2, while in male antenna 2 much longer than antenna 1, about twice in length; peduncular article 1 of antenna 1 in both sexes stouter and a little longer than article 2; primary flagellum of antenna 1 in both sexes shorter than the peduncle. On the contrary, CHILTON's specimens have the first antenna in male longer than the second, and have the peduncular article 2 of antenna 1 in female longer than article 1. Telson in my specimens more longer, about 2.5 times as long as broad. Otherwise, the present ones appear to agree quite well with his ones, particularly with the characteristic feature of male gnathopod 1, and therefore I could not consider these

specimens to be entirely distinctive from *I. Chilensis*. However, it is strange that CHILTON's specimens is contrary to the present ones in regarding to the relative lengths between the first and second antennae in male.

Distribution: Chilka Lake, India.

Idunella curvidactyla, sp. nov.

(Fig. 14)

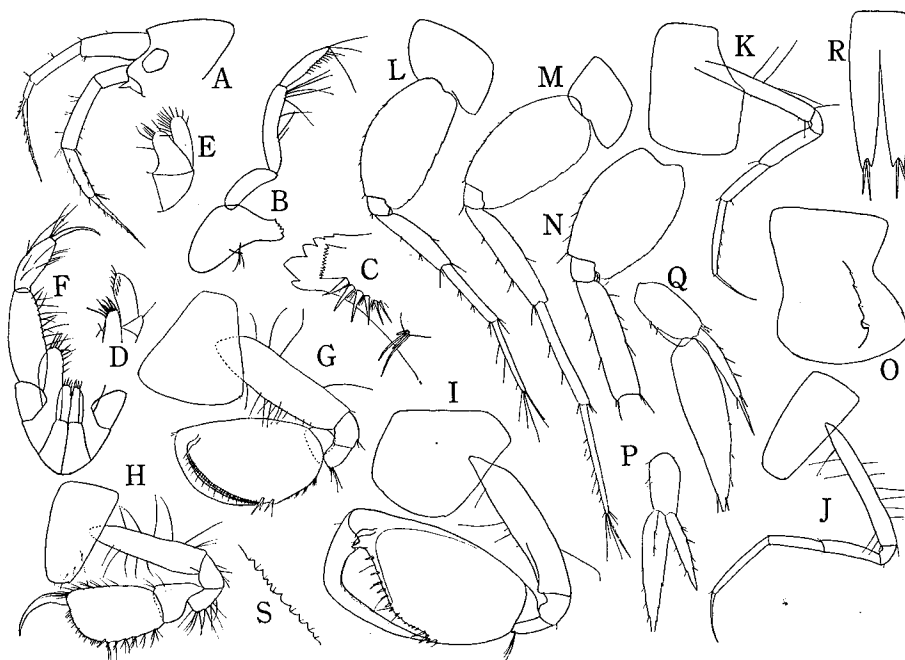


Fig. 14. *Idunella curvidactyla*, sp. nov. Female, 5 mm : A, head and antennae ; B, mandible ; C, distal half of right mandible magnified ; D, E, maxillae 1, 2 ; F, maxilliped ; G, H, gnathopods 1, 2 ; J, K, L, M, N, peraeopods 1, 2, 3, 4, 5 ; O, pleon segment 3 ; P, uropod 3 ; R, telson ; S, dorsal denticles of pleon segment 2 from upper view. Male, 6 mm : I, gnathopod 1 ; Q, uropod 3.

Material examined: Areas I (5), X (1), XI-a (14); up to 6.3 mm in length, from depths of 15-56 m

Description: Pleon segments 2-4 more or less minutely serrate on the posterodorsal edge respectively. Each of coxae 1-3 with a small tooth at the lower posterior corner. The third pleonal epimeron armed with a small tooth at the lower posterior corner, forming a small sinus above; the slightly convex posterior edge minutely serrate along the half below. Eyes oval,

narrowing below (my drawing in the figure is poor). Antenna 1 subequal in length to antenna 2, peduncular article 1 slightly longer than article 2, article 3 very short, accessory flagellum 2-jointed. Antenna 2 with peduncular article 5 shorter than article 4. The above characters of antennae nearly similar in both sexes. Mandibular palp fully elongate, geniculated between articles 1 and 2; article 1 relatively long, nearly as long as article 3. Inner plater of maxilla 1 with two setae. Gnathopod 1 in male more powerful than in female, and much larger than gnathopod 2; in female nearly like in the preceding species, but in male the palm sharply turned at the middle, lined with a row of short spines, and bearing an acute tooth near the finger hinge, finger strongly developed, abruptly and right-angularly curved. Gnathopod 2 typical, similar in both sexes. Peraeopods 3-5 successively larger, their article 2 rather slender than the type, the posterior edge minutely serrate. Uropod 3 with inner ramus longer than the outer, particularly in male powerful, much longer and broader, the outer bearing the slender second article (or spine?). Telson slender, more than twice as long as broad, the outer point of the bidentate apices longer than the inner, each notch armed with two long spines.

Holotype: KN No. 2978, male, 6.3 mm, from St. 3 of Area XI-a, 40-45 m, June 12, 1959.

Remarks: Three species of this genus have hitherto been in the world, i.e. *I. aequicornis* (SARS), *I. chilkinsis* CHILTON, and *I. longirostris* (CHEVREUX). The new species is obviously distinguished from the above-mentioned ones by the characteristic male gnathopod 1.

Family OEDICEROTIDAE

Key to the species of Oedicerotidae

1. Gnathopod 2 chelate *Pontocrates altamarinus*
1. Gnathopod 2 subchelate..... 2
 2. Gnathopod 2, article 5 produced into a long slender posterior lobe.....
..... *Monoculodes limnophilus japonicus*
 2. Gnathopod 2, article 5 not produced into such a lobe at all *Bathymedon longimanus*

Pontocrates altamarinus (BATE & WESTWOOD)

Pontocrates altamarinus, SARS 1895, p. 695, suppl. pl. VII, fig. 2; STEBBING 1906, p. 240; SCHELLENBERG 1942, p. 178, fig. 147; NAGATA 1960, p. 170, pl. 14, figs. 37-45.

Pontocrates arenarius, CHEVREUX & FAGE 1925, p. 166, fig. 167.

Material examined: Areas I (2), III (5), IV (108), VI (88), VII (132), IX-b (47), IX-c (10), IX-d (17), X (48), XI-a (991), XI-b (163), XIII-b (22). Total: 1633 specimens, up to 11.0 mm in length; from depths of low-water marks in spring tide to 56 m.

Distribution: European coasts (S. and N. coasts of Norway, Skagerrak, Kattegat, Dogger Bank, Netherlands, British Is., Atlantic coasts of France).

Bathymedon longimanus (BOECK)

Bathymedon longimanus, Sars 1805, p. 333, pl. 117; STEBBING 1906, p. 257; SHOEMAKER 1930, p. 273, figs. 24-25; GURIANOVA 1951, p. 552, fig. 336.

Material examined: Areas XI-a (330), XI-c (16); up to 6.0 mm. in length; from depths of 30-56 m.

Remarks: Comparing the specimens with Sars' figures, I can find only the following minor differences: Coxa 1 with the lower margin more rounded as seen in SHOEMAKER'S figure; antenna 1, the first peduncular article slightly longer than article 2; gnathopod 2, articles 5 and 6 somewhat more slender; telson rather similar to the shape of SHOEMAKER'S one, the apex truncated, with two short spines and two long setae; peraeopod 3 with the article 2 proximally more expanded; article 7 of peraeopod 5 sometimes about as long as article 6.

Distributions: Franz Josef Land, Barents Sea, Norwegian coasts, Iceland, W. of Greenland, Gulf of St. Lawrence, North Sea, and Japan Sea.

Monoculodes limnophilus japonicus, subsp. nov.

(Fig. 15)

Material examined: Area V, 23 specimens, up to 5.4 mm in length; 2.9-3.7 m in depth.

Description: The specimens are divergent from the type described by TATTERSALL (1922, p. 440, pl. 18, figs. 10-20) in the following respects: The second pleonal epimeron with the posterior lower corner not rounded, a little produced backwards; the margin of the three pairs of the epimera lined with setae; the lower margin of the last two pairs of epimera not evenly rounded. Coxa 2 of equal breadth; coxa 4 with the lower hind corner more strongly produced backwards. The penultimate article of the peduncle of antenna 2 nearly equal to the ultimate in length. Article 2 of gnathopods 1-2 and peraeopod 2 not so slender and longer. Article 7 of peraeopods 1-2 extremely small, just as seen in those of *M. carinatus*, almost less than a half the length of that figured by TATTERSALL throughout all of my specimens, while those of peraeopods 3-4 well developed, about two thirds as long as article 6, bearing a nail-like cap at the distal end. Article 2 of peraeopod 5 nearly quadrate. Uropods 1-2, the rami almost equal, the inner only slightly longer than the outer, and on the contrary, those of uropod 3 with the outer only slightly longer than the inner. Telson slightly tapering towards the

distal end which bears two long setae on the edge. These specimens, otherwise, hold fairly well for TATTERSALL's description and figures.

Holotype: KN No. 2430, female, 5.4 mm from the mouth of the River Ōta, Oct. 20, 1956.

Remarks: The new subspecies could not be considered to be quite distinct species from Tattersall's one because of the entire agreement of the structure of the first and second gnathopods, although his species was taken

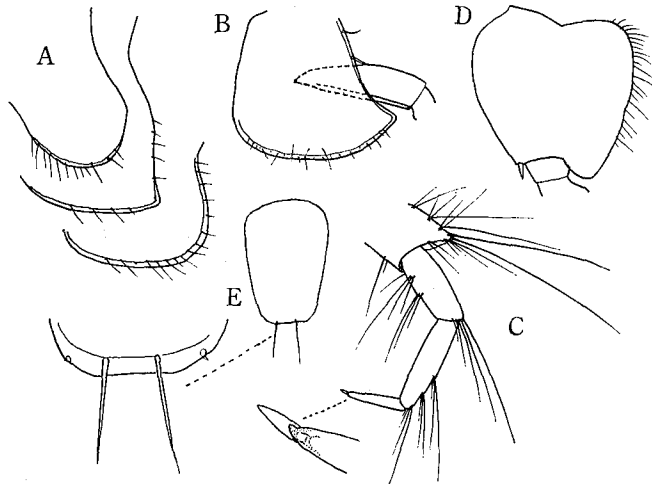


Fig. 15. *Monoculodes limnophilus japonicus*, subsp. nov. Female, holotype, 5.4 mm : A, plegnal epimera ; B, coxa 4 ; C, distal end of peraeopod 4, with the apex of finger magnified ; D, article 2 of peraeopod 5 ; E, telson, with the apical edge magnified.

from the fresh waters of China, whereas this was procured from the brackish waters of the river. The new one has a certain coincidence both with *M. synophthalmus* BULYCHEVA (1952, p. 209, Fig. 11) and with *M. uncinatus* BULYCHEVA (1952, p. 211, fig. 12), each from the Russian side of Japan Sea, but the former shows a different structure of gnathopod 2, the latter differs in gnathopod 1 from the present subspecies respectively.

(To be continued)

STUDIES ON MARINE GAMMARIDEAN AMPHIPODA
OF THE SETO INLAND SEA. II

KIZÔ NAGATA

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With 11 Text-figures

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Systematics (With Figs. 16-26)

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Family SYNOPIIDAE

Synopia ultramarina DANA

Synopia ultramarina, STEBBING 1906, p. 271; SCHELLENBERG 1926, p. 341; K. H. BARNARD 1930, p. 367; PIRLOT 1936, p. 301.

Synopia scheeleana, STEBBING 1888, p. 799, pl. 52; STEBBING 1906, p. 272; WALKER 1909, p. 332; REID 1951, p. 233.

Synopia orientalis, STEBBING 1906, p. 273.

Material examined: Area IX-d, 84 specimens, up to 5.0 mm in length; from many plankton collections at night.

Distribution: Atlantic (42° N to 18° S), Red Sea, Indian Ocean (Amirante, and Cargados), East Indies seas, and Pacific (34°29' N, 138°34' E).

Family TIRONIDAE

Syrrhoites pacificus, sp. nov.

(Fig. 16)

Material examined: Many specimens from the stomachs of benthos-feeding fishes caught extending over Bungo Suidō and Tosa Bay, September 1957 to August 1958, 20–100 m in depth. Length: 3.2–6.0 mm.

Description: Dorsally carinate, but not prominent throughout, posterior elevation usually raised from peraeon segment 5 or 6 (from the segment 2 in a small specimen of 3.2 mm long, figured here). Pleon segments 4–6 in male just like in *S. serrata* figured by Sars (1895, pl. 137). Head; rostrum

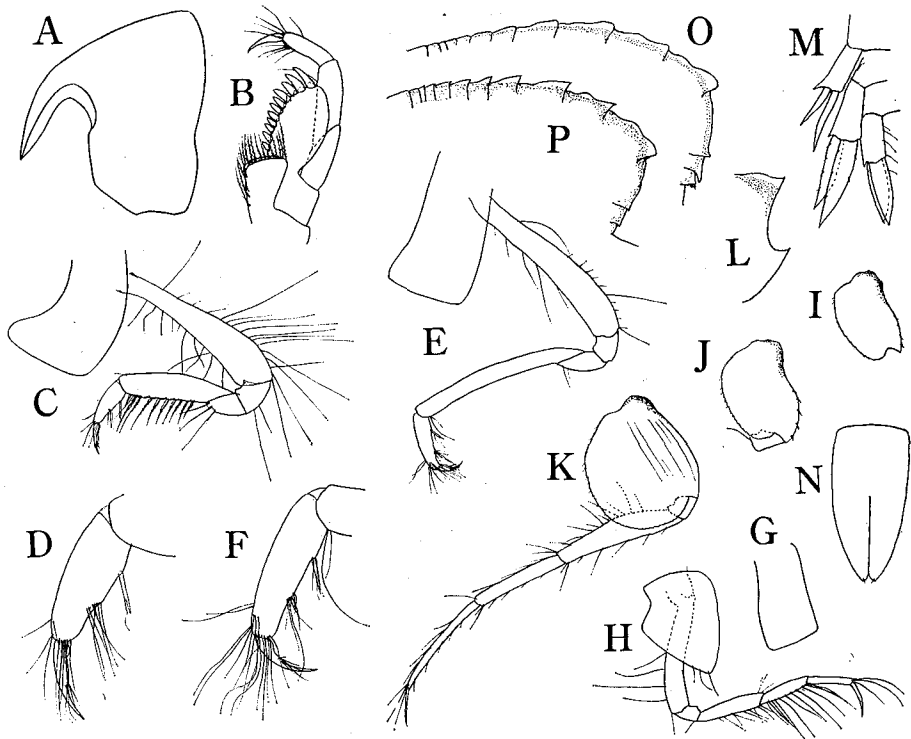


Fig. 16. *Syrrhoites pacificus*, sp. nov. Female, holotype, 6 mm: A, head; B, maxilliped; C, D, gnathopod 1 and its article 6 further enlarged; E, F, gnathopod 2 and its article 6 magnified; G, coxa 3, right; H, peraeopod 2; I, J, article 2 of peraeopods 3, 4; K, peraeopod 5; L, epimeral plate 3; M, uropods 1–3; N, telson. O, P, dorsal profile of male, 5.0 mm and female, 3.2 mm respectively.

strongly deflexed, extending to the end of the first peduncular article of antenna 1, lateral lobes somewhat slightly angular. Peraeon segment 2 very short. Coxa 1 produced forwards below; coxa 4 comparatively broad, nearly as deep as coxa 3. Third pleonal epimeron with the hind corner produced to an acutely upturned tooth, the margin above evenly concave, not serrate.

Antenna 1 in female, the second peduncular article nearly as long as the first, about 1.5 times as long as the third, flagellum shorter than peduncle,

accessory flagellum 2-jointed; in male the first peduncular article about as long as the second and third combined, flagellum longer than peduncle, with 8 joints, the first setose, as long as the following three articles combined, accessory flagellum 3-jointed, the first long, the third short. Antenna 2 in female typical, flagellum 7-jointed; in male the peduncular article 5 nearly 1.5 times as long as the article 4, flagellum much longer, filiform, nearly reaching to the end of the animal. Mandible: cutting edge conical, not dentate; article 3 of palp about as long as article 1. Maxilla 1: inner plate with 8 setae, outer with 11 spines. Maxillipeds: outer plate fringed with 11 spine-like teeth; article 4 of palp relatively long.

Gnathopod 1: article 2 distally widening, article 5 rather broad, more than twice as long as article 6, spinose on the hind margin, article 6 narrow, without a sharply distinctive palm, the hind margin with a strong spine at one third the length from the proximal end. Gnathopod 2 much slender, article 5 extremely long, about three times as long as article 6, of which both margin nearly parallel all along in both sexes, the hind margin with a strong spine at one third the length from the proximal end. Peraeopods 1 and 2: article 4 relatively long; article 7 also long and slender. Peraeopods 3-5: article 2 with the upper front corner a little carinate; article 2 of peraeopod 5 fully expanded nearly to the rounding form, the hind edge minutely serrated, article 4 considerably long. Uropod 1 much shorter than the others; uropod 2 reaching beyond the others, with outer ramus only slightly shorter than the inner; uropod 3 relatively short, bearing the rami subequal in length; rami of uropods 2-3 broadly lanceolate; outer ramus of uropod 3 probably not 2-jointed. Telson nearly or quite reaching the end of uropod 3, cleft slightly beyond the center, apices subacute, minutely notched, each bearing one setule.

Holotype: KN No. 3450, female, 6.0 mm, Bungo Suidō, Sept. 23, 1957.

Remarks: Although all the specimens are taken only from the stomachs of fishes, their exoskeleton of cutin is well preserved, and fully of use for examination. The above-mentioned characters are, therefore, trustworthy for their taxonomical features. The new species has some remarkable coincidences with *S. pusillus* ENEQUIST (1949, p. 338, figs. 57-60) from Skagerrak, in the conditions of uropods, third pleonal epimeron, lateral lobes of head, slender form of finger of peraeopods 1-2, and gnathopods 1-2, but the boundary of both species is here defined by the following differences: In his specimens, dorsal carinae more acutely armed, rostrum more sharply and right-angularly deflexed, the posterior edge of article 2 of peraeopods 3-5 more sharply serrated, while in the new species coxa 1 with the antero-distal corner strongly produced forwards, coxa 4 more broader and deeper, nearly as long as coxa 3, gnathopod 1 with article 5 comparatively long, peraeopods

1-5 with article 4 relatively long, article 2 of peraeopod 5 more rounding, and madibular palp with articles 1 and 2 relatively long, ratio of articles 1, 2 and 3 as 2:3:2.

Family CALLIOPIIDAE

Leptamphopus novaezealandiae (THOMSON)

Leptamphopus novaezealandiae, STEBBING 1906, p. 294; CHILTON 1920 (part, only in New Zealand specimens), p. 1, figs. 1-5.

Pherusa novaezealandiae THOMSON 1879, p. 239, pl. 10-c, fig. 2 (part, mixed with *Panoploea spinosa*).

Panoploea debilis THOMSON 1880, p. 3, pl. 1, fig. 3.

Material examined: Area IV (1), VII (2), XI-a (3); 2.8-4.0 mm in length; from depths of *Zostera* belt near low-water marks to 49 m.

Remarks: The specimens agree well with THOMSON'S figure for *Panoploea debilis*, and also with K. H. BARNARD'S details and figures given for some New Zealand specimens of *L. novaezealandiae* collected by CHILTON (1932, p. 162, fig. 95). However, BARNARD did not give any information concerning the oral parts of the specimens, therefore the characters have not been still known.

In the specimens at hand, the oral parts are well allied with those of *Oradarea longimana* (BOECK) figured by SHOEMAKER (1930, p. 299, figs. 35-37), particularly both with the shape of mandibular palp and with lower lip bearing well developed inner lobes. CHILTON says in his paper of 1920 (l. c.), "a minute accessory flagellum present in Antarctic specimens but not in those from New Zealand", and this fact is also made no mention by BARNARD. Unfortunately, antennae and also uropod 3 are missing on all of the specimens in the present collection, but it is pretty sure that the specimens at hand are well referred to *L. novaezealandiae* (THOMSON). A new genus may be probably more suitable for this species, or at least the genus name of *Oradarea* would be more preferable than *Leptamphopus*.

Distribution: New Zealand (Dunedin Harbour, Lyttelton, Akaroa, etc.).

Family PLEUSTIDAE

Key to the species of Pleustidae

Rostrum strong, gnathopods 1-2 powerful *Pleustes panopla*
 Rostrum not strong, gnathopods 1-2 not powerful *Parapleustes bicuspides*

Pleustes panopla (KRÖYER)

(Fig. 17)

Pleustes panoplus, Sars 1895, p. 344, pl. 121; STEBBING 1906, p. 310; SHOEMAKER 1930, p. 309; STEPHENSEN 1938a, p. 253; STEPHENSEN 1944a, p. 4; STEPHENSEN 1944-b, p. 84; GURJANOVA 1951, p. 635, fig. 433, p. 637; DUNBAR 1954, p. 750.

Pleustes panopla, SHOEMAKER 1955, p. 40, fig. 14, a-b; NAGATA 1960, p. 170, pl. 14, figs. 46-49.

Pleustes cataphractus, STEPHENSEN 1938a, p. 252, fig. 28; GURJANOVA 1951, p. 637, fig. 434 & p. 638, fig. 435; STEBBING 1906, p. 310.

Pleustes tuberculatus, STEBBING 1906, p. 311; STEPHENSEN 1938a, p. 252.

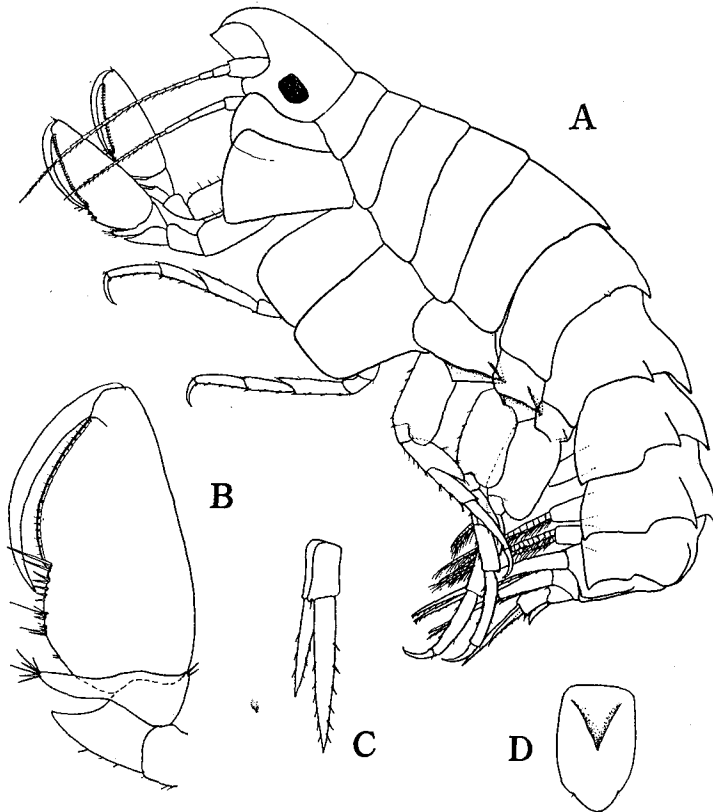


Fig. 17. *Pleustes panopla* (KRØYER). A, lateral view; B, gnathopod 2; C, uropod 3; D, telson.

Material examined: Areas IV (126), VI (1), VII (3), IX-b (2); up to 13.0 mm in length; found in *Zostera* belt near low water marks.

Distribution: Known as a circumpolar arctic and subarctic species; in North Atlantic, southerly to the New England coast, and to North Sea; in Pacific, through Alaska, Bering Sea, south to Japan Sea. In the shallow waters of the Japanese coast, this species is found by me from Mutsu Bay to the west coast of Kyūshū, particularly inhabits commonly in *Zostera* belt.

Parapleustes bicuspoides, sp. nov.

(Fig. 18)

Material examined: 33 specimens from the stomachs of benthos-feeding fishes taken extending over Bungo Suidō and Tosa Bay, Sept. 1957 to Aug. 1958, 20-100 m in depth. Length: 3.1-6.5 mm.

Description: Pleon segments 1 and 2 each with a backward pointing dorsal tooth. Third pleonal epimeron with the hind margin slightly convex, and with the lower corner produced to a small tooth, minutely sinuated above. Eyes of moderate size, almost rounded. Coxae 1-4 as deep as those of *P. assimilis*, which is figured by Sars for *Paramphithoe a.* (1895, pl. 124, fig. 1), and their lower hind corner each with 4-5 microscopically minute denticles;

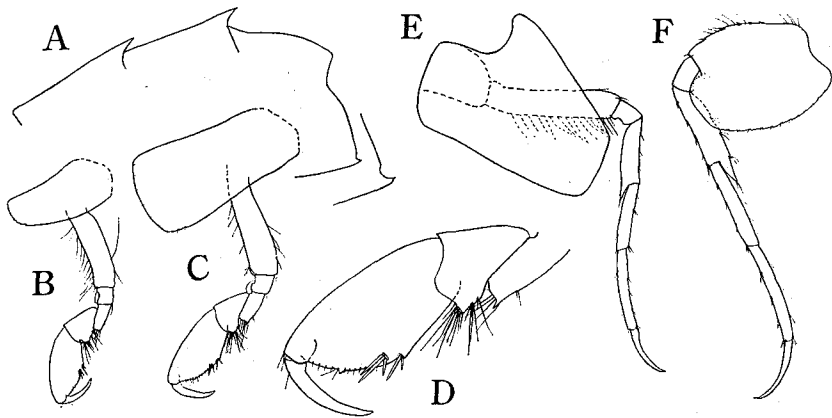


Fig. 18. *Parapleustes bicuspoides*, sp. nov. Female, ovig., holotype, 6.5 mm : A, dorsal profile of pleon segments 1-3, with third pleonal epimeron ; B, C, gnathopods, 1, 2 ; D, distal portion of gnathopod 2 magnified ; E, F, peraeopods 2 and 5. All legs the same proportion of enlargement.

coxa 1 very small, narrowing distally ; coxa 4 fairly resembles that of *assimilis* in shape. Oral parts typical of the genus ; mandible with molar small and simple, third article of maxillipedal palp lacks distal process.

Antennae appear to be comparatively short, though not well preserved on all of the specimens at hand. Gnathopods 1-2 comparatively small and feeble ; gnathopod 2 slightly larger than gnathopod 1, otherwise both almost similar in shape to each other except for coxae ; article 5 not produced to a narrow lobe, but triangular in shape ; article 6 a little widening towards the palm, which is evenly convex, bearing a small cusp at the middle, and defined by two groups of spines from the posterior margin, the margin straight and smooth, nearly as long as the palm. Peraeopods 1-5 slender, articles 6 and 7 proportionally long.

Holotype: KN No. 3472, female ovig., 6.5 mm, Bungo Suidō, Sept. 23, 1957.

Remarks: The new species falls undoubtedly into the genus *Parapleustes* according to J.L. BARNARD's revisional key (1960, p. 39). It resembles *P. bicuspis* (KRØYER) (SARS 1895, pl. 123, fig. 1, as *Paramphithoe* c.) in dorsal armature, but is rather closely related to *P. assimilis* (SARS) (l. c.), and to *P. gracilis* (BUCHHOLZ) (SARS 1895, pl. 124, fig. 2, as *Paramphithoe brevicornis*) in the other characters. Differing from *assimilis* in the third pleonal epimeron, in the form of article 5 of gnathopods 1-2, in the shape of coxa 1, in somewhat smaller eyes, in relatively longer articles 6-7 of peraeopods 1-5, and in the dorsal appearance; from *gracilis* in the depths of coxae 1-4 in comparing to the corresponding peraeon segment, in having no projecting posterior lobes of article 5 of gnathopods 1-2, and in the dorsal appearance. In *P. assimilis*, article 6 of gnathopods has the palm shorter than the hind margin, therefore more slender than in the new species, whereas in *P. gracilis* it is similar in shape to that of the new one.

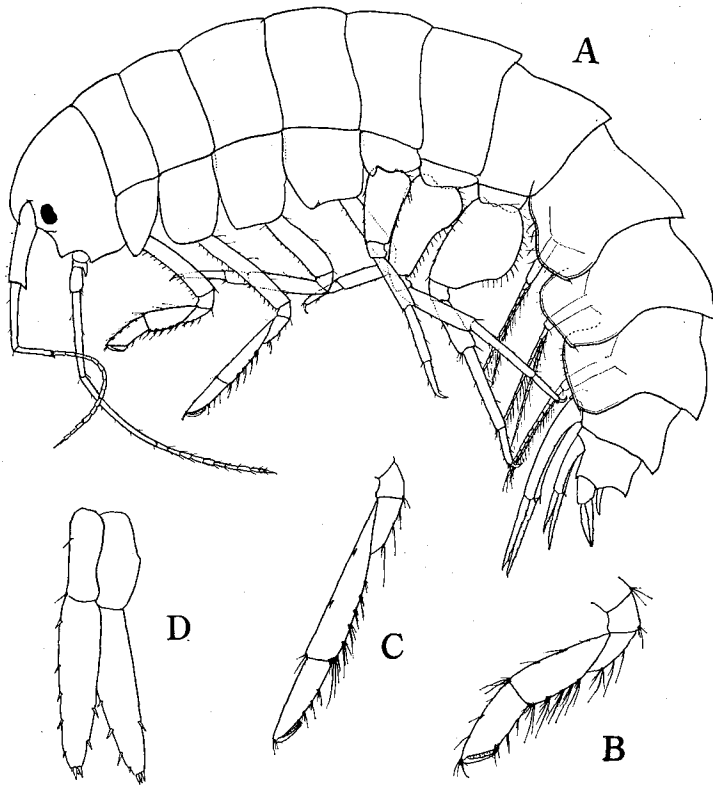


Fig. 19. *Atylus japonicus* NAGATA. A, lateral view; B, C, gnathopods 1, 2; D, uropod 3.

Family ATYLIDAE

Atylus japonicus NAGATA

(Fig. 19)

Atylus japonicus NAGATA 1961, p. 216, figs. 1-2.

Material examined: Areas IV (1), VI (1); 2 female specimens, 3.5 and 9.0 mm in length; from depths of 3-10 m.

Distribution: Known only from Japan; it is found by me from Tomioka Bay, the west coast of Kyūshū, after my paper of 1961 on this species was published.

Family MELPHIDIPPIDAE

Key to the species of Melphidippidae

1. Telson emarginate, not cleft.....*Melphisana japonica*
2. Telson deeply cleft..... 2
 2. Telson very narrow, nearly thrice as long as broad..... *Melphidippa borealis*
 2. Telson moderate, nearly twice as long as broad..... 3
3. Third pleonal epimeron with lower hind corner produced into a large tooth.....*Melphidippella sinuata*
3. Third pleonal epimeron with hind lower corner not produced into a large tooth.....*Melphidippa globosa*

Melphidippa borealis BOECK

(Fig. 20)

Melphidippa borealis, Sars 1895, p. 486, pl. 170, fig. 2; STEBBING 1906, p. 336; GURJANOVA 1951, p. 696, fig. 481.

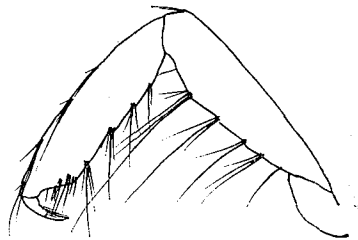


Fig. 20. *Melphidippa borealis* BOECK.
Female, 3.8 mm: articles 5-7 of gnathopod 2.

Material examined: Area XI-a, 11 specimens, 3.5-4.2 mm in length; from depths of 32-53 m.

Remarks: The specimens are all not good for full observation, nearly all of the appendages mutilated; both antennae, all of peraeopods, and uropod 3 are entirely missing on all of the specimens. In spite of it, these specimens appear to be referable to the present species without hesitation by the dorsal appearance, the third pleonal epimeron, the shape of telson, the small eyes, the broadly rounding lateral lobes of head, and gnathopod 1. They are well allied to those of Sars' figures for this species.

Gnathopod 2 is somewhat different from that of Sars' one; the articles 5 and 6 in my specimens are a little more elongate and slender than in Sars' one, as seen in the figure inserted here. However, it does not appear to be the discrepancy such as to be distinctive my specimens from this Boeck's species.

Distribution: From the whole coast of Norway, 54-260 m.

Melphidippa globosa, sp. nov.

(Figs. 21-22)

Material examined: Areas XI-a (45), XI-b (9); up to 6.5 mm in length; from depths of 32-56 m.

Description of female: Each posterior margin of pleon segments 1-3 produced to a medio-dorsal tooth, with one pair of latero-dorsal teeth on either side of it, showing no denticulation between them; the lateral teeth on pleon segment 1 very weak. Pleon segments 4 and 5 each with a spiniform medio-dorsal projection flanked more or less with minute denticles. Pleonal epimera 1-3 with the lower posterior corner bearing no distinctive projection, the hind margin of the two posterior epimera much minutely serrate. Eyes not very large, but well developed, hemispherically projecting. Head not short, lateral lobes of head with the rounding apex. Coxa 1 triangularly produced at the antero-distal corner. The third article of mandibular palp about two thirds as long as the second; maxillipedal palp somewhat elongate, the fourth article with a slender nail. Antenna 1 in female, 4.0 mm long specimen, the only representation on all the specimens at hand, about as long as the head to pleon segment 1 combined, flagellum 17-jointed, accessory flagellum 4-jointed, peduncular articles given here may be more broadly figured than in the actual one on account of being depressed by cover-glass, but the proportions of length between them are fully appreciable, and somewhat similar to those of *M. borealis* figured by Sars. Gnathopods 1 and 2 not densely setose than in three Norwegian species. Gnathopod 1: article 5 less expanded than in *M. goesi* (Sars 1895, pl. 169), article 6 not greatly constricted at the base, palm not distinctly defined. Gnathopod 2: article 5 subtriangularly in form, somewhat resembles that of *M. borealis*, but much broader and longer

than article 6, which is oblong oval, having the palm not defined. Peraeopods 1 and 2; article 5 relatively shorter and article 6 considerably longer in comparison with those of the Norwegian species, article 7 bearing no setae on both margins. Peraeopods 3 and 4: articles 6-7 each considerably longer. Finger of gnathopods and peraeopods all long and slender, with a slender nail. Telson nearly twice as long as broad, cleft extending a little beyond the middle, apices unequally bidentate, the notch each with one pair of long and short spines, and having also a long seta (?) on each outer side close to the apex. Antenna 2, peraeopod 5, and uropods 1-3 are missing or mutilated

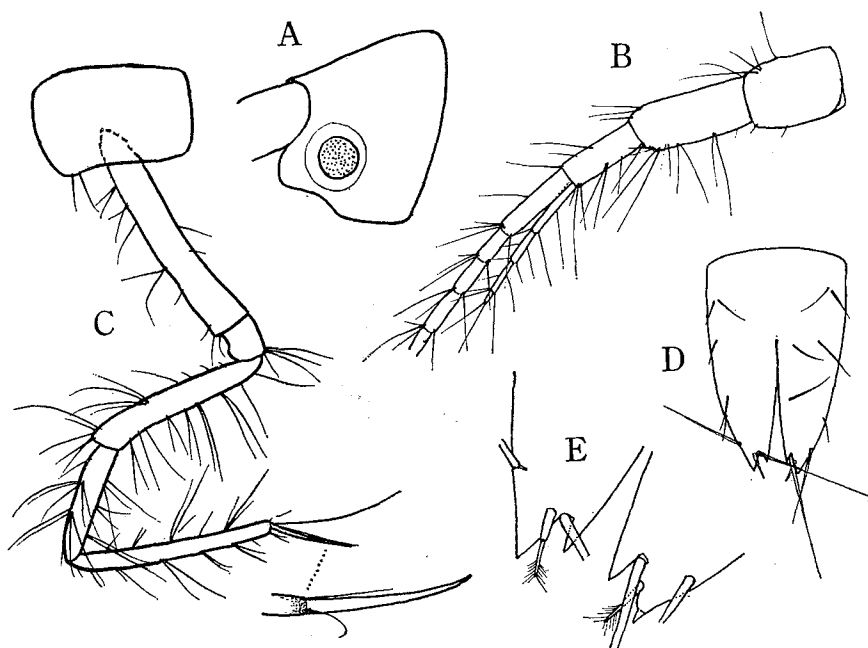


Fig. 21. *Melphidippa globosa*, sp. nov. Female, 5.2 mm : A, head ; D, telson ; E, apex of telson magnified. Female, 4.0 mm : B, antenna 1, left ; C, peraeopod 2, with nail of finger magnified.

in all of the specimens at hand. The specimens are probably all female.

Holotype: KN No. 2243, female, ovig., 5.5 mm. *Type locality*: St. 11 in Area XI-a, 47-53 m, June 15, 1959.

Remarks: As is seen in *Melphidippa antarctica* SCHELLENBERG, eyes of my specimens is similar in structure to that of the genus *Melphidippella*, but otherwise the new species has many characters fitting to this genus. There have hitherto been known 6 species in the world; *M. goesi* STEBBING, *M. borealis* BOECK, *M. macrura* SARS, *M. serrata* (STEBBING), *M. antarctica* SCHELLENBERG, and *M. macruroides* GURJANOVA. The new one is distinguished obviously

from any of them by the combination of the following characters: the structure of eyes, the dorsal armature, the third pleonal epimeron, gnathopod 2, all fingers of gnathopods and peraeopods, telson, and proportional lengths between articles in each of peraeopods 1-5.

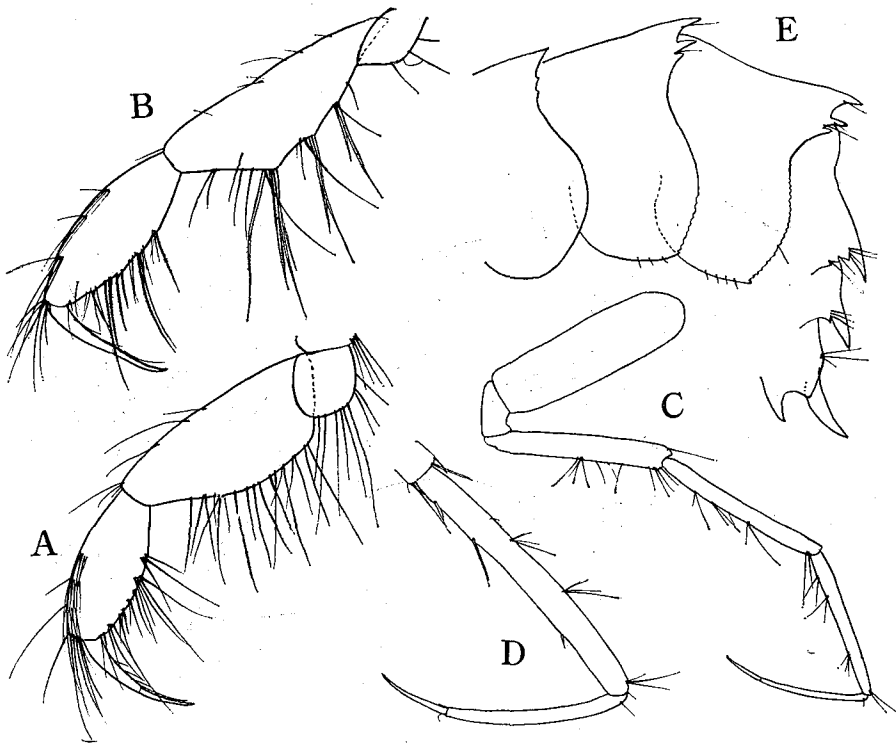


Fig. 22. *Melphidippa globosa*, sp. nov. Female, ovig., holotype, 5.5 mm : A, B, gnathopods 1, 2. Female, ovig., 5.5 mm : C, peraeopod 3. Female ovig., 4.2 mm : D, peraeopod 4, articles 6 and 7. Female, 5.8 mm : E, dorsal profile and epimera of pleon segments.

Melphidippella sinuata, sp. nov.

(Figs. 23-24)

Material examined: Areas XI-a (2), XI-b (8); up to 4.9 mm in length; from depths of 32-56 m.

Description: Pleon segments 1-3 each dorsally bearing a medial spiniform tooth, finely serrate on either side of it; pleon segments 4 and 5 each produced to a long prominent medial tooth, more or less denticulated on both sides of it. The dorsal appearance is fairly similar to that of *Melphidippa*

macrura (SARS 1895, pl. 170, fig. 1). Pleonal epimera 1-3 each with a tooth at the lower posterior corner, the hind margin of the last pair narrowly and prominently convex. Head short, eyes large, semiglobose, lateral lobes with a small acute point; they are just like in *Melphidippella macrura* (SARS 1895, pl. 171). Coxa 1 fully produced at the anterodistal corner, coxa 2 not produced downwards behind. Antenna 1, peduncular articles in male short and stout, article 1 of primary flagellum much elongate, somewhat laminar, longer than the peduncle, accessory flagellum 3-jointed, delicate and feeble. Antenna 1 of female and antenna 2 of both sexes are missing on all of the specimens

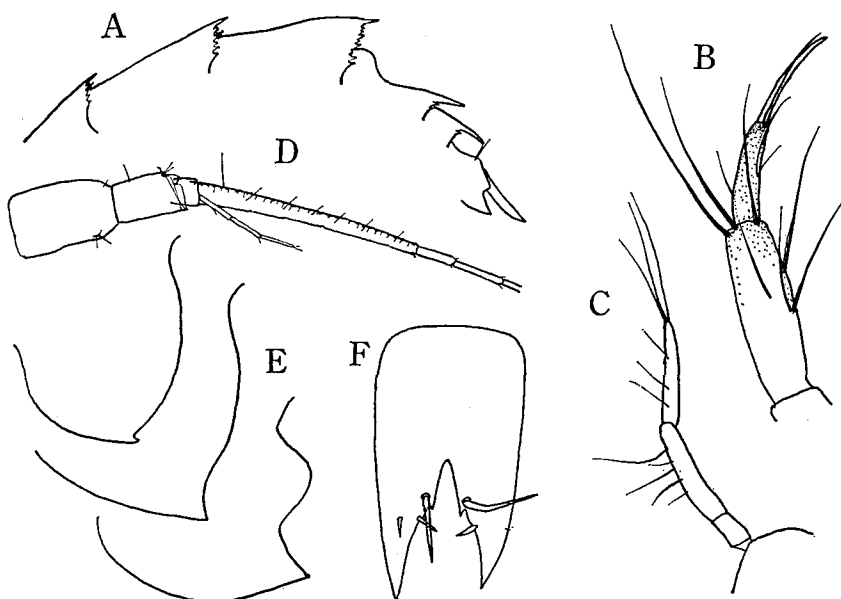


Fig. 23. *Melphidippella sinuata*, sp. nov. Male, holotype, 4.2 mm : A, dorsal profile of pleon segments 1-6 ; B, end of maxillipedal palp. Female, ovig., 4.9 mm : C, mandibular palp ; F, telson. Male, 4.0 mm : D, antenna 1, right from medial view ; E, pleonal epimera 1-3.

at hand. Third article of mandibular palp as long as the second; fourth article of maxillipedal palp with a long and slender nail. Gnathopods 1 and 2 not densely setose; gnathopod 1, article 5 moderately expanded proximally, narrowing distally, article 6 much shorter and smaller than article 5, bearing 4-5 slender spines on the middle of the posterior edge, palm ill-defined, finger long and slender, bearing a long nail, the inner edge with 5-6 spinules; gnathopod 2, in female resembles that of *M. macrura*, but in male shows no distinctive palm, and finger long and slender, bearing a nail, palm in female with 2-3 rows of spine-group, a nail presents also in female. Telson cleft

to the half, inner edge of each lobe with a small point at a distance of the apical end, and armed with one long and one short spines.

Holotype: KN No. 3157, male, 4.2 mm. *Type locality*: St. 6 in Area XI-a, 32-56 m in depth, sandy mud, June 13, 1959.

Remarks: The new species is referred to the genus *Melphidippella* by the short head, the structure of eyes, by having an acute point on lateral lobes of head, and by the short peduncle of antenna 1, but has also some important characters which have been used as generic distinction of the genus *Melphidippa* BOECK from the genus *Melphidippella* Sars, that is, the comparatively long article 3 of mandibular palp, accessory flagellum well developed, coxa 1 tri-

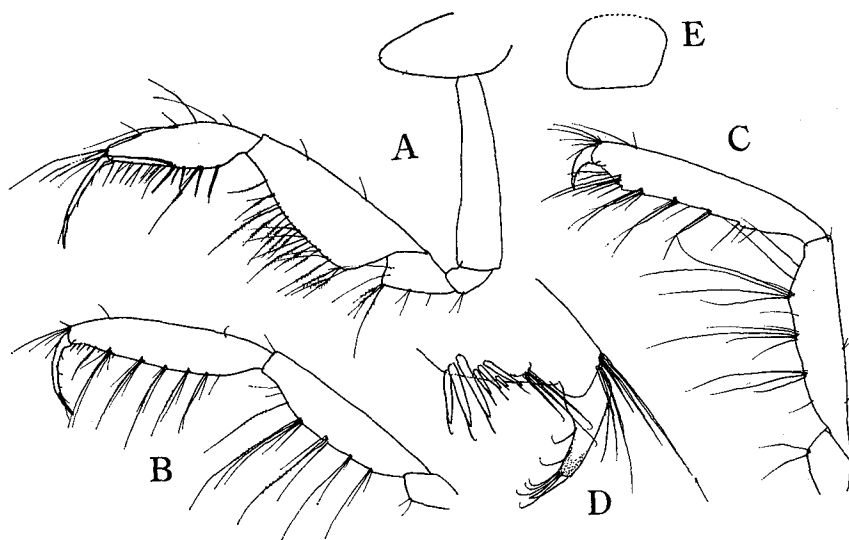


Fig. 24. *Melphidippella sinuata*, sp. nov. Male, holotype, 4.2 mm : A, B, gnathopods 1, 2. Female, ovig., 4.9 mm : C, D, gnathopod 2 and inside view of the end. Male, 4.0 mm : E, coxa 2, left.

angularly produced. The occurrence of the new species is certainly weakening the boundary line between the two genera. Only one species of *M. macrura* is known in the world. All of peraeopods and uropods are missing or mutilated on all the specimens at hand.

Melphisana japonica, sp. nov.

(Fig. 25)

Material examined: Areas IV (3), XI-a (2), XI-b (1), up to 4.5 mm long, from depths of 10-52 m.

Description: Pleon segments 2 and 3 each dorsally tridentate, not serrated;

pleon segments 4 and 5 each dorsally elevated to a compressed carina, and posteriorly produced into an acute point directed backwards. The second and third pleonal epimera with the posterior lower corner produced to an acute tooth, and the hind margin slightly convex, not serrate. Head short, eyes large, semi-globose on lateral lobes which terminate in an acute point, just as seen in *Melphidippella macrura*. Coxa 1 slightly produced forwards. Antenna 1: peduncle very short in female, rather resembles that of female

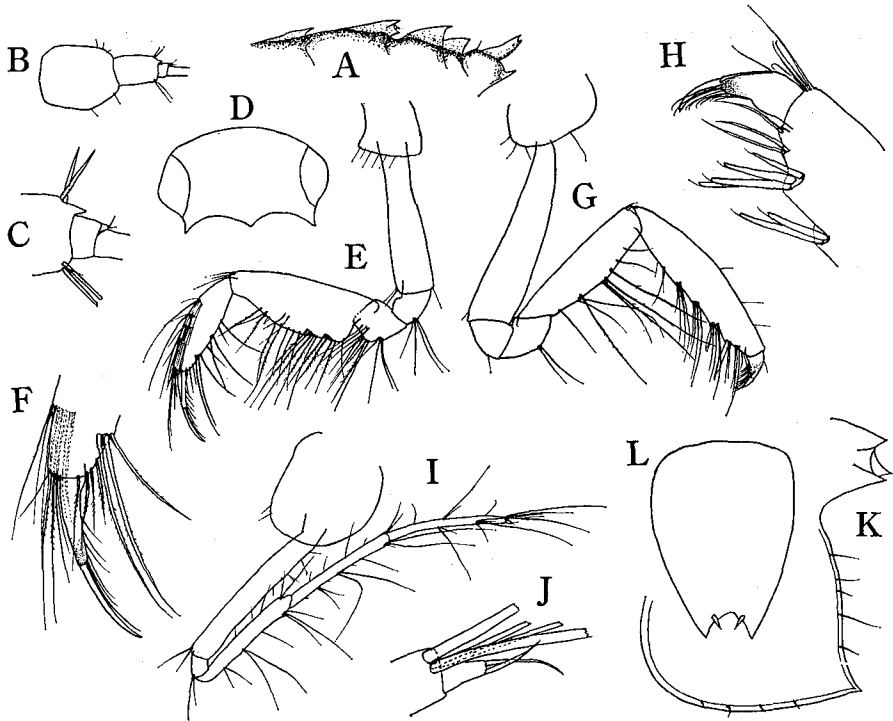


Fig. 25. *Melphisana japonica*, sp. nov. Female, holotype, 4.5 mm : A, dorsal profile of pleon segments 2-6 ; B, C, peduncle of antenna 1, and accessory flagellum magnified ; D, head from upper view ; E, F, gnathopod 1 and its end magnified ; G, H, gnathopod 2 and inside view of its end magnified ; I, J, peraeopod 1 and its finger magnified ; K, pleon segment 3 ; L, telson.

of *M. bola* figured by J. L. BARNARD (1962a, p. 81, fig. 7), but the article 1 more stout and longer than articles 2 and 3 combined ; accessory flagellum forms a minute nodule distinctly articulated, bearing two small apical setae. Third article of mandibular palp very short as in *M. bola* ; fourth article of maxillipedal palp with a long and slender nail, inner edge of outer plate of maxillipeds margined with short, stout spines (or teeth). Gnathopod 1: article 5 moderately expanded proximally, finger long and slender, bearing a nail, and

lined with 6 slender setules on the inner edge. Gnathopod 2 more longer and slender than gnathopod 1, rather similar to that of *Melphidippella macrura*; palm ill-defined, bearing two groups of 2-4 spines, finger short and stout, bearing a nail, and armed with 8-9 setules on the inner edge. Peraeopods 1 and 2 extremely slender and delicate, and fairly well resemble those of *M. macrura*, but finger much short, with the apical end truncated, bearing two small bristle. Uropods 1 and 2 like in *Melphisana bola*. Telson emarginate, not cleft, the emargination with one pair of short spinule on the inner edge.

Holotype: KN No. 3173; female, 4.5 mm. *Type locality*: St. 18 in Area XI-b, 5-52 m, Sept. 4, 1960.

Remarks: The new species is referred to the genus *Melphisana* by the prominent feature of the uncleft telson, but has also many coincidences with *Melphidippella macrura* (NORMAN). Differing from *Melphisana bola* in the dorsal appearance of pleon segments, pleonal epimera 2-3, the shape of coxa 1, gnathopod 2, peraeopods 1-2, and having an acute point in the lateral lobes of head. J. L. BARNARD established newly the genus *Melphisana* in his paper of 1962a, in which he says, "fourth palp article of maxilliped short, stout, not claw-like, bearing 2 apical setae", and this feature was described as one of diagnostic characters. In my specimens, the fourth article of maxillipedal palp has certainly a slender nail which is apt to be mistaken for two apical setae, and finger of gnathopods 1 and 2 has also a nail, the characters in gnathopods likewise seen in his figures.

On the other hand, however, it is noteworthy that the finger of peraeopods 1 and 2 in my specimens indicates the same feature as in the fourth article of maxillipedal palp of BARNARD's figure. Marginal armature of outer plate of maxillipeds in my specimens is also nearly alike to that of *Melphidippella macrura*. The specimens at hand are all female, and antenna 2, peraeopods 3-5, and uropod 3 are missing in all of the specimens.

Family PONTOGENEIIDAE

Pontogeneia rostrata GURJANOVA

(Fig. 26)

Pontogeneia rostrata GURJANOVA 1951, p. 719, fig. 500; J. L. BARNARD 1962a, p. 81.

Pontogeneia sp., NAGATA 1960, p. 171, pl. 14, figs. 50-53 & pl. 15, figs. 54-71.

Material examined: Areas II (1), IV (7331), V (27), VI (186), VII (13), IX-b (131), IX-c (1), IX-d (21), XIII-a (3), XIII-b (6), XIV (2). Total: 7722 specimens, up to 8.0 mm in length; from *Zostera* belt near low-water marks to a depth of 5 m.

Remarks: My specimens described as *Pontogeneia* undet. sp. in my preceding paper were referred to the present species by J. L. BARNARD (1962, l. c.).

However, some questions seem to still remain in the following respects: In GURJANOVA's specimens, head is pretty long, as long as the first three peraeon segments combined, whereas in my specimens it is only as long as the first two combined; inner plate of the first maxilla has 4 setae in him,

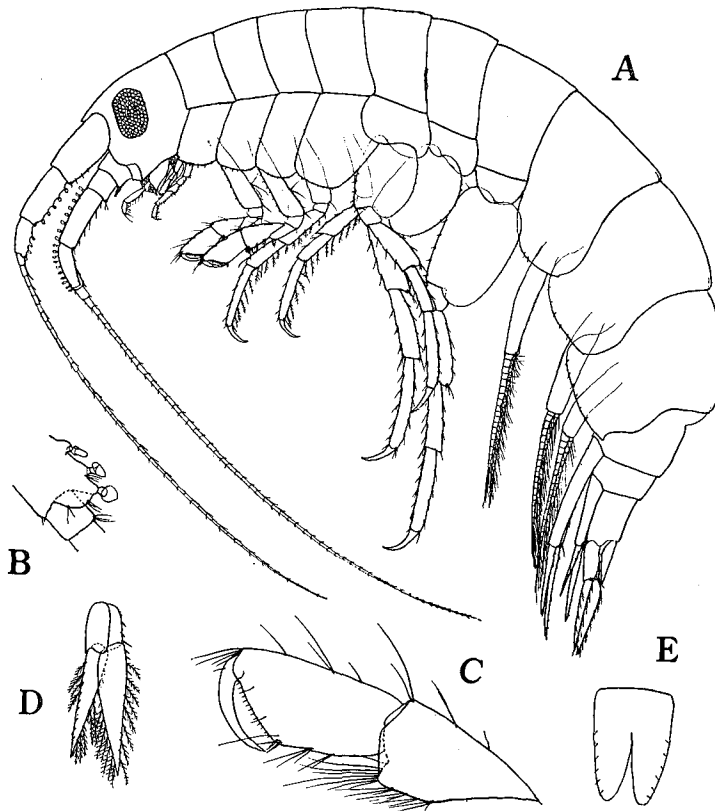


Fig. 26. *Pontogeneia rostrata* GURJANOVA. A, lateral view of male; B, accessory flagellum of antenna 1; C, gnathopod 2; D, uropod 3 of male; E, telson.

whereas has 6 setae in me. It may be noted that the specimens at my hand are also fairly well allied to *P. arenaria* BULYCHEVA (1952, p. 222, fig. 22).

Distribution; Bering Sea, Okhotsk Sea, Japan Sea (Russian side coast) and southern California.

(To be continued)

STUDIES ON MARINE GAMMARIDEAN AMPHIPODA OF THE SETO INLAND SEA. III

KIZÔ NAGATA

Inland Sea Regional Fisheries Research Laboratory, Hiroshima

With 18 Text-figures

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Family GAMMARIDAE

Key to the species of Gammaridae

1. Uropod 3, rami very unequal 2
 1. Uropod 3, rami not very unequal 7
 2. Body dorsally more or less spinous or dentate 3
 2. Body dorsally smooth 6
 3. Body with groups of dorsal spinules on all of pleon segments
..... *Anisogammarus (E.) amandalei*
 3. Body without groups of dorsal spinules on all of pleon segments 4
 4. Body without a median dorsal tooth on all of pleon segments *Melita koreana*
 4. Body with a median dorsal tooth on some of pleon segments 5
 5. Pleon segments 1-4 each with a median dorsal tooth, flanked with some minute teeth
on either side *Melita denticulata*
 5. Pleon segments 1-3 each with only a median dorsal tooth *Melita tuberculata*
 5. Pleon segments 2-4 each with only a median dorsal tooth *Melita japonica*
 6. Gnathopods 1-2, article 6 similar in shape *Eriopisella sechellensis*
 6. Gnathopods 1-2, article 6 dissimilar in shape *Eriopisa elongata*
-

7. Body dorsally quite smooth *Maera serratipalma*
 7. Body dorsally more or less dentate 8
 8. Uropod 3, rami oblong oval, rounded at apex *Megaluropus agilis*
 8. Uropod 3, rami not oval, not rounded at apex 9
 9. Third pleonal epimeron with hind margin serrate *Ceradocus (D.) capensis*
 9. Third pleonal epimeron with hind margin not serrate *Maerella tenuimana*

Anisogammarus (Eogammarus) annandalei (TATTERSALL)

Gammarus annandalei TATTERSALL 1922, p. 445, pl. 20, figs. 1-18; UENO 1933, p. 111; UENO 1935, p. 90, 92.

Anisogammarus (E.) annandalei, SCHELLENBERG 1937, p. 274; STEPHENSEN 1944, p. 52, fig. 13.

Material examined: Areas IV (2 at St. 14, see NAGATA 1960, fig. 2), V (1), IX-d (1); up to ca. 20 mm long; in Areas IV and V, from a depth of 2 m in high water at the mouth of river; in Area IX-d, from the surface water at night, 2-3 m in depth in high water.

Distribution: Known only from fresh water in the past records; Southern Kuril Is., Southern Sachalin, Japan (Hokkaidō to Lake Biwa), and China (Eastern China and Yunnan). Here, the first record from brackish waters, the mouth of river (it is noted that the species is found from the surface water in high water of Area IX-d, which is not just near the mouth of river but there is only a little inflow of the drainage).

Melita koreana STEPHENSEN

Melita koreana STEPHENSEN 1944, p. 39, figs. 6-8.

Melita rylovae BULYCHEVA 1955, p. 201, fig. 5.

? *Melita coroninii*, STEBBING 1906, p. 424; CHEVREUX & FAGE 1925, p. 229, figs. 238, 240.

Material examined: Areas I (2), V (30), VI (13), VII (17), IX-a (18), IX-b (1), IX-d (8), XII (3), XIV (11). Total: 103 specimens, up to 12.7 mm in length; from intertidal to a depth of 1.5 m in low-water.

Remarks: The specimens somewhat differ from STEPHENSEN's description and figures in the following respects: Pleon segment 5 is armed with a latero-dorsal tooth and 2-3 spines on each side. The teeth are much minute in comparatively small specimens, and are often apt to be overlooked (STEPHENSEN must have lost sight of this fact). This dorsal armature of my specimens agrees with that of *M. coroninii* HELLER from the coast of Mediterranean.

The lower posterior corner of this third pleonal epimeron entirely agrees with that of *M. coroninii* figured by CHEVREUX & FAGE. The corner appears to be somewhat variable in shape, and to be of no specific value. The sub-rectangular form of the corner described by STEPHENSEN is sometimes also seen in my collections,

Male gnathopod 1, particularly in the distal end of the legs, agrees well with CHEVREUX & FAGE'S description and figure for *M. coroninii*. The finger figured by STEPHENSEN is probably not actually the true one but it is the recurved antero-distal process of article 6, and the genuine finger is folding down on the inner side of the palm. Such a false appearance as figured by STEPHENSEN is also often seen in the present specimens. Therefore, J. L. BARNARD'S key by which *M. koreana* is separated from *M. coroninii* should be revised (J. L. BARNARD 1962a, p. 108).

Otherwise, My specimens quite agree with STEPHENSEN'S one. *Melita koreana* is known by STEPHENSEN from Makinoshima, Fuzan, Korea, and my specimens referred to this species are also found by me from the west coast of Kyūshū. Therefore, it is almost incredible that the present specimens are wholly distinctive from *M. koreana* STEPHENSEN. On the other hand, as seen in the above-mentioned consideration, my specimens much resemble *M. coroninii* HELLER, and it seems to me that *M. koreana* may be a synonym of *M. coroninii*. As a matter of fact, I am now unable to distinguish the former from the latter, except for female coxa 6. In the former, female coxa 6 has the front lobe produced to a recurved process, while in the latter the hooked process of coxa 6 has been described neither in STEBBING'S monograph (1906, l. c.) nor in CHEVREUX & FAGE'S one (1925, l. c.), although it was unable to refer to HELLER'S original description (1886). It is now necessary to confirm whether *M. coroninii* is actually armed with the hooked process on female coxa 6.

I believe that *Melita rylovae* BULYCHEVA from the Russian coast of Japan Sea is a synonym of *M. koreana*. The former is only a fully grown-up form of the latter. Dorsal armature on pleon segment 5 as mentioned above is quite conformable between *M. rylovae* and my specimens, and the presence of one pair of subdorsal tooth on pleon segments 2 and 3 begins to appear in about 9-10 mm long specimens in the Seto Inland Sea, and in much fully grown-up my specimens the teeth are also developed on pleon segment 1. An evidence of the continuity between *koreana*-form and *rylovae*-form may be proved by many facts that the both forms occurred together in a collection at a certain station, and in fact I can find no other qualitative differences between *M. rylovae* and my specimens of *M. koreana*, particularly in characteristic features of male gnathopods 1 and 2, and the hooked process of female coxa 6.

Distribution: Korea (Makinoshima) and Bay of the Great Peter.

Melita denticulata, sp. nov.

(Fig. 27)

Material examined: Areas IV (7), VII (3); up to 4.5 mm in length, from

depths of 1-2 m in low-water.

Description: Pleon segments 1-4 each with a large medio-dorsal tooth, flanked with some minute teeth on each side; pleon segment 5 with a latero-dorsal tooth on each side, together with a spine at the same base; pleon

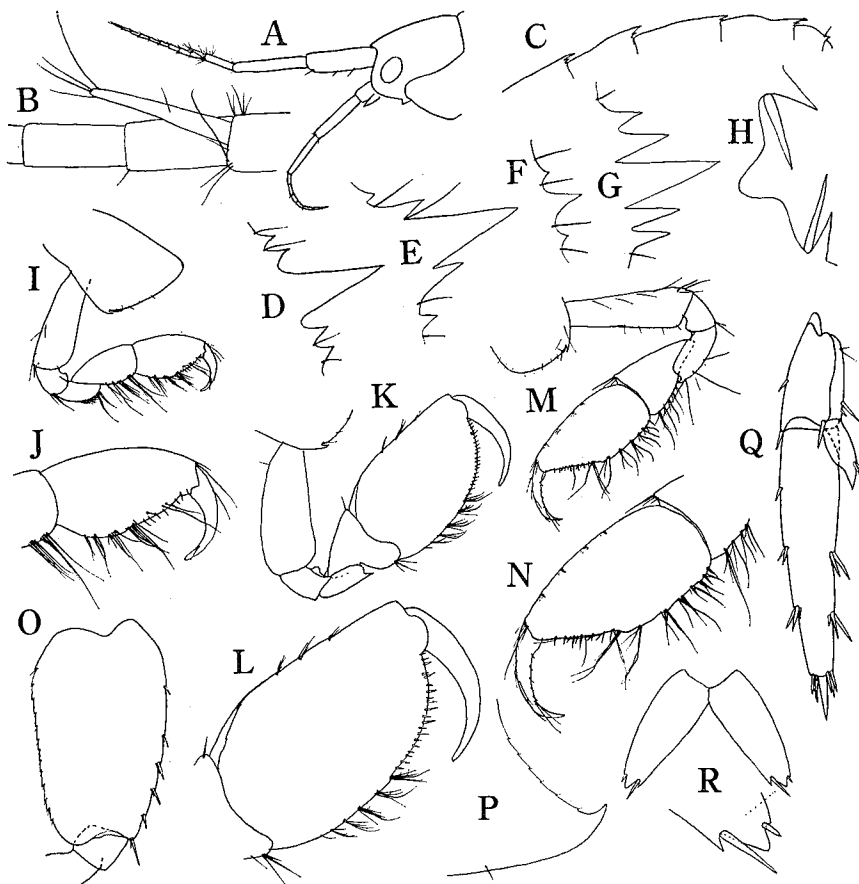


Fig. 27. *Melita denticulata*, sp. nov. Male, 4.0 mm: A, head and antennae; B, accessory flagellum of antenna 1; C, dorsal profile of pleon segments 1-5; D, E, F, G, H, upper view of dorsal teeth of pleon segments 1, 2, 3, 4, 5; P, lower hind corner of third pleonal epimeron; Q, uropod 3. Male, holotype, 4.0 mm: I, J, gnathopod 1 and the end magnified; K, L, gnathopod 2 and the end magnified; O, article 2 of pereopod 4, right. Female, ovig., 4.5 mm: M, N, gnathopod 2 and the end magnified; R, telson.

segment 6 lacks any tooth. Coxa 1 distally expanded, coxae 1-3 each with a small acute tooth at the lower hind corner. The third pleonal epimeron with the posterior corner produced into an acute upturned tooth, minutely serrated above. Antennae comparatively short; antenna 1 much shorter than a half

the length of the body; peduncular article 2 of antenna 1 equal in length to article 1; flagellum of antenna 1 shorter than the peduncle, 9-10 jointed; accessory flagellum somewhat long, 1-jointed; flagellum of antenna 2 with 5-6 joints. Gnathopod 1 like figured here, similar in both sexes. Gnathopod 2, in male, article 2 stout, article 6 broad and tumid, the palm evenly rounded extending over the end of the hind margin, undefined by any process, and lined with a row of short spines, the hind margin with some groups of setae, finger smooth, not acute at apex; in female, article 2 normal, article 5 relatively longer, article 6 subtrapezoid the palm obliquely straight, undefined by any distinct tooth. Telson simply armed as figured here, each lobe not acute at apex, with one short spine outside the apex, one long spine inside. Otherwise, the new species nearly like in Sars' figures for *M. dentata* (Sars 1896, pl. 181, fig. 1).

Holotype: KN No. 2925, male, 4.0 mm. *Type locality*: St. 2 in Area VII, 4 m in high-water, Jan. 23, 1957, mud. *Zostera* belt, W. T. 9.8°C (bottom), Cl. 18.16‰ (bottom).

Remarks: The new species is closely related to *M. dentata* (Krøyer) (l. c.) in general appearance; the latter species has been recorded from Japan (? Japan Sea), according to Stephensen (1940a, p. 309). Iwasa has also inserted the species as found near low-water marks into "Illustrated encyclopedia of the fauna of Japan" (press of 1957). The specimens at my hand are all up to 4.5 mm in length. At least, I suspected that the present specimens might be a juvenile form having a link with such an adult form as figured by Sars. However, one female specimen at hand is already ovigerous at 4.5 mm long, and I can not, in the present stage of my work, believe the specimens to be identical with *M. dentata* by the following characters; that is, by having a prominent median dorsal tooth on each of pleon segments 1-4, by lacking a medial dorsal tooth on pleon segment 5, by having no armature on pleon segment 6, by having a serration on the posterior edge of the third pleonal epimeron, by having a comparatively short antennae, by being not produced to an acute tooth at the postantennal corner of head, by having distally expanded coxa 1, and by the form of male gnathopod 2.

The new species marvelously resembles *M. lagunae* Oliveira from Rio de Janeiro (1953, p. 316, figs. 5-6) in male gnathopod 2, but differs from the latter by the dorsal appearance, and the structure of gnathopod 1.

Melita tuberculata, sp. nov.

(Figs. 28-29)

Material examined: Areas VII (1), X (1), XI-a (15); up to 9.0 mm in length; from depths of 7.5-56.0 m.

Description of male, 8.0 mm long: Body slender, pleon segment 1, 2, and 3 each with a medial dorsal tooth, pleon segment 5 with two small laterodorsal teeth enclosing a spine on each side, pleon segments 4 and 6 having no dorsal armature. Coxa 1 expanded distally; the third pleonal epimeron with the hind lower corner produced to a short upturned tooth, slightly serrate below, and the hind edge bearing a long seta above the corner. Eyes dark, rounded oval, post-antennal corner distinct but not acute. Antenna 1 reaching nearly the end of pleon segment 3; peduncular article 2 about 1.5 times as long as article 1; article 3 shorter than one half the length of article 1; flagellum 29-jointed; accessory flagellum with 4 joints plus 1 rudimentary one. Antenna

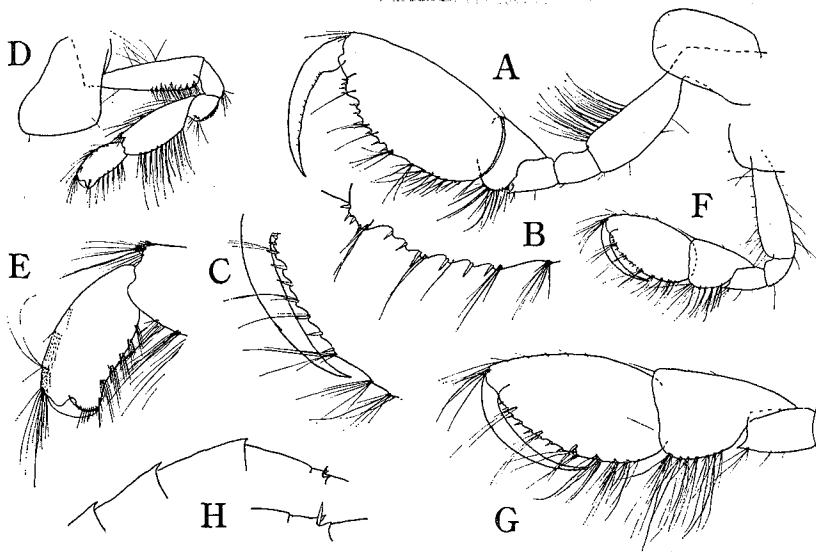


Fig. 28. *Melita tuberculata*, sp. nov. Male, holotype, 9.0 mm: A, B, gnathopod 2 and the palm enlarged; D, gnathopod 1. Female, ovig., 6.1 mm; F, G, gnathopod 2 and its articles 4-7 magnified; H, dorsal profile of pleon segments 1-5, with the segment 5 magnified. Male, 6.4 mm: C, palm of gnathopod 2; E, end of gnathopod 1.

2 reaching slightly beyond the middle of flagellum of antenna 1; peduncular article 5 slightly shorter than article 4, somewhat narrower; flagellum a little shorter than article 5, with 11 joints. Gnathopod 1, anterior margin of article 2 with a continuous groove through the length, distally densely setose; article 5 much longer than article 6, bearing a small bump covered with many bristles (?) at the antero-distal corner; article 6 proximally somewhat narrow, the palm transverse, short, and slightly convex, lined with 9 setae on the posterior half; finger short, abruptly narrowing to the apex. Gnathopod 2 much larger than gnathopod 1; article 2 with the anterior margin like in

gnathopod 1; article 5 produced to an acute small tooth at the postero-distal corner; article 6 very large, fully elongate, the palm very oblique, lined with several tubercles, each with a short spine, except for the one near the finger hinge which is larger, bearing 3-4 spines, undefined by a distinct angle;

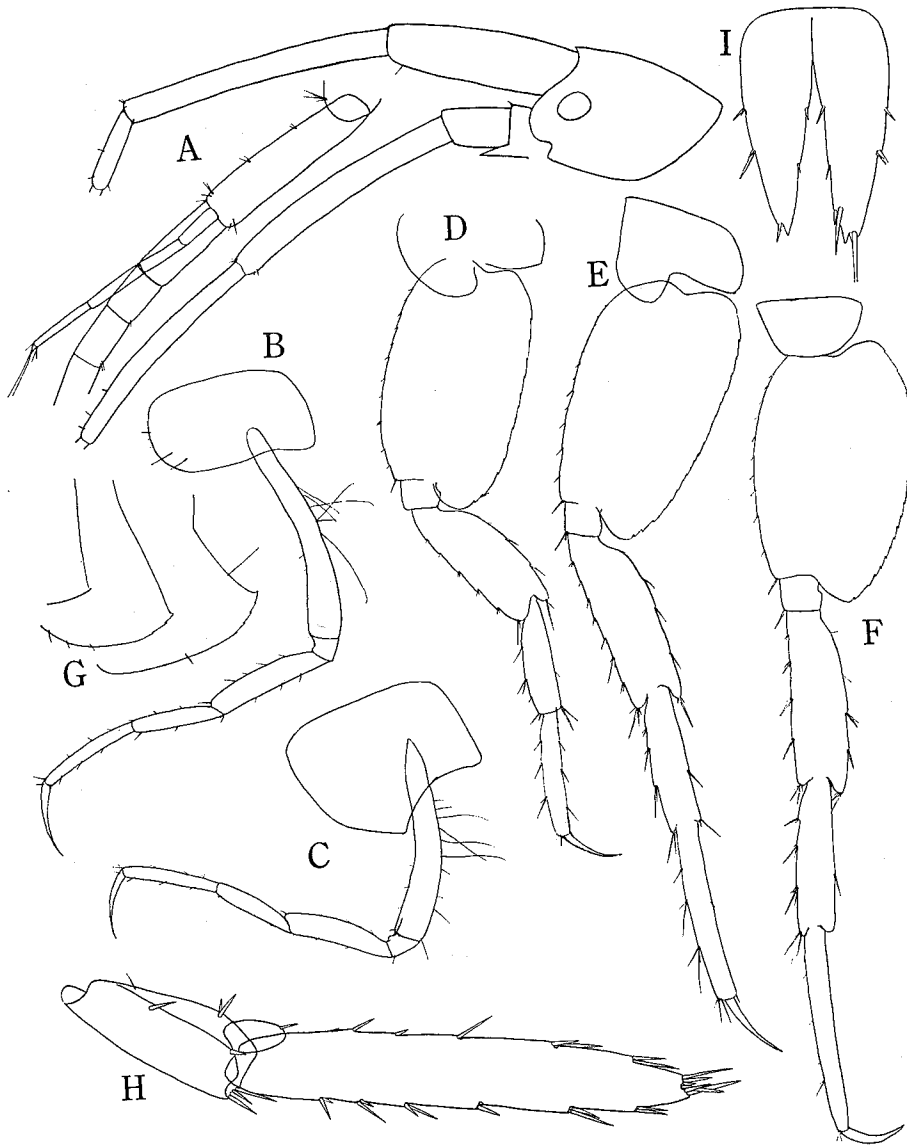


Fig. 29. *Melita tuberculata*, sp. nov. Male, 8 mm: A, head and peduncle of antennae, with accessory flagellum magnified; B, C, D, E, F, pereopods 1, 2, 3, 4, 5; G, lower posterior corner of pleonal epimera 1-3; H, uropod 3; I, telson.

finger somewhat longer than palm, acute at apex. Gnathopods 1-2 rather more setiferous than in the preceding species. Peraeopods 1 and 2 slender and delicate, finger relatively long, about two thirds as long as article 6. Peraeopods 3-5, article 2 broadly oval, minutely serrate along the hind margin, with the lower hind corner somewhat produced downwards, rounded; peraeopods 4 and 5 nearly equal in length. Uropod 3 much elongate, outer ramus more than twice as long as the peduncle, the apex rather truncate, with 6-7 unequal spines, inner ramus not twice as long as broad. Telson about 1.5 times as long as broad, cleft nearly to the base, each lobe rather narrow, the apices with a small point, both margin of each lobe armed with 2-3 small bundles of spine respectively. Color pale brown.

Female differs from male in gnathopod 2; gnathopod 2 in female larger than gnathopod 1, but not so larger as male, article 5 relatively long, article 6 with the palm not prominently tuberculated, more oblique, and evenly running into the hind margin.

Holotype: KN No. 2921, male, 9.0 mm. *Type locality*: St. 7 in Area XI-a, 47-51 m, June 13, 1959, sandy mud.

Remarks: The new species has no agreement with any species shown in "pleonal tooth formulas of species in genus *Melita*" by J.L. BARNARD (1962a, p. 107), and is easily distinguished from any other species by the dorsal appearance, gnathopods 1-2, pleonal epimera, and telson.

Melita japonica, sp. nov.

(Fig. 30)

Material examined: Area VII, one male (8.0 mm) and one female (7.0 mm) specimens. Depth: 2.5-3.0 m in high water; near the low tide marks.

Description: Pleon segments 2, 3, and 4 each with a large medio-dorsal tooth, pleon segment 5 with two small subdorsal teeth enclosing a spine on each side, pleon segments 1 and 6 without dorsal armature. Coxa 1 scarcely expanded distally. Eyes rounded oval. Antenna 1, article 3 of peduncle much longer in comparison with that of *M. desdichada* J.L. BARNARD (1962a, p. 110, fig. 22), about a half the length of article 1, accessory flagellum with 3-5 joints. Gnathopod 1 in male, article 6 oblong oval, slightly longer than article 5, palm evenly rounded, lined with spinules, undefined from the hind margin; the hind margin of articles 4 and 6 covered with a thick brush of short bristles, and also the antero-distal corner of article 5 armed with some serrate spine-like setae broadened at the base and a small bump covered with many small bristles; finger sharply curved at the base. Gnathopod 1 in female, article 6 rather roundly oval, slightly shorter than article 5; finger normal, somewhat shorter; otherwise nearly like in male. Gnathopod 2 in male, article 4

with the postero-distal corner produced to a small acute tooth, article 5 short, cup-shaped, article 6 large, ovate, narrowed distally, palm obliquely rounded, slightly crenulate, lined with short spines, undefined from and running into the hind margin, finger slightly longer than palm; in female, article 5 relatively longer, article 6 with the palm obliquely truncated, undefined by any distinct process from the hind margin, and armed with two short spines and

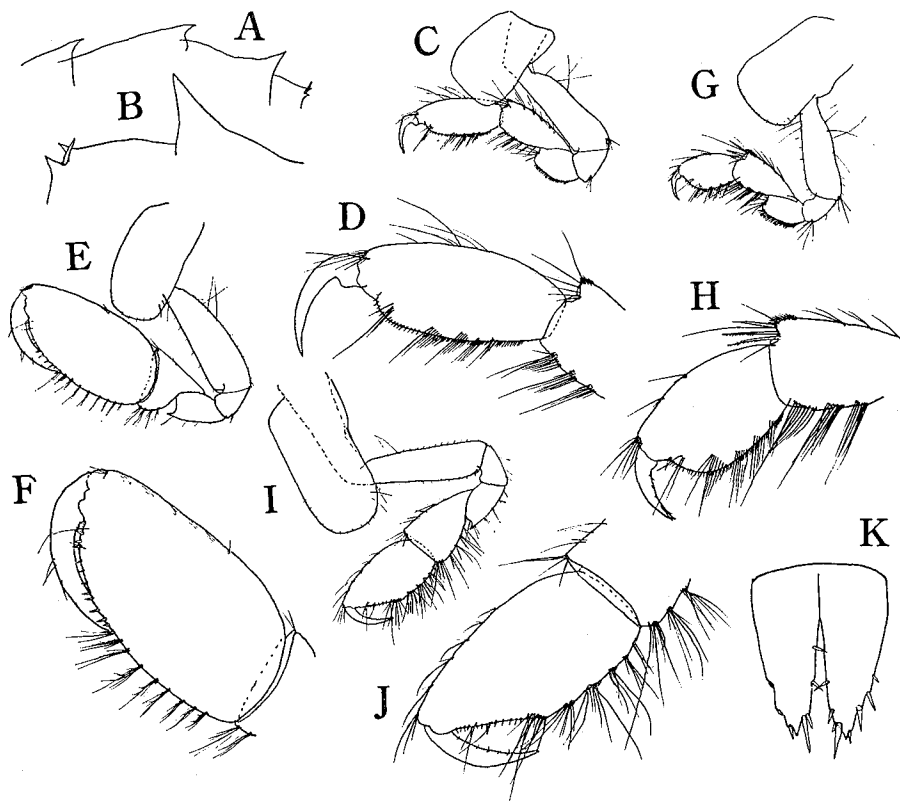


Fig. 30. *Melita japonica*, sp. nov. Male, holotype 8 mm: A, B, dorsal profile of pleon segments 2-5, and the segments 4-5 magnified; C, D, gnathopod 1, and the articles 5-7 magnified; E, F, gnathopod 2, and the end magnified; K, telson. Female, 7 mm: G, H, gnathopod 1, and the articles 5-7 enlarged; I, J, gnathopod 2, and the end magnified.

many spinules. Pleonal epimera, peraeopods, uropods, telson, and other respects are all nearly like in *M. desdichada* (l. c.).

Holotype: KN No. 3170, male, 8.0 mm. *Type locality*: St. 7 in Area VII, near low water marks, sand, W.T. about 10°C in high water (bottom), Cl. 18.16%, Jan. 23, 1957.

Remarks: The new species is fairly well related to *M. desdichada*, but distinguished by the dorsal appearance, and somewhat different forms of gnathopods 1 and 2. The new one is also closely related to *M. californica* ALDERMAN (1936, p. 60, figs. 26-32) particularly in gnathopods 1-2, and the proportional length of peduncular article 3 of antenna 1, but here distinguished by the following respects; in *M. californica*, pleon segments 2-3 untoothed, pleon segment 4 with three dorsal teeth, eyes rounded, male coxa 1 distally expanded, article 5 of male gnathopod 1 longer than article 6, palm of article 6 of gnathopod 1 oblique (probably like in J. L. BARNARD's figure of *M. desdichada*), and article 6 of gnathopod 2 in my specimens more fully elongate. However, the above-mentioned two eastern Pacific species and the present new one appear to be essentially pretty akin to each other. It is also noted that this new one is somewhat related to *M. somovae* BULYCHEVA (1952, p. 226, fig. 25).

According to the pleonal tooth formulas of species in the genus *Melita* given by J. L. BARNARD (1962a, p. 107), the new species agrees with *M. lignophila* J. L. BARNARD (1961, p. 225, fig. 77) from Gulf of Panama, 915 m in depth, in the same arrangement of dorsal teeth, i. e. 0, 1, 1, 1, 4 in accordance with the order of pleon segments 1-5, but in the latter species, eyes absent, and male gnathopod 2 shows a different form in article 6.

Maera serratipalma, sp. nov.

(Fig. 31)

Material examined: Areas IV (7), V (1), VI (7), VII (5), IX-b (7), IX-d (14), XI-a (4), XI-b (2), XIII-b (8). Total: 55 specimens, up to 8.0 mm in length; from near low water marks to 52 m in depth.

Description: Body slender, smooth; coxae 1-4 shallow, subsquare, the front corner of coxa 1 acutely produced, coxa 5 deeper than coxa 4. Third pleonal epimeron with the lower hind corner produced to an acute small tooth, not serrate. Lateral lobes of head subtruncate, post-antennal corner acutely produced, eyes ovate. Antennae slender; peduncular article 2 of antenna 1 subequal in length to article 1 which bears three spines along the under edge, narrower; flagellum rather shorter than the peduncle, about 17-jointed; accessory flagellum well developed, usually just a little shorter than a half the length of the primary flagellum, about 6-jointed; antenna 2, gland-cone of peduncular article 2 reaching only to the middle of the article 3, article 5 shorter and narrower than article 4, flagellum subequal in length to peduncular article 5, about 7-jointed. Maxilla 1, inner plate with 2 setae; mandibular palp nearly typical. Gnathopod 1; article 5 as long as article 6, both widened distally, article 5 with the anterior margin very slightly

depressed near the distal corner. Gnathopod 2; article 2 without antero-distal lobe, article 4 produced to an acute postero-distal tooth, article 5 cup-shaped, article 6 very large, longer than broad, nearly rectangular, a little widened to the palm, which is transverse, serrated with 6 subacute denticles, defined by a strong tooth from the hind margin; finger slightly convex at the middle of inner edge.

Peraeopods 1-5; finger each produced to a nail dorsally bearing two minute teeth as figured here. Peraeopods 1 and 2 slender. Peraeopods 3-5;

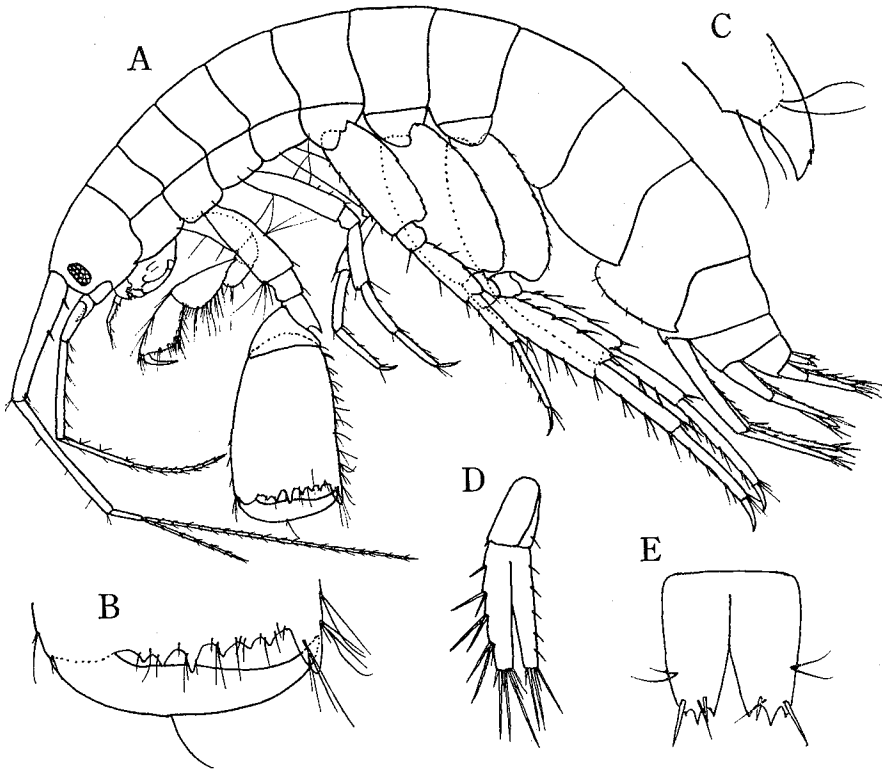


Fig. 31. *Maera serratipalma*, sp. nov. Male holotype, 7.0 mm: A, lateral view; B, end of gnathopod 2; C, nail of finger of peraeopod 5; D, uropod 3; E, telson.

article 2 with the hind margin minutely serrate, article 4 rather broad; article 2 of peraeopod 3 somewhat narrow, while those of peraeopods 4 and 5 moderately expanded; peraeopod 3 much shorter than peraeopods 4 and 5 which are subequal in length. Uropod 3 scarcely extending beyond the other uropods, rami equal or subequal in length, the apices truncate, armed with several unequal spines. Telson slightly longer than broad, deeply cleft, each lobe tridentate at the apex which is armed with a long and a short spine.

Holotype: KN No. 3055, male, 7 mm (figured). *Type locality*: St. 2 in Area VII, 4.0 m in high water, Jan. 23, 1957, *Zostera* belt, mud, W. T. 9.8°C, Cl. 18.16%.

Remarks: The new species is closely related to *M. inaequipes* (COSTA), *M. quadrimana* (DANA), and *M. pacifica* SCHELLENBERG, but distinguished from any of the above three species by a prominent sculpture of the palm of male gnathopod 2, a character unique among the hitherto known species of this genus, and which is consistently represented through the growth series up to 8.2 mm long in the materials at hand. In the specimens, female could not be distinguished from male by any prominent characters, particularly in gnathopod 2, both sexes show similar form both in the shape and in the size. In fact, this peculiarity is also indicated by WALKER on *M. scissimana* (1904, p. 273) that the size and shape of the hand of the second gnathopod is much the same in male and female.

Maerella tenuimana (BATE)

Maera tenuimana, STEBBING 1906, p. 436.

Maerella tenuimana, CHEVREUX 1911, p. 219, fig. 11 & pl. 15, figs. 1-13; CHEVREUX & FAGE 1925, p. 242, figs. 253-254.

Material examined: Area XI-b, 2 ovig. female specimens, 4.2 and 4.5 mm in length; from depths of 50-52 m, Sept. 4, 1960.

Remarks: The present female specimens agree fairly well with CHEVREUX's description and figures of *M. tenuimana*, except for the following minor details: The third article of mandibular palp is not fully falcate; dorsal armatures of pleon segments 1-6 shown by the arrangement of 1, 3, 3, 2, 2, 0 in order; uropod 3 with the rami rather broader than those of female figured by him.

Distribution: Coasts of Scotland, England, and France; Mediterranean (N. of Tunisia), 10-180 m.

Ceradocus (Denticeradocus) capensis SHEARD

(Fig. 32)

Maera rubromaculatus, STEBBING 1888, p. 1008 (part), pl. 95, E.

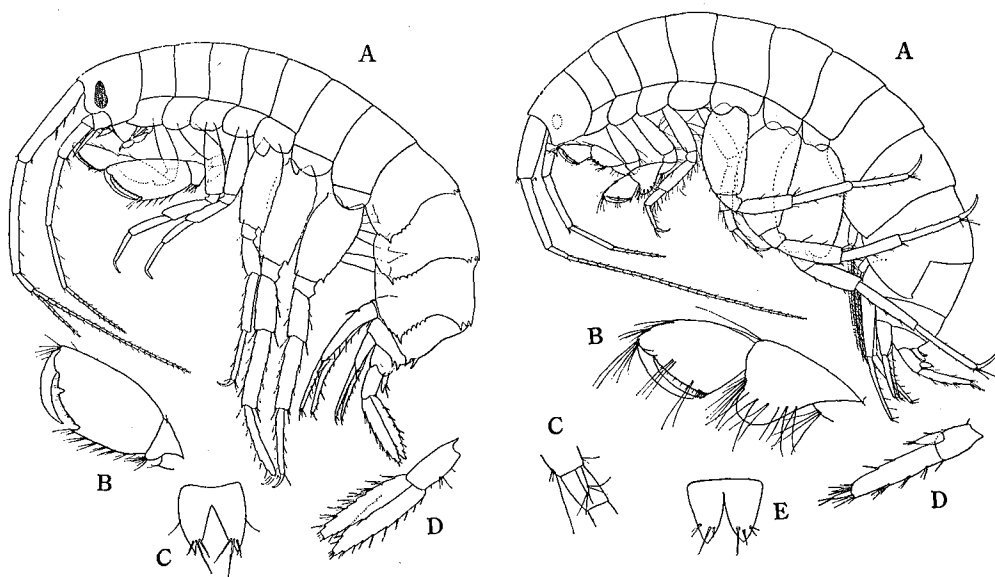
Ceradocus (D.) capensis SHEARD 1939, p. 290.

Material examined: Area XI-a, St. 8, 5 specimens, up to 12.5 mm long; from depths of 47-53 m, sandy mud.

Remarks: SHEARD in his paper of 1939 re-examined and revised the species of subgenus *Denticeradocus*, and divided into 7 species. Now following his key to the species, my specimens fall into *C. (D.) capensis*. However, the identification do not necessarily fully content myself in the following respect, e. g.

the lower hind corner of article 2 of peraeopods 3-5 rather similar to that of of *rubromaculatus*. SHEARD gave no full description and figures of this species, therefore the differences could not be fully examined.

Distribution: South Africa (off Cape Agulhas, 274 m, and Table Bay).



(Fig. 32)

(Fig. 33)

Fig. 32. *Ceradocus (D.) capensis* SHEARD. A, lateral view of female; B, male gnathopod 2; C, telson; D, uropod 3.

Fig. 33. *Eriopisella sechellensis* (CHEVREUX). A, lateral view; B, gnathopod 2; C, accessory flagellum of antenna 1; D, uropod 3; E, telson.

Eriopisa elongata (BRUZELIUS)

Eriopisa elongata, DELLA VALLE 1893, pl. 38, figs. 17-30 & pl. 60, fig. 5; SARS 1895, pl. 181, fig. 2; STEBBING 1906, p. 411.

Material examined: Only one male specimen, 7.2 mm long; from St. 10 in Area V, 1.8 m in depth, Mar. 1956.

Remarks: The specimen is well allied to *E. elongata* figured by SARS, except for the following respects: Accessory flagellum of antenna 1 one-jointed, and reaching beyond the end of the first primary flagellar article; peduncle of uropods 1-2 relatively long, particularly that of uropod 1 much longer than the rami, just like in *E. chilkinsis* (CHILTON 1921a, p. 531, fig. 4, as in *Niphargus c.*) from Chilka Lake, India; Each expansion of article 2 of peraeopods 3-5

like in *E. elongata*, but the posterior margin rather straight; the general appearance of peraeopods 1-5 rather similar to *E. chilensis*, except for article 2, particularly in the broader and stouter form of articles 4 and 5.

Otherwise, the specimen agrees entirely with *E. elongata*. Characteristic form of male gnathopod 2 of this specimen is very distinctive from both that of *E. chilensis* figured by CHILTON (l. c.) and that figured by K. H. BARNARD taken from Lower Bengal (1935, p. 283, fig. 3).

Distribution: Lofoten Isles to Great Britain and Mediterranean.

Eriopisella sechellensis (CHEVREUX)

(Fig. 33)

Eriopisa sechellensis CHEVREUX 1901, p. 403, figs. 19-23.

Niphargus chilensis, (not CHILTON 1921a), CHILTON 1925, p. 534, fig. 1.

Eriopisella sechellensis, K. H. BARNARD 1935, p. 284, fig. 4; RUFFO 1958, p. 6, figs. 1-2.

Gammaridae undet. sp., NAGATA 1960, p. 173, pl. 15, figs. 72-79 & pl. 16, figs. 80-92.

Material examined: Areas I (98), II (11), III (4), IV (201), VII (28), IX-d (2), X (9), XI-a (528), XI-b (35). Total: 916 specimens, up to 5.5 mm in length; from depths of *Zostera* belt near low water marks (where the tide does not entirely recede even in the spring tide) to 50 m. Generally inhabiting abundantly on the mud or sandy mud bottom deeper than low water marks, as the members of Ampeliscidae.

Remarks: The specimens seem referable to the present species without much doubt. Re-examination of the specimens at hand is as follows: Eyes small, round, the facets in some fresh specimens composed of three, light red, reticulated with milky white. Gnathopods 1 and 2; article 6 rather closely resembles that of CHILTON's figures of *Niphargus chilensis* than that of CHEVREUX's one of *Eriopisa sechellensis*, but the breadth of the article 6 is somewhat variable even in my specimens, although the shape is usually triangular and the palm is always longer than the hind margin. Peraeopods 3-5; finger nearly as described and figured by CHEVREUX, the shape unguiform, bearing one or two spinules at the base of the ungula (the slender form of the legs figured in my preceding paper was caused by not being depressed under the cover-glass). The apices of telson pretty variable in shape, rounded or pointed, sometimes rather notched just by the apical point. Coxa 1 sometimes strongly produced at the antero-distal corner as seen in CHEVREUX's figure.

J. L. BARNARD in his paper of 1962a (p. 110) created a new genus *Netamelita* having much close resemblance to the genus *Eriopisella*, from which it differs only in wanting the second article of the outer ramus of uropod 3, and he says that the undetermined genus and species of Gammaridae described by

me in 1960 should belong to the present new genus. However, he may have overlooked the genus *Eriopisella*, which perhaps be identical with *Netamelita*. In fact, *Netamelita cortada*, new species described therein appears to be much closely related to *E. sechellensis* figured by RUFFO (l. c.) in the similar shapes of articles 5 and 6 of gnathopods 1 and 2.

Distribution: Seychelles Is. (CHEVREUX); Tale Sap, Siam (CHILTON); Travancore, India (K. H. BARNARD).

Megaluropus agilis HOEK

Megaluropus agilis, DELLA VALLE 1893, pl. 34, figs. 1-17; STEBBING 1906, p. 420; CHEVREUX & FAGE 1925, p. 226, figs. 236-237; GURJANOVA 1951, p. 745, fig. 515.

Material examined: Area XI-b, 5 female specimens, up to 4.2 mm in length; St. 22, 54-56 m in depth, Sept. 4, 1960.

Remarks: The specimens agree well with CHEVREUX & FAGE's description and figures.

Distribution: Widely distributed along the European coasts; Kattegat, Holand, Firth of Forth, Liverpool Bay, English Channel, Bristol Channel, France, Gulf of Naples, and Black Sea.

Family DEXAMINIDAE

Key to the species of Dexaminidae

Lateral lobes of head with an acute point at apex *Paradexamine barnardi*
Lateral lobes of head rounded at apex *Paradexamine flindersi*

Paradexamine flindersi (STEBBING)

Dexamine flindersi STEBBING 1888, pl. 137c.

Guerneia flindersi, STEBBING 1906, p. 522, fig. 92.

Paradexamine flindersi, STEBBING 1910, p. 603, pl. 52; SHEARD 1938, p. 185.

Material examined: Area IV, 8 specimens (6 females, 2 males) up to 5.8 mm in length; from depths of 10-25 m.

Distribution: Flinders Passage, Bass Strait, 15 m; off Port Hacking, and off Wata Mooli, 54-59 fathoms.

Paradexamine barnardi SHEARD

(Fig. 34)

Paradexamine barnardi SHEARD 1938, p. 178, fig. 6.

Paradexamine pacifica (non THOMSON), NAGATA 1960, p. 174, pl. 16, fig. 93.

Material examined: Areas I (1), IV (1643), V (11), VI (77), VII (72), IX-b (644),

IX-d (875), XIII-a (2), XIII-b (48). Total: 3373 specimens, up to 6.0 mm in length. Abundantly found in *Zostera* belt near low water mark.

Remarks: After the Seto Inland Sea specimens had been referred to *P. pacifica* in my preceding paper (l. c.), Dr. K. SHEARD kindly sent me his copy on the genus *Paradexamine* in which he analyzed strictly their distinction among the eight species of this genus.

According to his paper, the specimens are conformed with *P. barnardi* of the *pacifica* group. This species is much closely related to *P. pacifica*, but

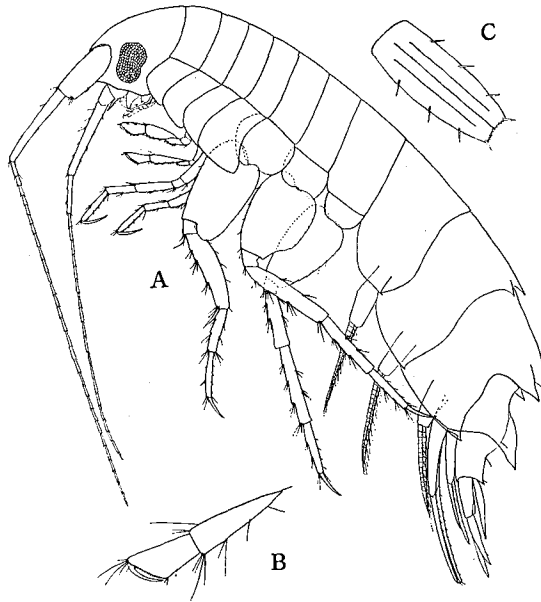


Fig. 34. *Paradexamine barnardi* SHEARD. A, lateral view of female; B, gnathopod 2; C, telson.

distinguished by the following two characteristics; 1) gnathopod 2, article 5 more than 1.5 times as long as article 6, 2) lower lip with one minute tooth on the apex of each outer lobe.

Distribution: Off Three Kings Islands, north of New Zealand (coll. by 'Terra Nova' Expedition). This species is also recorded by me from *Zostera* belt of Mutsu Bay, northern Japan.

Family TALITRIDAE

Orchestia platensis japonica (TATTERSALL)

Talorchestia japonica TATTERSALL 1922, p. 452, pl. 21, figs. 1-10.

Orchestia japonica, STEPHENSEN 1935, p. 6.

Orchestia platensis japonica IWASA 1939, p. 261, pl. 10 & text-figs. 4-6; STEPHENSEN 1944, p. 59, fig. 17.

Material examined: A large number of specimens from high water marks of Area IX; max. 14.3 mm long, male (see Part II).

Distribution: Widely distributed on the beach of Japan from Hokkaidō (Wakkanai) to Danzyō Is., west of Kyūshū; sometimes limicolous, terricolous.

Family HYALIDAE

Key to the species of Hyalidae

1. Gnathopod 2 in male, article 5 masked behind by article 4 2
1. Gnathopod 2 in male, article 5 produced between articles 4 and 6 3
 2. Finger of pereopods minutely pectinate *Hyale grandicornis*
 2. Finger of pereopods smooth, not pectinate *Hyale schmidtii*
3. Antenna 2 strongly feathered below *Allorchestes plumicornis*
3. Antenna 2 not feathered below *Allorchestes angustus*

Hyale grandicornis (KRÖYER)

Hyale prevostii (part), DELLA VALLE 1893, pl. 2, fig. 6 & pl. 16, figs. 23-42.

Nicea novaezealandiae THOMSON 1879, p. 235, pl. 10-B, figs. 1, a-f.

Hyale novaezealandiae, STEBBING 1906, p. 567; IWASA 1939, p. 276, pl. 16 & text-fig. 16.

Hyale grandicornis, STEBBING 1906, p. 566; K. H. BARNARD 1916, p. 230; RUFFO 1950, p. 55; K. H. BARNARD 1955, p. 93, fig. 46; HURLEY 1957, p. 904, figs. 1-23 (with two forms *novaezealandiae* and *thomsoni*).

Material examined: Area XIV, 11 specimens, up to 10 mm in length; among algae near low water marks, May 31, 1962.

Distribution: Chile (Valparaiso), New Zealand, South Africa, South Atlantic (Gough I.), S. W. of New Zealand (Macquarie I.), Antarctica (Commonwealth Bay), and Japan, where it is known by IWASA, found among algae near low water marks from Hokkaidō to Kyūshū.

Hyale schmidtii (HELLER)

Hyale schmidtii, STEBBING 1906, p. 571; CHEVREUX 1911, p. 237, pl. 16, figs. 9-12; CHEVREUX & FAGE 1925, p. 288, fig. 299; IWASA 1939, p. 278, pl. 17 & text-fig. 17.

Material examined: Area XIV, 30 specimens, up to 8.0 mm long; among algae near low water marks, May 31, 1962.

Distribution: Azores, Canary Is. (Tenerife), Portugal, and Mediterranean; Japan and the neighboring waters (Hokkaidō and Korea Strait),

Allorchestes angustus DANA

Allorchestes angustus, J. L. BARNARD 1952, p. 20, pl. 5, figs. 2-6; J. L. BARNARD 1954a, p. 21, pl. 21.

Allorchestes malleolus STEBBING 1899, p. 409, pl. 33-A; IWASA 1939, p. 285, pl. 20, text-figs. 20-22.

Material examined: Area X, only one male specimen, 9 mm long; St. 2, 20-23 m in depth, June 2, 1959.

Remarks: This species is also recorded by me from the inshore waters near Shirikishinai, Hokkaidō.

Distribution: East China Sea, Korea Strait, Japan Sea (E. of Korea) (STEBBING, 1899); coasts of Oregon and California (DANA, STIMPSON, STOUT, and J. L. BARNARD). On the Japanese coast, found on the beaches of Akkeshi, Muroran and Birō in Hokkaidō, by IWASA.

Allorchestes plumicornis (HELLER)

Allorchestes plumicornis, STEBBING 1899, p. 412, pl. 33-C; STEBBING 1906, p. 583; CHEVREUX & FAGE 1925, p. 291, fig. 302; IWASA 1939, p. 289, pl. 22, text-figs. 25-26; STEPHENSEN 1944, p. 71, fig. 25.

Material examined: One male specimen, ca. 8.0 mm in length, from the tide pool of Area IX, Jan. 20, 1958.

Distribution: Mediterranean, and Japan (Hokkaidō and Japan Proper).

Family AORIDAE

Key to the species of Aoridae

- | | |
|---|---------------------------|
| 1. Antenna 1, accessory flagellum well developed | <i>Aora typica</i> |
| 1. Antenna 1, accessory flagellum absent or rudimentary | 2 |
| 2. Gnathopod 1 in male densely setiferous | <i>Aoroides secunda</i> |
| 2. Gnathopod 1 in male not densely setose | <i>Aoroides columbiae</i> |

Aora typica KRØYER

Aora typica, THOMSON 1879a, p. 331; THOMSON 1881, p. 216; STEBBING 1906, p. 587, fig. 101; CHEVREUX 1907, p. 510; CHEVREUX 1911, p. 242; CHILTON 1911, p. 565; K. H. BARNARD 1916, p. 236; CHEVREUX & FAGE 1925, p. 293, figs. 304-305.

Aora gracilis, SARS 1895, pl. 193.

Aora kergueleni STEBBING 1888, pl. 109, figs. a, d.

Aora trichobostrychus STEBBING 1888, pl. 109, figs. b, c.

Microdeutopus maculatus THOMSON 1879a, p. 331, pl. 16, figs. 5-8; THOMSON 1881, p. 217, pl. 8, figs. 7a-c.

Material examined: Areas IV (17), VI (21), VII (30), XIII-b (5). Total: 73 specimens, up to 7.0 mm long. Found from *Zostera* belt near low water marks

to a depth of 5.5 m in low water.

Remarks: Male gnathopod 1 of a specimen of 6.5 mm long resembles fairly well in the general appearance that of SARS' figure of *A. gracilis*, but article 2 with a triangular tooth on the anterior margin as in New Zealand specimen described by THOMSON (1881, p. 217); the apex of article 4 not always reaching the end of article 5; article 5 much elongate, longer than article 2, about 4 times as long as wide; article 6 about three fifths as long as article 5, bearing a minute tooth at the postero-distal end, but has no spine on the posterior margin; finger about two thirds the length of article 6; several fascicles of long setae are seen on the distal end of article 6.

Male gnathopod 2, female gnathopods 1-2, peraeopod 1, and the slender mandibular palp are all nearly like in those of *A. trichobostrychus* figured by STEBBING. Pleonal epimera 1-3 each with a tooth at the lower hind corner, the tooth also seen in the third pleonal epimeron described and figured by CHEVREUX & FAGE. The palp of maxilla 1 lined with several simple, slender spines along the inner margin above half the length. The most peculiar feature of my specimens is that the lower lip has the principal lobes excavated on the same portion as seen in the species of Ampithoidae, and the mandibular process somewhat strongly constricted at the base. It is also noted that coxae 1-4 somewhat shallower in comparison with the corresponding peraeon segment than in SARS' figure of *A. gracilis*, and pleon segment 4 dorsally with a pair of seta. Antenna 2 and peraeopods 3-5 are missing on all the specimens at hand.

Distribution: From the coast of Norway to South Africa; Mediterranean. Indian Ocean: Kerguelen Is. South Pacific: Australia, New Zealand, Chile, Gambier Archipelago, Kermadec Is., and Auckland Is.

Aoroides columbiae WALKER

Aoroides columbiae WALKER 1898, p. 285, pl. 16, figs. 7-10; STEBBING 1906, p. 586; J. L. BARNARD 1954a, p. 24, pl. 22; NAGATA 1960, p. 175, pl. 16, fig. 94.
Aoroides californica ALDERMAN 1936, p. 63, figs. 33-38.

Material examined: Areas I (101), III (1), IV (580), V (14), VI (7), VII (72), IX-b (2), IX-d (55), XI-b (1), XII (27), XIII-b (6). Total: 866 specimens, up to 5.0 mm long; *Zostera* belt near low water mark to a depth of 20-25 m.

Distribution: Puget Sound, and California.

Aoroides secunda GURJANOVA

Aoroides secunda GURJANOVA 1951, p. 828, fig. 579.

Material examined: Areas IX-d (16), XIII-a (1), XIII-b (3); up to 5.0 mm long, found between near low water mark and 2 m line at the outside.

Remarks: This species is characterised by male gnathopod 1 covered all over with a thick brush of plumose setae, but the specimens are not entirely conformed with GURJANOVA's description and figures. Eyes small, subtriangular (narrowing below). Antenna 1 without accessory flagellum; flagellum of antenna 2 with three joints, each tipped with a long curving strong spine. Mandibular palp very slight as in *A. columbiae*, but the article 2 about twice as long as article 1, article 3 two thirds the length of article 2, and only furnished with two long setae on the top of article 3. Peraeopod 5 much longer and slender in proportion to his figure, and much longer than the preceding peraeopods. Telson longer than broad, narrowing distally, the apex rounding in male, excavated in female in dorsal view respectively, with 2-3 setae on each side of the apex. Color whitish, with speckling of small black spots, particularly along the articulate line of body segments.

Distribution: Russian coast of the Japan Sea (intertidal zone of inlets).

Family PHOTIDAE

Key to the species of Photidae

1. Uropod 3 with inner ramus much smaller than the outer 2
1. Uropod 3 with the rami not very unequal 3
 2. Lateral lobes of head little produced *Photis reinhardi*
 2. Lateral lobes of head much produced *Photis longicaudata*
3. Antenna 1, accessory flagellum well developed 4
3. Antenna 1, accessory flagellum obsolete *Podoceroopsis nitida*
 4. Gnathopod 2, article 6 broad, oval form *Eurystheus japonicus*
 4. Gnathopod 2, article 6 narrow, club-shaped *Eurystheus utinomii*

Photis reinhardi KRØYER

Photis reinhardi, Sars 1895, p. 569, pl. 202; STEBBING 1906, p. 607; SHOEMAKER 1930, p. 338; STEPHENSEN 1940, p. 61; STEPHENSEN 1942, p. 369; SCHELLENBERG 1942, p. 200, fig. 165; STEPHENSEN 1944a, p. 23; STEPHENSEN 1944b, p. 117; SHOEMAKER 1945, p. 3, fig. 1; GURJANOVA 1951, p. 843, fig. 590.

Material examined: Areas IV (2185 specimens in total, putting together with *Photis longicaudata*), XI-a (59), XI-b (5). Length: up to 5.0 mm. Found from depths of 10-56 m.

Distribution: A boreo-arctic species; in North Atlantic, south to the coast of Connecticut, and to North Sea; in North Pacific, through Bering Sea and Okhotsk Sea, to the Japan Sea.

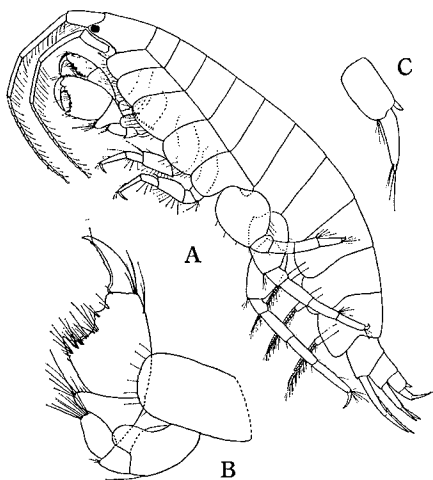
Photis longicaudata (BATE & WESTWOOD)

(Fig. 35)

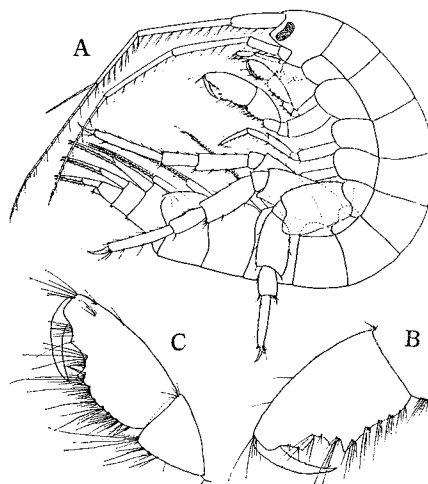
Photis longicaudata, Sars 1895, p. 571, pl. 203, fig. 1; WALKER 1904, p. 286, pl. 6, fig. 43; STEBBING 1906, p. 608; WALKER 1909, p. 339; CHEVREUX 1911, p. 249; STEPHENSEN 1915, p. 51; CHEVREUX & FAGE 1925, p. 310, fig. 319; SCHELLENBERG 1926a, p. 231; SCHELLENBERG 1928, p. 662; K. H. BARNARD 1937, p. 164; SCHELLENBERG 1942, p. 201, fig. 166; SHOEMAKER 1945, p. 11, fig. 5; REID 1951, p. 262.

Material examined: Areas IV (2185 specimens in total, putting together with *Photis reinhardi*), XI-a (106), XI-b (9); up to 8.0 mm in length; from depths of 10-56 m.

Distribution: From the south-west coast of Norway, along the European coasts, southwards to the tropical coast of West Africa; Gulf of Mexico;



(Fig. 35)



(Fig. 36)

Fig. 35. *Photis longicaudata* (BATE & WESTWOOD). A, lateral view of male; B, male gnathopod 2; C, uropod 3.

Fig. 36. *Eurystheus japonicus* NAGATA. A, lateral view of male; B, male gnathopod 2; C, female gnathopod 2.

Mediterranean and Suez Canal; on the coast of Indian Ocean, South Arabian coast, British East Africa, Amirante, Seychelles, Cargados, Ceylon, and Chilka Lake. Also known from the west coast of Greenland, and Franz Josef Land, according to SCHELLENBERG (1942).

Eurystheus japonicus NAGATA

(Fig. 36)

Eurystheus japonicus NAGATA 1961a, p. 32, fig. 1.

Material examined: Areas IV (10), VI (12) XI-a (1), XI-b (3), XIII-a (1); up to 8.0 mm in length; from depths of 2-46 m.

Distribution: Known only from Japan; Mutsu Bay to the west coast of Kyūshū.

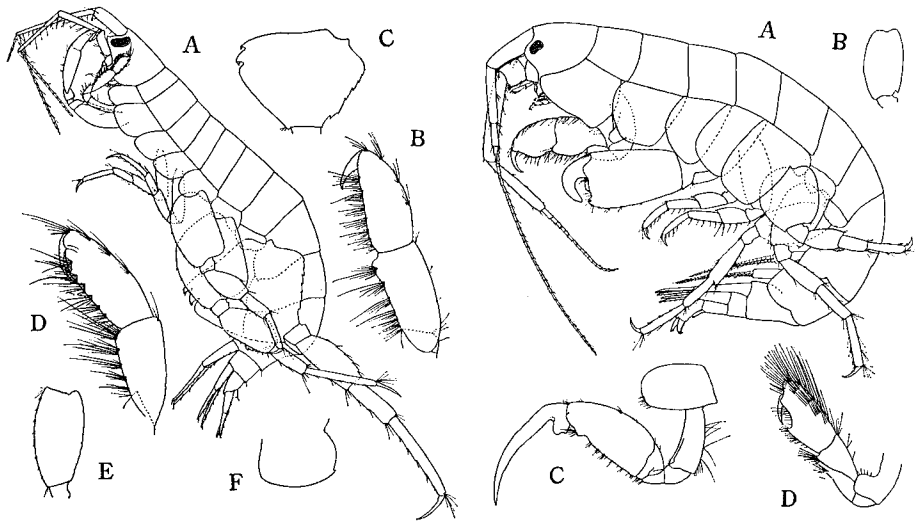
Eurystheus utinomii NAGATA

(Fig. 37)

Eurystheus utinomii NAGATA 1961a, p. 34, fig. 2.

Material examined: Areas IV (1702), XI-a (56), XI-b (3); up to 8.5 mm in length; from depths of 10-56 m.

Distribution: Known only from Japan; also found off Tsuyazaki, Kyūshū by me.



(Fig. 37)

(Fig. 38)

Fig. 37. *Eurystheus utinomii* NAGATA. A, lateral view of male; B, male gnathopod 2; C, article 2 of male pereopod 5; D, female gnathopod 2; E, article 2 of female pereopod 5; F, pleonal epimeron 3.

Fig. 38. *Ampithoe valida* SMITH: A, lateral view of male; B, article 2 of pereopod 4. *Ampithoe orientalis* DANA: C, male gnathopod 2. *Ampithoe ramondi* AUDOUIN: D, male gnathopod 2.

Podoceropsis nitida (STIMPSON)

Podoceropsis excavata, SARS 1895, p. 576, pl. 205.

Podoceropsis nitida, HOLMES 1908, p. 543; STEBBING 1906, p. 620; CHEVREUX & FAGE 1925, p. 317, fig. 326; SHOEMAKER 1930, p. 342; SCHELLENBERG 1942, p. 194, fig. 161; STEPHENSEN 1944a, p. 26; GURJANOVA 1951, p. 855, fig. 600.

Material examined: Areas XI-a (2), XI-b (2); up to 9.0 mm in length; from depths of 47-56 m.

Distribution: From Norwegian coast, around Faroes and Iceland, to Great Britain and France; Davis Strait to Rhode Island; East Siberian Sea, Chukot Sea, Bering Sea, Alaska (Alitak Bay, Kadiak Bay), and Japan Sea (Bay of the Great Peter).

Family AMPITHOIDAE

Key to the species of Ampithoidae

1. Third pleonal epimeron with the lower hind corner produced into a small, rounded tooth *Ampithoe lacertosa*
1. Third pleonal epimeron with the lower hind corner rounded 2
 2. Gnathopod 2 in male, palm transverse *Ampithoe valida*
 2. Gnathopod 2 in male, palm oblique 3
3. Gnathopod 2 in male, palm defined by a conspicuous tooth from the posterior margin *Ampithoe ramondi*
3. Gnathopod 2 in male, palm undefined from the hind margin *Ampithoe orientalis*

Ampithoe lacertosa BATE

Ampithoe lacertosa, DELLA VALLE 1893, pl. 57, fig. 37; STEBBING 1906, p. 633; J. L. BARNARD 1954a, p. 31, pls. 29-30; NAGATA 1960, p. 175, pl. 16, figs. 95-96.

Amphithoe macrurus STEPHENSEN 1944, p. 80, figs. 30-31.

Amphithoe japonica STEBBING 1888, p. 1124, pl. 138-A; GURJANOVA 1951, p. 895, fig. 621.

Material examined: Areas IV (909), V (32), VI (26), VII (24), IX-a (7), IX-b (51), IX-c (5), IX-d (1), XIII-a (2), XIII-b (19), XIV (1). Total: 1077 specimens, up to 25.0 mm in length. Popular among algae or eelgrass in *Zostera* belt near low water marks, and also found among the floating kelp.

Remarks: *Amphithoe macrurus* STEPHENSEN from Port Shimizu of Japan is referred to *A. lacertosa* by J. L. BARNARD in his paper of 1954a. In Challenger Report of 1888, STEBBING described a new species, *A. japonica* from Kōbe Bay of the Seto Inland Sea, and his description is based on the three specimens comprising only females. I have had a large number of materials referred to *A. japonica* from the other various localities of the Japanese coast as well as from the Seto Inland Sea, and it is unable to be distinguished *A. lacertosa* at all from the present female specimens of *A. japonica* in the essential characters; for instance, in the forms of gnathopods 1-2, in the powerful peduncle of uropod 3, and moreover in having a small tooth at the lower hind corner of the third pleonal epimeron, the last character is said by J. L. BARNARD to be unique in the species of this genus.

On the other hand, GURJANOVA in his paper of 1951 described a male of *A. japonica*, and the male gnathopod 2 figured therein appears to have no

particular difference in the structure from those of both *A. lacertosa* figured by J. L. BARNARD and *A. macrurus* by STEPHENSEN. He says there that *A. japonica* is widely distributed in the Japan Sea, found among seaweed on the bottom between 0-50 m in depth along the coasts of Hokkaidō and the Russian side of the Japan Sea. I have already mentioned briefly in my preceding paper about the northern specimens of Japan of *A. lacertosa* found from the inshore waters near Shirikishinai, east of Hakodate, Hokkaidō, whose male gnathopod 2 has such a cheliform component as figured by J. L. BARNARD (1954a, pl. 29, F), and those northern ones are otherwise entirely the same as those from the Seto Inland Sea in their characters. Even among Seto Inland Sea specimens, a slight indication of the transition to cheliform could be occasionally seen in the larger ones more than about 20 mm long. Differences of the relation between the degree of the chelate formation and the size of animals, or relative length of the peduncle of uropod 3 to the rami, are probably due to those of each environmental condition in the various localities inhabited by the animals. STEBBING says in the last part on the new species, "The great similarity which prevails among the more or less definitely ascertained species of this genus, and the scantiness of the details which in many instances have been thought sufficient for their identification, necessarily leave new species on a very insecure footing. To review all the species of *Amphithoe* will be a task by itself for any one who is willing to undertake it." It is, thus, pretty sure that *A. japonica* is a synonym of *A. lacertosa*, and the former is only a stage in the process of development towards the latter.

Distribution: A boreo-arctic form; to Oregon southwards on the Pacific coast of North America, and to the Japan Sea in the north-western Pacific.

Amphithoe valida SMITH

(Fig. 38, A-B)

Amphithoe valida, STEBBING 1906, p. 635; ALDERMAN 1936, p. 68; J. L. BARNARD 1954a, p. 34, pl. 31; NAGATA 1960, p. 176, pl. 16, figs. 97-98.

Amphithoe shimizuensis STEPHENSEN 1944, p. 77, figs. 28-29.

? *Amphithoe mitsukurii* DELLA VALLE 1893, pl. 57, figs. 30-32.

Material examined: Areas IV (539), V (1), IX-b (2); up to 20.0 mm in length. Found in *Zostera* belt near low water marks.

Remarks: According to STEBBING's mention in his "Tierreich", *A. mitsukurii* is known from Japan, and judging from DELLA VALLE's figures, this species is probably identical with *A. valida*. His text is, unfortunately, unavailable to me.

Distribution: North Atlantic; New Jersey and Long Island Sound. In North Pacific, from California, Oregon, and Japan. Mediterranean (?).

Ampithoe ramondi AUDOUIN

(Fig. 38, D)

Ampithoe ramondi, SCHELLENBERG 1928, p. 665; K. H. BARNARD 1935, p. 305; K. H. BARNARD 1937, p. 170; PIRLOT 1938, p. 346; SCHELLENBERG 1938, p. 87; K. H. BARNARD 1940, p. 480; SHOEMAKER 1942, p. 40; J. L. BARNARD 1955, p. 28.

Ampithoe vaillantii, WALKER 1904, p. 291; STEBBING 1906, p. 639; CHEVREUX 1911, p. 260, pl. 20, figs. 1-4; STEPHENSEN 1915, p. 51; K. H. BARNARD 1916, p. 253; CHEVREUX & FAGE 1925, p. 333, figs. 341-342; GURJANOVA 1951, p. 880, fig. 614.

Ampithoe intermedia WALKER 1904, p. 290, pl. 7, fig. 46; WALKER 1909, p. 341; CHEVREUX 1907, p. 515, fig. 29; SHOEMAKER 1921, p. 102.

Ampithoe lobata WALKER 1909, p. 342, pl. 43, fig. 9.

Ampithoe divisura SHOEMAKER 1933, p. 255, fig. 9.

Material examined: Areas IX-b (4), IX-c (3), IX-d (8), XIII-a (6), XIII-b (4), XIV (4). Total: 29 specimens, up to 8.5 mm in length. Found among sea weed in depths of low water mark to 4 m.

Distribution: Very frequent in the tropical and subtropical seas.

Ampithoe orientalis DANA

(Fig. 38, C)

Ampithoe orientalis, STEBBING 1906, p. 641; J. L. BARNARD 1955, p. 26, fig. 14.

Material examined: Areas XIII-a (1), XIII-b (1); 8.0 mm and 9.5 mm in length, both males, found in the *Zostera* belt near low water marks.

Distribution: Philippine Is. and Hawaiian Is.

Family ISCHYROCERIDAE

Key to the species of Ischyroceridae

Coxa 5 much deeper than coxa 6 *Jassa falcata*
Coxa 5 not much deeper than coxa 6 *Microjassa cumbrensis*

Jassa falcata (MONTAGU)

Jassa falcata, SEXTON & REID 1951, pp. 29-91, pls. 4-30 (with many references).

Material examined: Areas IX-d (1), XII (43); up to 5.0 mm in length.

Distribution: Cosmopolitan, except for the polar circles.

Microjassa cumbrensis (STEBBING & ROBERTSON)

Podocerus cumbrensis STEBBING & ROBERTSON 1891, p. 38, pl. 6, B.

Microjassa cumbrensis, STEBBING 1906, p. 651; CHEVREUX & FAGE 1925, p. 350, fig. 358.

Material examined: One female specimen, 2.5 mm long from Area IX-d.

Remarks: Three species of this genus have hitherto been known: *M. macrocoxa* SHOEMAKER (1942, p. 44, figs. 16-17), *M. litotes* J. L. BARNARD (1954, p. 127, pls. 35-36), and the present species. The specimen is undoubtedly referred to this species, for I have examined several specimens of the species (up to 4.5 mm long, including males) from Ariake Sea, the west coast of Kyūshū, and the male gnathopod 2 agrees well with that of CHEVREUX & FAGE's figure.

Distribution: Known from the coasts of England and France.

Family COROPHIIDAE

Key to the species of Corophiidae

- | | |
|---|--------------------------------|
| 1. Mandibular palp 2-jointed | 2 |
| 1. Mandibular palp 3-jointed | 10 |
| 2. Pleon segments 4-6 separate | 3 |
| 2. Pleon segments 4-6 coalesced | 4 |
| 3. Uropod 3, ramus ovate | <i>Corophium volutator</i> |
| 3. Uropod 3, ramus long and narrow | <i>Corophium kitamorii</i> |
| 4. Lateral lobes of head acute | <i>Corophium crassicorne</i> |
| 4. Lateral lobes of head not acute | 5 |
| 5. Antenna 2, peduncular article 4 with a large terminal tooth | (Male) |
| 6. Antenna 2, peduncular article 4 without such a tooth | (Female) |
| 6. Rostrum triangular, short | <i>Corophium acherusicum</i> |
| 6. Rostrum lanceolate, long | 7 |
| 7. Antenna 1, peduncular article 1 with a blunt outgrowth on inner surface about opposite middle of rostrum | <i>Corophium insidiosum</i> |
| 7. Antenna 1, peduncular article 1 without such a outgrowth | <i>Corophium uenoi</i> |
| 8. Antenna 2, peduncular article 4 with spines set in a single row | <i>Corophium uenoi</i> |
| 8. Antenna 2, peduncular article 4 typically with spines set in pairs, except the terminal one | 9 |
| 9. Antenna 2, peduncular article 4 typically with 3 pairs of spines and a single terminal one | <i>Corophium acherusicum</i> |
| 9. Antenna 2, peduncular article 4 typically with 2 pairs of spines and a single terminal one | <i>Corophium insidiosum</i> |
| 10. Uropod 3, ramus much shorter than peduncle | 11 |
| 10. Uropod 3, ramus longer than peduncle | 12 |
| 11. Uropod 2 biramous | <i>Erichthonius pugnax</i> |
| 11. Uropod 2 uniramous | <i>Cerapus tubularis</i> |
| 12. Third pleonal epimeron with the lower posterior corner quadrate | |
| | <i>Grandidierella japonica</i> |
| 12. Third pleonal epimeron with the lower posterior corner completely rounded | |
| | <i>Unciolella lunata</i> |

Corophium volutator (PALLAS)

Corophium volutator, STEBBING 1906, p. 686; CHEVREUX & FAGE 1925, p. 364, figs. 371-372; CRAWFORD 1937, p. 595; SCHELLENBERG 1942, p. 218, fig. 177; STEPHENSEN 1942, p. 409; SHOEMAKER 1947, p. 51, fig. 1, k-n; GURJANOVA 1951, p. 981, fig. 683.

Corophium grossipes, Sars 1895, pl. 219.

Corophium bicaudatum, DELLA VALLE 1893, pl. 56, figs. 2-6.

Material examined: Area II, 24 specimens, up to 5.8 mm in length.

Remarks: There is nothing to remark particularly here, except for the first peduncular article of antenna 1, which is armed usually with only a spine on the lower margin near the distal end.

Distribution: From W. Norway, along the European coast, into Mediterranean, to Adriatic Sea and Black Sea (Sea of Azov); the coast of Senegal; Bay of Fundy, and Maine.

Corophium acherusicum COSTA

Corophium acherusicum, CHEVREUX 1911, p. 271; K. H. BARNARD 1916, p. 272 (part); CHEVREUX & FAGE 1925, p. 368, fig. 376; CRAWFORD 1937, p. 617, fig. 2-P; SHOEMAKER 1947, p. 53, figs. 2-3; SHOEMAKER 1949, p. 76; REID 1951, p. 269; GURJANOVA 1951, p. 977, fig. 680; J. L. BARNARD 1954a, p. 36; HURLEY 1954a, p. 442, figs. 35-39; J. H. BARNARD 1955, p. 37; IRIE 1956, p. 5, fig. 6; NAGATA 1960, p. 177.

Material examined: Areas I (5), IV (979 in total, putting together with both *C. insidiosum* and *C. uenoi*), V (1), VI (5), VII (1), VIII (1), IX-d (23), XII (56); all up to 5.5 mm in length.

Distribution: From the European coast to the tropical West Africa; Mediterranean and Black Sea; Suez Canal; the coast of East Africa (Dar-es-Salaam and Durban Bay); Baffin Bay to Brazil; British Columbia to California; Hawaiian Is., New Zealand, Hong Kong (from a ship's bottom), and Japan.

Corophium crassicorne BRUZELIUS

Corophium crassicorne, Sars 1895, pl. 220; WALKER 1904, p. 294; STEBBING 1906, p. 690, figs. 116-118; CHILTON 1925, p. 538; CHEVREUX & FAGE 1925, p. 367, fig. 375; CRAWFORD 1937, p. 607, fig. 4, a-f; STEPHENSEN 1942, p. 410; STEPHENSEN 1944b, p. 132; SHOEMAKER 1947, p. 53, fig. 4; SHOEMAKER 1949, p. 76; GURJANOVA 1951, p. 976, fig. 679.

Material examined: St. 20 in Area XI-b, 5 specimens (one juvenile, four females, ovig.), 2.5-3.7 mm in length; 47-52 m in depth, Sept. 4, 1960.

Distribution: Jan Mayen, Murman Coast (Kola Bay), Barents Sea, White Sea, East Greenland; from Norwegian coast and Faroes, along the European coast to the Black Sea, by far extending to Ceylon and Tale Sap; on the east coast of North America, from Bay of Fundy to New York (Long Island); on the Pacific coast, Alaska (Chichagof I.), E. of Kamchatka, and the Japan Sea.

Corophium uenoi STEPHENSEN

Corophium uenoi STEPHENSEN 1932, p. 414, figs. 3-4; CRAWFORD 1937, p. 616; J. L. BARNARD 1952, p. 28, pls. 8-9; J. L. BARNARD 1959c, p. 39; NAGATA 1960, p. 178.

Material examined: Areas IV (see *C. acherusicum*), IX-d (47), XI-a (20), XIII-a (1), XIII-b (16); all up to 5.5 mm in length.

Distribution: Japan and California.

Corophium insidiosum CRAWFORD

Corophium insidiosum CRAWFORD 1937, p. 615, fig. 2, a-g; SHOEMAKER 1947, p. 53, figs. 6-7; SHOEMAKER 1949, p. 77; J. L. BARNARD 1959c, p. 38; NAGATA 1960, p. 177.

Material examined: Areas IV (see *C. acherusicum*), up to 4.7 mm in length.

Distribution: England, Denmark, Germany, and Italy; on the west coast of North America, Massachusetts (Newburyport) and New York (Amityville, Long Island); on the Pacific coast, Washington to Chile (Talcahuano); and Japan.

Corophium kitamorii, sp. nov.

(Fig. 39)

Material examined: Areas I (2), III (4), IV (6), VI (2), X (1), XI-a (3). Total: 18 specimens, 3.9-6.0 mm in length, from depths of 3-49 m.

Description: Segments of urosome separate. Head with the front broadly convex, without a true rostrum; lateral lobes of head narrowly rounding at the apex; eyes not well developed (eyes position figured here are not right, and they are properly placed into lateral lobes). Antenna 1 rather slender; in male about as long as the head to pleon segment 2 combined; peduncular article 1 subequal in length to article 2, expanded on the upper surface, bearing an outgrowth near the base of the inner edge, and two spines on the lower edge, one near the outgrowth, the another near the distal end; peduncular article 3 one half the length of the article 2; flagellum 11-jointed, about as long as peduncular articles 2 and 3 combined. Antenna 2 of a single male specimen unfortunately missing. Antenna 1 in female a little longer than antenna 2; the first peduncular article shorter than the second and third combined, bearing 2-5 spines on the proximal half of the inner edge, and 3-4 spines on the lower edge; flagellum with 11-12 joints, nearly as long as peduncular articles 1 and 2 combined. Antenna 2 in female bearing 3-4 spines on the lower edge of the fourth article of peduncle, the fifth without spines, flagellum 3-jointed.

Gnathopod 1 nearly like in *C. annulatum* CHEVREUX (1908, p. 73, figs. 4-5). Gnathopod 2 in male; finger long and slender, curved, nearly two thirds as long as article 6, otherwise gnathopod 2 rather like in *C. aculeatum* CHEVREUX (1908, p. 70, figs. 1-3) than in *C. annulatum*, particularly in relatively narrower article 6. Gnathopod 2 in female nearly like in male, except that finger very

narrow and delicate, not curved but linear, slightly narrowing towards the distal end, which is not acute, bearing two long setae.

Peraeopods 1 and 2; article 5 proportionally long, about as long as article 4, finger shorter than article 6. Uropod 3, ramus narrow, longer than peduncle, both margin spinose.

Holotype: KN No. 2979, male, 4.6 mm. *Type locality*: St. 9 in Area XI-a,

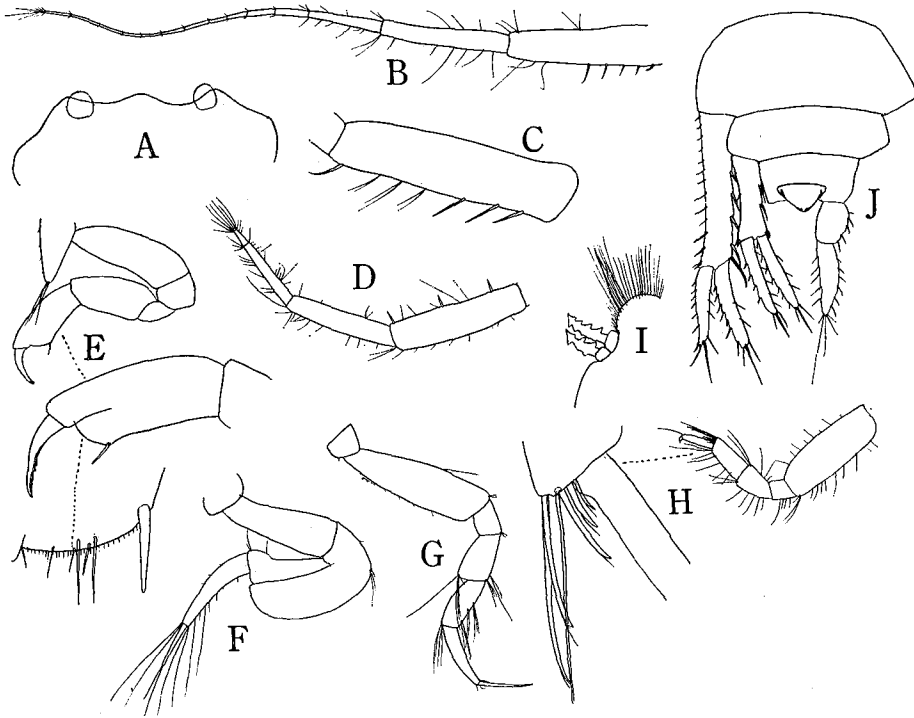


Fig. 39. *Corophium kitamorii*, sp. nov. Female, 6.0 mm: A, front of head, upper view; B, right antenna 1, upper view; C, right antenna 1, peduncular article 1 magnified, inner side view; E, F, gnathopods 1 and 2; I, inner side of peduncle of pleopod 3; J, urosome and uropods 1-3. Female, 5.0 mm: D, left antenna 2, articles 4 and 5 of peduncle, and flagellum, inner side view; G, peraeopod 1; H, peraeopod 3, with posterodistal corner of article 5 magnified.

42-49 m in depth, June 14, 1959.

Remarks: The new species is closely related to *C. annulatum* CHEVREUX in having no true rostrum, and in having the outgrowth on peduncular article 1 of male antenna 1, but differs from the latter in the poorly developed eyes, in the finger of female gnathopod 2, and in comparatively long article 5 of peraeopods 1-2.

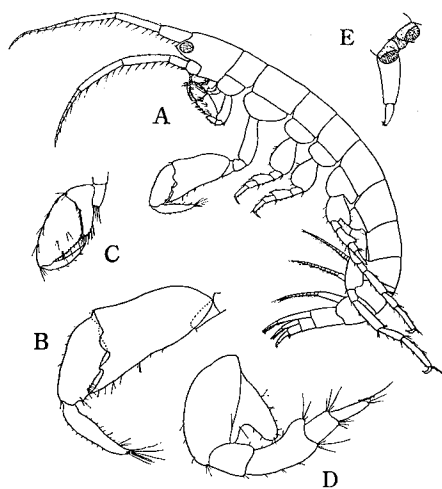
Ericthonius pugnax DANA

(Fig. 40)

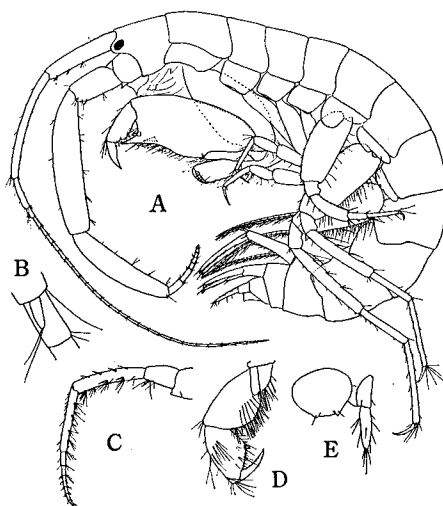
Ericthonius pugnax, STEBBING 1906, p. 672; PIRLOT 1938, p. 352; HURLEY 1954a, p. 445, figs. 40-61; NAGATA 1960, p. 179, pl. 17, figs. 99-102.

Material examined: Areas I (1), IV (33), VI (15), VII (2), IX-b (2), IX-d (43), XII (37), XIII-a (4), XIII-b (71). Total: 208 specimens, up to 7.5 mm in length, from depth of 2 m in low wafer.

Distribution: Sulu Sea (DANA), East Indies (PIRLOT), New Zealand (HURLEY), and Japan.



(Fig. 40)



(Fig. 41)

Fig. 40. *Ericthonius pugnax* DANA. A, lateral view of male; B, male gnathopod 2; C, female gnathopod 2; D, peraeopod 3; E, uropod 3 and telson.

Fig. 41. *Grandidierella japonica* STEPHENSEN. A, lateral view of male; B, accessory flagellum of antenna 1; C, antenna 2 of female; D, female gnathopod 1; E, uropod 3 and telson.

Grandidierella japonica STEPHENSEN

(Fig. 41)

Grandidierella japonica STEPHENSEN 1938, p. 179, figs. 1-2; NAGATA 1960, p. 179, pl. 17, fig. 103.

Material examined: Areas I (6), II (12), IV (2023), V (49) VI (4), VII (78), VIII (19), IX-b (1), IX-d (45). Total: 2237 specimens, up to 12.0 mm in length; from the depth of about 10 m at the deepest.

Distribution: Known only from Japan.

Cerapus tubularis SAY

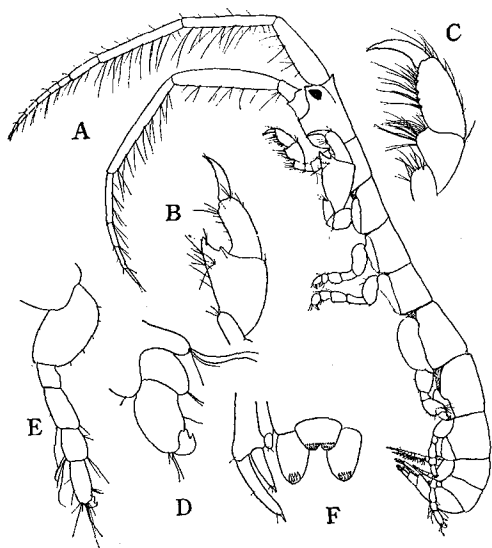
(Fig. 42)

Cerapus tubularis, SHOEMAKER 1942, p. 48; J. L. BARNARD 1962b, p. 61, figs. 28-29.

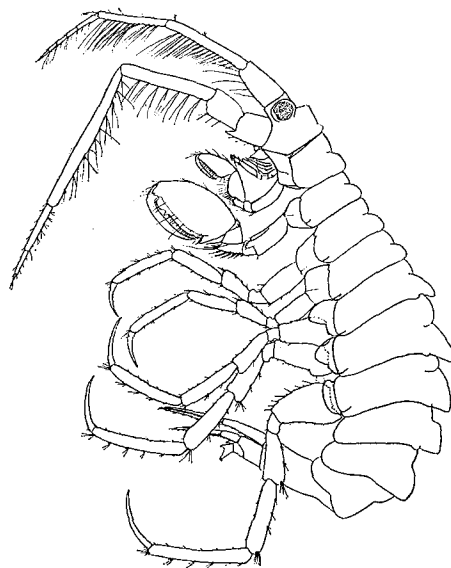
Cerapus abditus, STEBBING 1910, p. 616, pl. 55A; PIRLOT 1938, p. 349, figs. 157-158.

Cerapus erae BULYCHEVA 1952, p. 248, fig. 39.

Material examined: Area IV, 45 specimens, up to 5.3 mm long; from the depth of 25 m at the deepest.



(Fig. 42)



(Fig. 43)

Fig. 42. *Cerapus tubularis* SAY. A, lateral view of male; B, male gnathopod 2; C, female gnathopod 2; D, articles 4-7 of peraeopod 3; E, peraeopod 5; F, telson and uropods 1-3.

Fig. 43. *Podocerus inconspicuus* (STEBBING).

Distribution: East coast of North America (New Jersey, Vineyard Sound, and Connecticut); Pacific coast of North America (southern California, and Lower California); South Africa; Indian Ocean (Mauritius?); Ceylon, and Bengal; Indonesia; North Australia, and New South Wales.

Unciolella lunata CHEVREUX

Unciolella lunata CHEVREUX 1911, p. 264, text-fig. 16 & pl. 20, figs. 5-16; SCHELLENBERG 1928, p. 669, fig. 207.

Material examined: Areas IV (20), XI-b (8); up to 5.0 mm in length, all female; from depths of 10-54 m.

Remarks: It seems to be fairly questionable whether male gnathopod 1 figured by SCHELLENBERG is that of male of the present species or not, for it resembles much closely that of members of the genus *Grandidierella*, and in *Unciolella feveolata* K. H. BARNARD (1955, p. 97, fig. 49), their gnathopods 1-2 are nearly alike in both sexes. SCHELLENBERG says in his paper, "a pair of large male gnathopod 1 is lying loose with the materials." The specimens at hand are, to my regret, all female, and therefore I could not confirm the account described by SCHELLENBERG.

My specimens agree fairly well with CHEVREUX's description and figures, except for the following respects: Mandibular palp more fully elongate; both gnathopods of nearly equal in size, having two small spines at the palmar angle of article 6; accessory flagellum of antenna 1 bearing 2-3 articles; finger of pereopods 1-2 comparatively short, about a half the length of article 6.

Distribution: Algeria (CHEVREUX) and ? Suez Canal (SCHELLENBERG).

Family PODOCERIDAE

Podocerus inconspicuus (STEBBING)

(Fig. 43)

Platophium inconspicuum STEBBING 1888, p. 1194, pl. 131.

Podocerus inconspicuus, STEBBING 1906, p. 702; PIRLOT 1938, p. 356, fig. 160; K. H. BARNARD 1940, p. 483.

Podocerus palinuri K. H. BARNARD 1916, p. 277, pl. 28, fig. 23; K. H. BARNARD 1937, p. 175, fig. 18.

Podocerus sp., NAGATA 1960, p. 179, pl. 17, figs. 104-112.

Material examined: Areas IV (39), VI (14), XI-a (1); up to 8.9 mm long; found from depths of 2-42 m.

Remarks: Identification for the species of this genus is truly difficult in so far as the references are available. The present specimens are here referred to *P. inconspicuus* by nearly complete agreement with male and female gnathopod 2 figured by PIRLOT.

Distribution: Port Jackson, New South Wales (STEBBING); South Africa (K. H. BARNARD); South Arabian coast (K. H. BARNARD); East Indies (PIRLOT), and Japan.

ZOOGEOGRAPHICAL NOTE

83 species and 2 subspecies of gammaridean amphipods were found in the Seto Inland Sea. All of the enclosed bays along the coasts of Honshū,

Shikoku, and Kyūshū, are more or less recognized as a "warm temperate" area. Many of the species found in the Seto Inland Sea have been, therefore, collected by me from other inlets or bays of the Japanese coast, and the occurrences of others are also expected in future. It is a pretty well known fact that many of littoral gammaridean members are generally distributed widely in the world, though they are benthic and normally inhabiting on the muddy sea floor.

Of all the species described here, 59 species (69.4 percent) are found also outside the Japanese area. Their distributional outlines in respective regions are shown in Table 1, and summarized in Figure 44, in which the number of species in each region is shown as the percentage to 59 species. Here, 19 regions are somewhat expediently defined as follows:

I. Arctic region (Baffin Bay, Davis Strait, W. and E. coast of Greenland, Jan Mayen, Murman Coast, White Sea, Barents Sea, Spitsbergen, Bear I., Franz Joseph Land, Novaya Zemlya, Kara Sea, East Siberian Sea, Chukot Sea, and N. coast of Alaska).

II. North-western part of the North Pacific (Bering Sea, Okhotsk Sea, and the Russian coast of the Japan Sea—down to Bay of Peter the Great).

III. Northern part of the Pacific coast of North America (coasts of Alaska and British Columbia).

IV. Southern part of the Pacific coast of North America (coasts of Washington, Oregon, California, and Lower California—to Magdalena Bay southwards).

V. Atlantic coasts of Canada and North America (Gulf of St. Lawrence to New Jersey).

VI. Norwegian coast, including Skagerrak, Kattegat, Baltic Sea, and Iceland.

VII. European coast (down to the coast of Portugal), including Faeroes, Shetland Is., and Azores.

VIII. Mediterranean and its coast, including Black Sea and Sea of Azov.

IX. Northern coast of West Africa (down to the coast of Senegal), including Canary Is. and Cape Verde Is.

X. Tropical coast of West Africa (down to the coast of Cameroon).

XI. Atlantic coast of Central America (coast of Florida, Gulf of Mexico, and Caribbean Sea).

XII. Coasts of Indian Ocean, southwards to 20° S (Zanzibar, Amirante Is., Seychelles, Cracados, Suez Canal, Red Sea, Southern Arabian coast, Gulf of Aden, Maladiv Is., Ceylon, Chilka Lake, Tale Sap, and East Indies seas).

XIII. Tropical and subtropical Pacific (Hawaiian Is., Marshall Is., Sulu Sea, Bismarck Arch., Gilbert Is., Fiji Is., N. E. coast of Australia, Kermadec Is., Gambier Arch., and Galapagos Is.).

XIV. Coast of Brazil.

Table 1. (contd.)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX
<i>Leucothoe incisa</i>	—	—	—	—	—	—	♣	♣	—	♣	—	—	—	—	—	—	—	—	—
<i>Allorchestes plumicornis</i>	—	—	—	—	—	—	—	♣	—	—	—	—	—	—	—	—	—	—	—
<i>Unciolella lunata</i>	—	—	—	—	—	—	—	♣	—	—	—	—	—	—	—	—	—	—	—
<i>Synopia ultramarina</i>	—	—	—	—	—	—	—	—	♣	♣	—	♣	♣	—	♣	—	—	—	—
<i>Stenothoe gallensis</i>	—	—	—	—	—	—	—	—	—	♣	♣	♣	♣	—	—	♣	—	—	—
<i>Ampelisca cyclops</i>	—	—	—	—	—	—	—	—	—	—	—	♣	♣	—	—	—	—	—	—
<i>Idunella chilensis</i>	—	—	—	—	—	—	—	—	—	—	—	♣	♣	—	—	—	—	—	—
<i>Eriopisella sechellensis</i>	—	—	—	—	—	—	—	—	—	—	—	♣	—	—	—	—	—	—	—
<i>Ampithoe orientalis</i>	—	—	—	—	—	—	—	—	—	—	—	—	♣	—	—	—	—	—	—
<i>Erichthonius pugnax</i>	—	—	—	—	—	—	—	—	—	—	—	♣	♣	—	—	—	—	—	—
<i>Podocerus inconspicuus</i>	—	—	—	—	—	—	—	—	—	—	—	♣	—	—	—	♣	♣	—	—
<i>Ceradocus capensis</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	♣	—	—	—
<i>Endevoura mirabilis</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	♣	—	—
<i>Leptamphopus novaezealandiae</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	♣	—	—
<i>Paradexamine flindersi</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	♣	—	—
<i>Paradexamine barnardi</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	♣	—	—
<i>Hyale grandicornis</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	♣	♣	♣	♣
<i>Melita koreana*</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>Anisogammarus amandalei**</i>	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

*) Species found also in Makinoshima, Fuzan, Korea, that is not included in any region.

***) Species known also from southern Kuril Is., southern Sakhalin, and China, but all from fresh water localities.

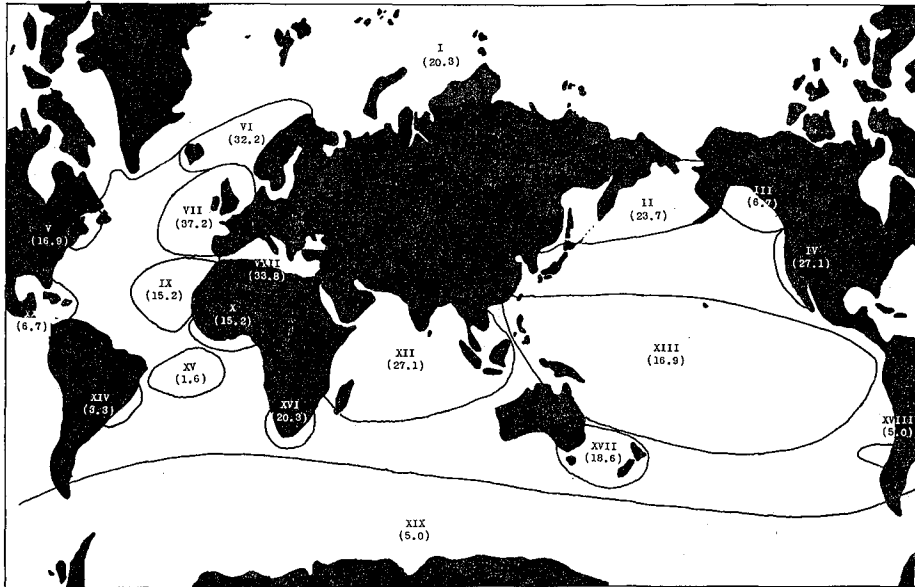


Fig. 44. Number of species in respective regions, represented as percentage to the total 59 species shown on Table 1.

XV. Tropical Atlantic Ocean (plankton collection).

XVI. Coast of South Africa.

XVII. Coasts of New South Wales and New Zealand, including Auckland Is.

XVIII. Coast of Chile (coast of Valparaiso and Juan Fernandez Is.).

XIX. Antarctic and subantarctic regions (Falkland Is., South Georgia Is., S. Orkney Is., Kerguelen Is., Macquarie Is., and Commonwealth Bay), including Gough Is. of South Atlantic Ocean.

On Table 1, regions are numbered from the north to the south (Regions III and IV may be placed after Region V, but are here inserted just after Region II, as they are fringing all together the North Pacific), and species are generally arranged in the order of northern to southern forms. It will be seen that many of the species have each a wide range of distribution. In fact, their distributions are so variable that it is difficult to divide them into some definite distributional forms; some of them are quite cosmopolitan, some species widely spread in the northern hemisphere, and several may be said, extending over both the eastern and western hemispheres, to be nearly cosmopolitan in boreo-temperate seas, or in temperate to tropical, or also in boreal to tropical. As seen in Figure 44, there are many species common to Japan and the regions far apart from Japan such as Regions V, VI, VII, VIII, XVI, and XVII, and this may be partly attributable to the fact that those regions have been well explored since the early stages of the systematic study for this group.

Most of gammarideans often make the nocturnal migration towards the surface water, and therefore they are not necessarily found on the sea bottom, for instance some of them may be found among oyster shells hung from the oyster-raft in the waters more than 10 meters above the bottom, among the drift-algae in the tidal flow or ocean current, or found in colonies on the buoys in harbors. Accordingly, they can be transported to the foreign waters together with oyster spats, or clinging to any ships anchored.

On the other hand, it is very probable that endemic forms are differentiated in such enclosed places as the Inland Sea, affected by the local climate. The following 24 species and 2 subspecies of the forms described in this paper are limited to Japanese waters at present.

Orchomenella littoralis, sp. nov.

Ampelisca bocki DAHL

Ampelisca misakiensis DAHL

Ampelisca miharaensis NAGATA

Ampelisca naikaiensis NAGATA

Byblis japonicus DAHL

Harpinia miharaensis NAGATA

Liljeborgia japonica, sp. nov.

Liljeborgia serrata, sp. nov.

Idunella curvidactyla, sp. nov.

Monoculodes limnophilus japonicus, subsp. nov.

Syrrhoites pacificus, sp. nov.

Parapleustes bicuspidatus, sp. nov.

Atylus japonicus NAGATA

Melphidippa globosa, sp. nov.

Melphidippella sinuata, sp. nov.

Melphisana japonica, sp. nov.

Melita denticulata, sp. nov.

Melita tuberculata, sp. nov.

Melita japonica, sp. nov.

Maera serratipalma, sp. nov.

Orchestia platensis japonica (TATTERSALL)

Eurystheus japonicus NAGATA

Eurystheus utinomii NAGATA

Corophium kitamorii, sp. nov.

Grandidierella japonica STEPHENSEN

(To be continued)

STUDIES ON MARINE GAMMARIDEAN AMPHIPODA OF THE SETO INLAND SEA. IV

KIZÔ NAGATA

Inland Sea Regional Fisheries Research Laboratory, Hiroshima

With 4 Text-figures

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PART II. SOME ECOLOGICAL INFORMATIONS

1. General Remarks on the Biology of *Orchestia platensis japonica*

Orchestia platensis japonica is well known as one of the "sand-hoppers" among the gammaridean group and commonly inhabits at the high-water marks on the beach; often found in a great abundance under damp seaweed or straw-mat washed ashore, sometimes living under dead leaves in the damp places far above the sea-shore. The animal is a scavenger, showing the feeding habit of a "biting" type, and often seen crowding together and biting at the shucked meat of oyster while the animals are kept in an experimental glass-vessel in the laboratory.

The material was collected once a month from March 1962 to March 1963, at the high-water mark on the beach of Ônoura, Saeki-gun, Hiroshima Pref., where the sampling spot was located just beneath the stone wall, submerged always in the high-tide of each lunar month and covered all over with

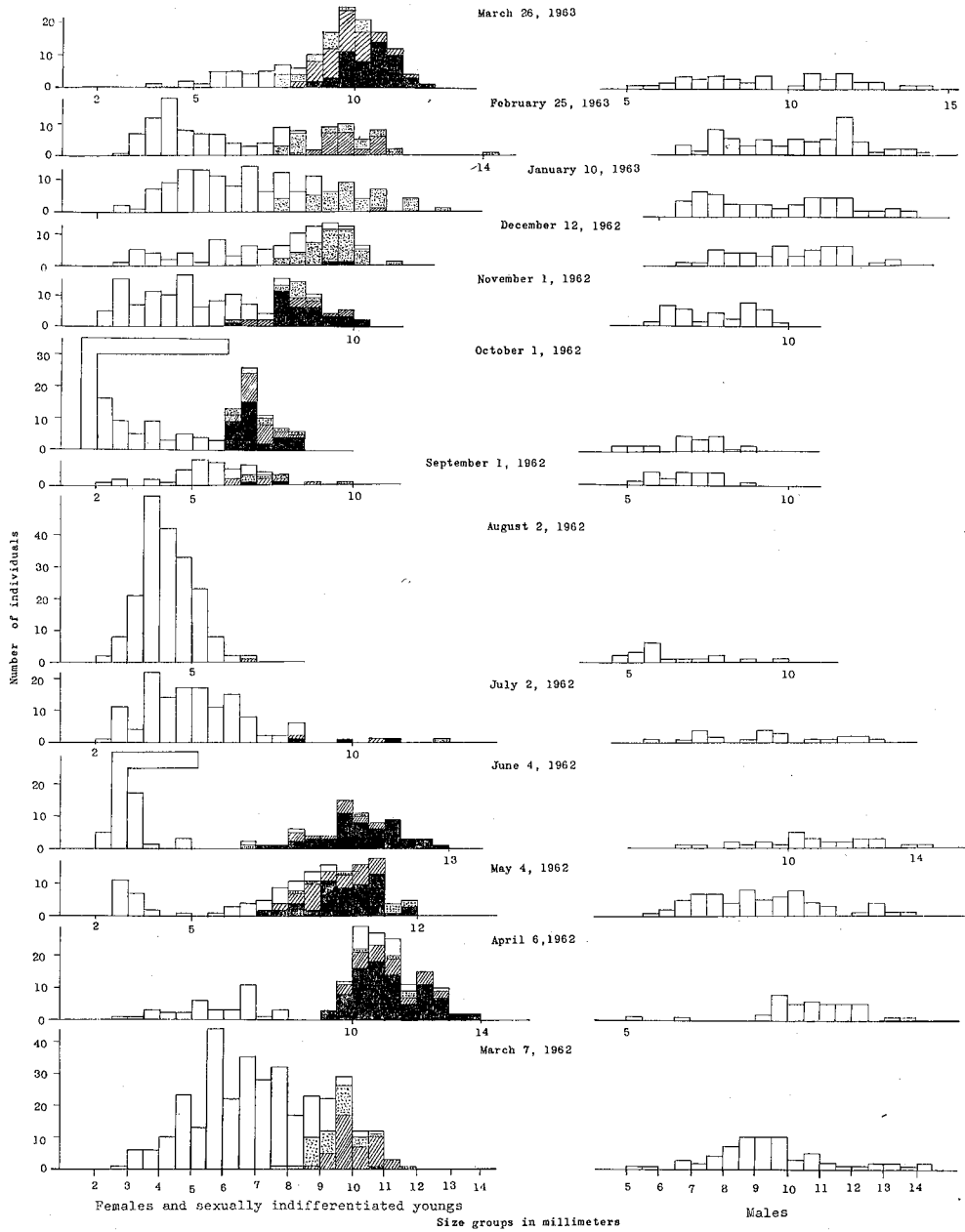


Fig. 45. Seasonal change of size-composition of *Orchestia platensis japonica*. (For female: ovigerous female; females whose ovary is well developed; females bearing the empty brood pouch),

empty shells of "Asari". Sampling in each month was made in the daytime of the new moon or the full moon when the tide was outgoing, keeping a constant distance from the stone wall. The specimens were put quickly into the collecting bag by a small elliptical hand shovel.

The length of animals is measured from head to telson along the natural curve of the dorsal line. All the individuals or a part of the total collection of each month were measured and sorted into size groups. Seasonal change of size-composition may be seen by comparing one another the results of analyses of the specimens scooped by shovel in respective months (Fig. 45). The individuals less than 4.5 mm long are defined as the sexually indifferently youngs and treated together with the female. Adult females examined are classified into three groups according to the states, ovigerous, with fully developed ovary, or with the empty brood pouch. The number of embryos or youngs within the brood pouch is counted, when the animals are ovigerous.

The spawning appears to continue nearly throughout the year, and therefore it is difficult to define distinctively each spawning group, but it is

Table 2. Collecting data in reference to the investigation on the biology of *Orchestia platensis japonica*.

Date	Time	Age of moon in days	W.T. (°C)	Extracting rate	Material examined				
					Total	Indiffer-entiated young 4.5 mm >	Female 4.6~6.0 mm	Male 6.1 mm <	
7/III	12.00	0.7	10.7	1/4	406	23	80	236	67
6/IV	11.45	1.3	12.0	1/4	212	7	11	154	40
4/V	11.00	29.3	18.0	1/4	208	20	2	119	67
4/VI	10.40	1.6	19.2	1/2	174	75	3	68	28
2/VII	10.30	0.1	21.6	1/2	157	52	45	37	23
2/VIII	11.00	1.6	26.8	1/1	212	125	64	5	18
1/IX	11.10	2.0	27.2	1/1	66	6	20	20	20
1/X	11.50	2.3	24.2	1/1	216	118	12	63	23
1/XI	13.00	3.6	19.9	1/1	181	48	30	71	32
12/XII	11.45	14.9	12.9	2/3	146	12	13	74	47
10/I	11.00	14.2	10.2	1/2	210	19	37	88	66
25/II	11.50	1.0	6.2	1/3	189	38	22	65	64
26/III	11.20	0.6	11.0	1/2	187	1	8	134	44

probable that two active spawnings are seen in the period from spring to early summer and in the autumn season from October to November. The spawning season in spring is more prominent than that in autumn, and the total number of spawns is considered to be most abundant in this season throughout the year, although a large number of the newly hatched small specimens are not shown in the figure; this is probably on account of either

the error of sampling or of the operation extracting samples from the total specimens collected. Similar seasonal change of size composition and the presence of two main spawning seasons, were also observed at another station on the same beach, at a certain damp place where the kitchen residues were piled up.

Ovigerous females are 6.0-6.5 mm in length at the minimum. For the external appearances of the adult females drawing toward the spawning, the marsupial plates begin to develop at first, in time the ovary comes to mature fully so that the purplish blue mass can be seen through the dorsal chitinous cuticle of the pereion, at this time the marsupial plates have fairly developed, but not yet armed fully with the marginal setae, and then the individuals bearing embryos within the brood pouch come to appear. The moulting will be taken just before the issue of mature eggs into the brood pouch, and after this moulting the so-called "riding position" will be seen again, followed then by a copulative posture immediately before or in the middle of the issue of mature eggs. It is pretty sure that the fertilization takes place outside the body. During the breeding period with embryos within the brood pouch, the marsupial plates develop fully and are densely armed with long marginal setae. After the release of young or embryos, the fully developed marsupial plates remain empty for a short period and then fall off in time. Such breeding processes are repeated several times by each adult female during the spawning season. Durations for respective processes (e.g. of riding position, purplish blue state of ovary, of incubation of embryos within the brood pouch, and of retaining the empty pouch), are not made clear as yet; this requires many careful observations in laboratory in future. It is, here, to be noted that the purplish blue state of ovary has never been seen from the outside in all of 434 ovigerous specimens. The mature eggs within the ovaries may all be issued into the brood pouch in a short time.

Thus, as shown in the figure, the females defined as "females whose ovary is well developed" always indicate to be in a state prior to the ovigerous stage, and "females bearing the empty brood pouch" always in a state after the release of young or embryos from the brood pouch. The latter is clearly distinguished from the former in having marsupial plates fully developed, but no sign of the purplish blue mass of ovary.

The size of mature ova within the ovary is 0.32 mm-0.43 mm in diameter. The embryonal stages within the brood pouch were provisionally divided into "eggs", "medium", and "advanced" stages, respectively 0.62 mm, 0.71 mm, and 0.79 mm in diameter on an average. In the "advanced" stage, the appendages of the young are more or less perceptible through the chorion, and the shape is almost ovoid, 0.83-1.05 mm in longer diameter. The newly hatched young is 1.5-2.0 mm long.

More than 50 percent of ovigerous females bear 5-9 embryos within the brood pouch respectively, but 22 at the maximum in a 10.7 mm long specimen. When a few number of embryos are included within the brood pouch, they are usually consisting of only young or embryos of the advanced stage, while when abundant, all or most of them are the eggs of the earlier stages. And it is often met with that embryos in some different stages of development are observed within the same brood pouch. These facts seem to show the possibility that the embryos may hatch or be released from the brood pouch by and by in the order of development. On the other hand, however, it is generally said in some members of both Isopods and Tanaidaceans that the number of the fertilized eggs is reduced by the expulsion of embryos before their development is completed (Howes 1939, p. 290). Anyhow, the number of embryos within the brood pouch is very variable so far as I examined, and no significant correlation could be found between it and the season or the size of mother. If the fertilized eggs in the brood pouch could be counted exactly soon after the issue from the ovary, there might be found any relation between the egg number and some factors.

The gammaridean animal is usually said to live on for about a year. The present specimens fully grown up attain nearly to 15.0 mm long in both sexes. The spawning group seen in March 1963 is likely to belong to the group hatched in the season April to June 1962. Now, taking it into account that the size of the newly hatched specimens is 1.5-2.0 mm long, the average growth rate per a month may be roughly estimated to be about 1.0 mm, although the growth rate naturally differs according to the water temperature. Sex-ratio indicates no positive relation with the season, even though the specimens less than 6.0 mm are excluded.

2. An Observation on the Nocturnal Migration of Benthic Gammaridean Amphipods

The nocturnal migration of gammaridean amphipods inhabiting the sea floor or among seaweeds is one of the most interesting phenomena. The object of this observation was first to obtain the general outline of the upward movement at night, and second to distinguish the species migrating up to the surface waters at night from many benthic amphipods living abundantly both in number of individuals and species on the *Zostera* belt near the low-water mark.

It was planned to see successive changes in the number of individuals at different hours of observation from nightfall to dawn. The result is represented graphically in Figure 46. The "number of individuals" is represented by the number of gammarideans per horizontal haul of a plankton

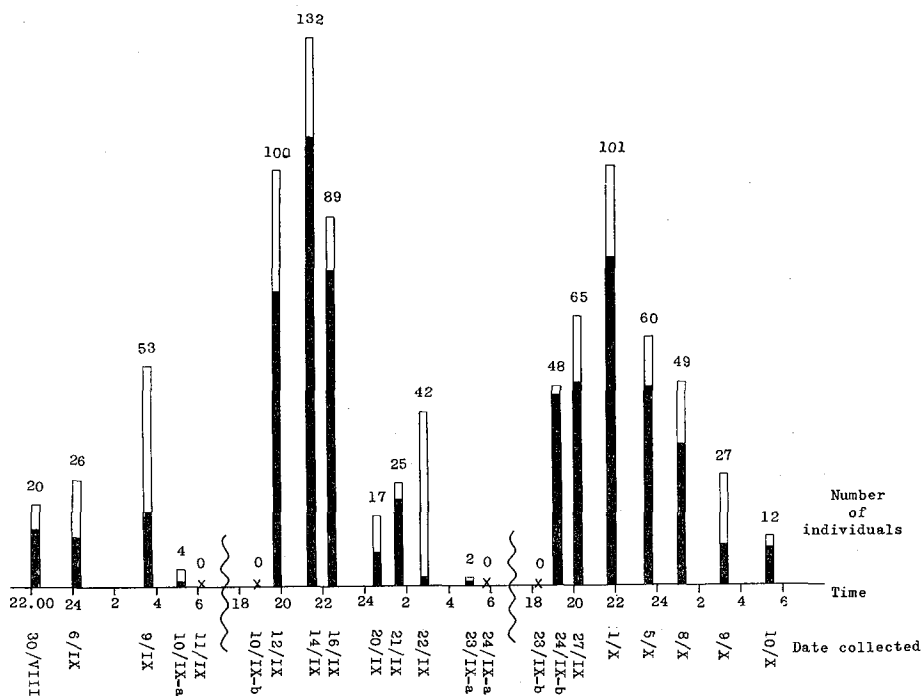


Fig. 46. Diagram showing the diurnal change of number of individuals of the benthic gammarids per sample obtained by the horizontal towing of plankton net in the surface waters on *Zostera* belt near the low-water mark. The solid column indicates the proportion of *Paradexamine barnardi* to the total sample.

net (stretched with GG 40, mesh 39/inch), towed by a return sailing of a distance of about 250 meters in the surface water above the *Zostera* belt off the Ôno-Branch of our laboratory, Ônoura, Saeki-gun, Hiroshima Pref.

In the Seto Inland Sea, the tide range is fairly prominent, and the tidal flow is very fast, particularly in "Seto" (strait). This *Zostera*-belt is facing Ôno Seto, and narrowly spreads outside the inlet in the direction along the tidal flow; therefore, it is desirable to collect at the time when the tidal flowing is dead. Moreover, the *Zostera*-belt is very shallow being about 0.5 meter in depth in low water at the spring tide. Thus, the collecting was always done in the slack water just before the high water, and then it was impossible to carry out successive observations in the same day.

As seen in Table 3, the samples of both series A and C were collected after the moonset, while the series B was taken after the moonrise. No distinctive relations, however, could be seen between the migration and the moon light so far as the present collections were concerned. In general, the number of individuals rapidly increases as soon as it becomes completely dark after the nightfall, reaching to the maximum just before 22.00, then

Table 3. Data of the observations on the nocturnal migration of benthic gammarids.

Series	Date	Time	Age of moon in days	Moon-		Sun-		Depth (m)	W.T. (°C)
				rise	set	rise	set		
A	30/VIII	22.05	29.6	5.30	18.55	5.42	18.40	3.5	25.4
	6/IX	0.01	7.0	11.51	22.38	5.46	18.31	2.4	24.7
	9/IX	3.20	10.0	14.41	0.07	5.48	18.26	2.3	25.6
	10/IX-a	5.08	11.0	15.36	1.01	5.49	18.25	2.6	24.6
	11/IX	5.58	12.0	16.28	2.02	5.50	18.25	2.5	24.2
B	10/IX-b	18.35	11.0	15.36	1.01	5.49	18.25	3.0	25.4
	12/IX	19.35	13.0	17.16	3.07	5.50	18.23	3.0	25.0
	14/IX	21.15	15.0	18.42	5.28	5.52	18.20	3.7	25.0
	16/IX	22.15	17.0	20.01	7.50	5.53	18.17	3.2	25.5
	20/IX	0.30	21.0	22.55	12.19	5.56	18.11	3.0	24.8
	21/IX	1.35	22.0	23.45	13.18	5.56	18.10	2.6	24.5
	22/IX	2.45	23.0	—	14.12	5.57	18.08	2.4	25.0
	23/IX-a	4.50	24.0	0.39	15.00	5.58	18.07	2.2	25.1
	24/IX-a	5.45	25.0	1.34	15.43	5.59	18.05	2.6	25.1
	23/IX-b	18.15	24.0	0.39	15.00	5.58	18.07	2.3	25.3
C	24/IX-b	19.00	25.0	1.34	15.43	5.59	18.05	2.5	25.0
	27/IX	20.00	28.0	4.19	17.28	6.01	18.01	3.0	23.8
	1/X	21.45	2.3	7.55	19.29	6.04	17.56	3.2	23.4
	5/X	23.25	6.3	11.37	22.02	6.07	17.51	2.5	22.2
	8/X	1.00	9.3	14.17	—	6.10	17.46	2.1	22.5
	9/X	3.00	10.3	15.06	0.48	6.10	17.45	2.1	22.5
	10/X	5.15	11.3	15.51	1.54	6.10	17.44	2.6	22.8

gradually decreases towards the dawn, and animals wholly disappear while the sky is turning gray before dawn. The result of series A seems unusual.

Nevertheless, these observations made only in high water of different days are considered to accord with the day of lunar month. The results indicate, thus, the number of migrating individuals increases in the spring tide of the full moon or new moon. Similar phenomenon is also observed in the nocturnal migration of members of amphipod genus *Bathyporeia* carried out in the intertidal waters of Kames Bay, open to the Firth of Clyde, by WATKIN (1939). He says there, "when the samples are related to the day of lunar month it is shown that the numbers increase in the tidal waters in the periods immediately preceding the full moon and preceding and partly overlapping the new moon." My results show that the animals stop migrating upwards in the day time, even in the twilight. It is still questionable if the numbers always show the maximum at about 22.00 at night, although this time corresponds just to the high water of the new moon or full moon as it was so in my observations. In future, the nocturnal change of the number of migrating individuals throughout the same night will be clearly

explained by further investigations made at the location in a certain much deeper inshore area, deep enough even in the low water of neap tide and without any prominent tidal flow in neither spring nor neap tide, which will disturb the towing of plankton net.

The total number of individuals of each species obtained is given below, together with the frequency of occurrences shown by the number of samples for each species:

	(Number of individuals)	(Frequency)
<i>Paradexamine barnardi</i>	607	18 (all)
<i>Aoroides columbiae</i>	45	10
<i>Erichthonius pugnax</i>	41	11
<i>Corophium uenoi</i>	39	6
<i>Synopia ultramarina</i>	23	7
<i>Pontogeneia rostrata</i>	21	7
<i>Corophium</i> sp. (juv.)	19	8
<i>Byblis japonicus</i>	16	8
<i>Pontocrates altamarinus</i>	11	8
<i>Gitanopsis vilordes</i>	10	4
<i>Maera serratipalma</i>	8	5
<i>Grandidierella japonica</i>	6	5
<i>Stenothoe gallensis</i>	4	4
<i>Melita koreana</i>	4	4
<i>Orchomenella littoralis</i>	4	3
<i>Corophium acherusicum</i>	4	2
<i>Eriopisella sechellensis</i>	2	2
<i>Melita</i> sp. (juv.)	2	2
<i>Jassa falcata</i>	2	2
<i>Ampelisca miharaensis</i>	1	1
<i>Aoroides secunda</i>	1	1
<i>Ampithoe lacertosa</i>	1	1
<i>Microjassa cumbrensis</i>	1	1

Paradexamine barnardi occurred most abundantly nearly in all samples, showing 69.6 percent of the total individuals of all species. It is noticeable that such groups as the burrowing or tubicolous forms often appear in surface water at night. These facts seem to show that nearly all of the benthic gammarideans act the nocturnal migration. Unfortunately, the present observations were made in the season when the gammarideans were rather scarce, and so it is very desirable that further investigations will be carried out in the season when much larger numbers of individuals are available, for instance in spring to early summer.

There has been discussions by some authors on the factors causing this nocturnal migration, and the influence of the tide is regarded as an important factor in the tidal area. This may be supported also in the present observation by the increase of individual number in the high tide of the new and full moon. The migration may really have something to do with the

breeding cycle for each species. Nearly all the individuals obtained were small specimens; further detailed analyses are needed on the size and age compositions and sex-ratio.

3. A Note on the Comparison of Species Composition Between Two Different Areas

Nearly all of the species described in this paper are found in relatively shallow waters, from the *Zostera*-belt near low-water mark to about 60 meters deep; and the bottoms of the localities are in most cases composed of silt, mud, or sandy mud. Unfortunately, no detailed analyses of the nature of the bottom inhabited by animals have been made, so that the relations between the animals and the important factor, the soil grade, are almost unknown. But there is an interesting difference between the species obtained from *Zostera*-belt near low-water mark and those collected from the deeper area. The '*Zostera*-belt near low-water mark' mentioned here is the place where the tide does not completely go out even in the spring tide and about 5 meters at the deepest place in low-water. Such a *Zostera*-belt usually offers a habitat suitable for many young fishes as well as for small crustaceans important as prey-animals. Particularly gammarideans are very rich there in the number of both individuals and species, and occupies 60-90 percent of small crustaceans on the *Zostera*-belt of Mihara Bay (NAGATA 1960). The abundant occurrences of gammarideans on the *Zostera*-belt is obviously shown also by the stomach contents of fishes caught there (KITAMORI, NAGATA, and KOBAYASHI 1959).

The species of gammarideans very commonly found on the *Zostera*-belt near low water mark are listed below:

- | | |
|-----------------------------------|-------------------------------------|
| 1) <i>Paradexamine barnardi</i> | 10) <i>Corophium acherusicum</i> |
| 2) <i>Pontogeneia rostrata</i> | 11) <i>Byblis japonicus</i> |
| 3) <i>Ampithoe lacertosa</i> | 12) <i>Eriopisella sechellensis</i> |
| 4) <i>Ampithoe valida</i> | 13) <i>Pontocrates altamarinus</i> |
| 5) <i>Grandidierella japonica</i> | 14) <i>Orchomenella littoralis</i> |
| 6) <i>Erichthonius pugnax</i> | 15) <i>Aoroides columbiae</i> |
| 7) <i>Pleustes panopla</i> | 16) <i>Eurystheus japonicus</i> |
| 8) <i>Cerapus tubularis</i> | 17) <i>Corophium uenoi</i> |
| 9) <i>Jassa falcata</i> | |

Of the above-listed species, species 11, 12, and 13 are found abundantly and species 14-17 are found occasionally also in the area more deeper than the *Zostera*-belt near low-water mark. While the species 1-10 are mostly limited to the *Zostera*-belt. On the *Zostera*-belt of Mihara Bay (Area IV), species 1-5 were found very abundantly in net-collections, while species 6 was unexpectedly rather scarce. The list of the species living very abundantly on the inshore *Zostera*-belt is based on the materials obtained from Mihara Bay in

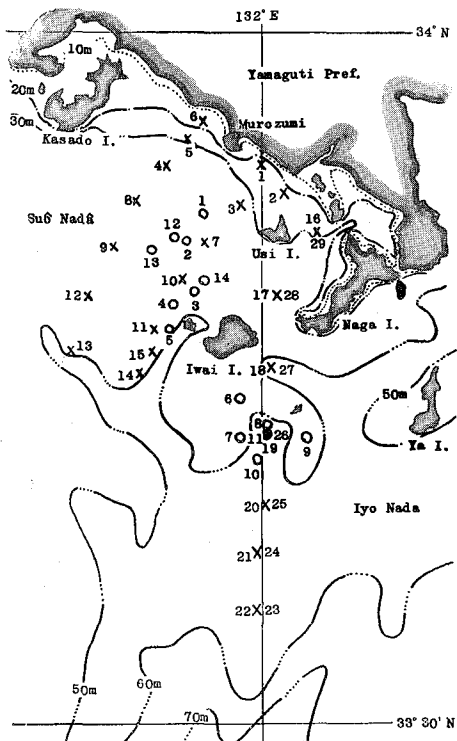


Fig. 47. Map showing station localities in two surveys of "Area XI". Marks ○ and × indicate respectively stations in 1959 (Area-a) and 1960 (Area-b). Sts. 16-22 in 1960 nearly coincide with Sts. 29-23, and so does St. 11 in 1959 with Sts. 19 and 26 in 1960.

the Seto Inland Sea and near Asamushi in Mutsu Bay. On the *Zostera*-belt of the latter locality, species 1, 3, 6-9, and 13-16 were very rich.

On the other hand, general aspects of their occurrences in the area deeper than the *Zostera*-belt near low-water mark are well represented in Tables 4 and 5 (see also Figs. 1 and 47). The collections in this area were made by drawing a bottom-layer net (NAGATA 1960, fig. 1) on the soft sea floor for 1.5-4 minutes at each station, but the drawing can never be done under the constant conditions throughout the stations and therefore the collections are not to be estimated quantitatively. However, several common species widely distributed in the littoral areas below the level of the low-water mark may be clearly shown in the catches of these two surveys. More than 90 percent of total individuals in each catch is occupied by the following 10 species: all the 7 species of Ampeliscidae, *Pontocrates altamarinus*, *Eriopisella sechellensis*, and *Bathymedon*

longimanus. Most of them have often been found in the stomach contents of benthos-feeding fishes, too. J. L. BARNARD started in the opening of his paper of 1954b, "Amphipoda of the family Ampeliscidae form an important component of any littoral marine soft-bottom fauna", and this appears to be the fact common to all amphipod faunas of the littoral sea floor along the Japanese coast deeper than about 10 meters. *Eurystheus utinomii*, *Anonyx nugax pacificus*, and two species of the genus *Photis* have been collected most abundantly at the three stations deeper than 10 m in Mihara Bay (NAGATA 1960, fig. 2), but not so numerously as expected in the two surveys.

As mentioned above, a prominent difference in their occurrences was noted between the species commonly found in respective areas, but other species occur comparatively less abundantly and less frequently, and thus it is unable to show definitely for each species the area of the richest occurrence.

4. Gammaridean Amphipods as Prey-animals, with Special Relation to the Triglid Fishes Caught in the Seto Inland Sea

As previously mentioned again and again, amphipods are important prey-animals often found abundantly in the stomach contents of many benthos-feeding fishes. To make clear the trophic relations between higher consumers and their preys, our laboratory carried out the collecting of benthic fishes by the experimental two-boat trawler (30 tons & 80 H.P.), which had eight cruises over eleven "Nada"-areas around the coast of Shikoku in the period from Sept. 1957 to Sept. 1960 and obtained enormous catches of benthic fishes. And I have had an opportunity to observe the stomach contents of nearly all of the benthic fishes, but piscivorous fishes and plankton feeders.

For an example, a qualitative analysis of their feeding frequency by food-group of the fishes caught during the fourth cruise made in May-June 1958 is given in Table 6. Here, the feeding frequency is shown by the percentage of the number of fish feeding on a respective food-group to the total number of the fish examined. The total number of fishes examined here amounts to 2880 individuals, including 75 species, but in this table, only the results for 31 species are given, the species represented by less than 10 individuals being omitted. As seen on this table, main food items of those benthic fishes except for piscivores in the Seto Inland Sea are shrimps, small crustaceans, annelids, and fishes; although the proportions of these food animals are different with feeders, nearly all of fishes are known to show a fairly high percentage of shrimps in the stomach contents. Fishes or squids which all the feeders listed in this table preyed upon are small in size and not so significant quantitatively so far as concerned with those found in the Seto Inland Sea. Strictly saying, all the values in the table may be swayed to some extent by the number of feeding individuals examined, variation of their size, and also by the seasonal change of prey-animals themselves; although they may be available to get the general view of the food organisms of the fishes.

Relatively high percentages of small crustaceans are seen in flatfishes and triglid ones. Especially it is noteworthy that unexpectedly large amount of small crustaceans including gammaridean amphipods are eaten by the latter. Particularly as to *Lepidotrigla microptera*, a large number of individuals were examined so that the above-mentioned trend seems to be unsuspecting. It is supposed that triglid fishes bear some resemblance to flatfishes in their feeding habits. In feeding they usually lie prostrate on the bottom and feel the sea floor by means of their long finger-like pectoral filaments.

Of course, like other feeders, triglid fishes show some changes in the composition of food animals with growth. Table 7 shows the percentage of

Table 6. Feeding frequency of the benthic fishes caught during May-June 1958, by food-group.

Feeding fish	Food group	Range of T.L. (cm)	Number of feeding individuals examined										
				Fish	Squid	Shrimp	Crab	Stomatopod	Small crustacean	Annelid	Molluscan	Echinoderm	Undet. contents
Triglidae													
Lepidotrigla abyssalis		8-15	11	—	9	73	—	—	64	18	—	—	—
L. guntheri		9-21	12	—	—	83	—	—	8	17	—	—	—
L. japonica		8-19	30	—	20	80	7	—	57	10	7	—	—
L. microptera		7-30	287	2	7	89	1	—	39	7	3	—	2
L. kishinouyei		14-24	37	—	3	100	—	—	27	—	3	—	—
Pachytrigla alata		11-22	15	7	—	94	7	—	—	—	—	—	—
Flatfishes													
Laeops lanceolata		8-13	41	—	—	—	—	—	—	100	—	—	—
Areliscus sp.		12-17	31	—	—	—	—	—	3	90	—	—	16
Poecilopsetta plinthus		6-11	22	—	—	—	—	—	73	64	—	—	9
Pleuronichthys cornutus		9-17	20	—	—	5	—	—	5	75	5	—	25
Limanda yokohamae		14-21	19	—	—	32	—	—	26	63	16	—	32
Areliscus interruptus		6-10	39	—	—	5	—	—	21	54	—	—	28
Psettina ijimai		5-8	115	—	2	2	1	—	96	45	—	—	—
Scidorhombus pallidus		5-6	13	—	—	23	—	—	92	8	—	—	—
Eopsetta grigorjewi		12-19	41	—	2	61	7	—	44	—	—	—	—
Arnoglossus japonicus		7-10	57	14	—	60	—	—	74	—	—	—	—
Pseudorhombus pentopthalmus		6-13	100	25	6	44	1	—	47	2	—	—	—
Sparidae													
Chrysophrys major		12-35	16	—	—	69	—	—	—	—	—	6	25
Branchiostegidae													
Branchiostegus spp.*		11-32	55	29	6	33	4	—	16	22	—	4	11
Nemipteridae													
Nemipterus spp.**		9-47	39	41	3	56	18	—	5	10	—	—	—
Sciaenidae													
Argyrosomus argentatus		9-23	274	37	—	68	—	—	12	1	—	—	7
Platycephalidae													
Kumococius detrusus		14-26	22	27	—	59	5	—	5	—	—	—	5
Suggrundus meerdervoorti		14-23	32	25	—	91	—	—	3	—	—	—	—
Cociella crocodila		20-44	18	33	6	50	28	33	—	—	6	—	—
Lamnina													
Mustelus griseus		42-85	11	27	—	55	36	18	9	—	—	—	—
M. manazo		40-77	63	16	—	81	41	11	6	—	—	—	—
Rajina***													
Holorhinus tobijeji		13-35	28	—	—	82	—	—	—	—	75	—	—
Raja kenoeji		9-24	58	14	—	86	3	—	2	—	—	—	5
Dasyatis akajei		15-32	27	30	—	85	4	—	7	4	—	—	4

*) Comprising two species *B. argentatus* and *B. japonicus japonicus*.**) Comprising two species *N. virgatus* and *N. bathybus*.

***) Measured by 'Body Length'.

Table 7. Feeding frequency of *Lepidotrigla microptera* caught during June 1959, by size and by food-group.

T.L. (mm)	<120	<160	<200	<240	<280	<320	Total
Number of feeding individuals	1	12	103	69	35	5	225
Fish	—	—	3.8	5.7	11.4	—	5.3
Squid	—	—	5.8	2.9	2.9	—	4.0
Large shrimp	—	41.6	43.6	50.7	71.4	80.0	50.6
Small shrimp	100.0	66.6	56.3	55.0	71.4	40.0	58.6
Crab	—	—	0.9	—	—	—	0.4
Amphipod	—	75.0	43.6	26.0	22.8	20.0	36.0
Cumacean	—	—	1.9	—	—	—	0.9
Polychaete	—	16.7	4.9	2.9	5.7	—	4.9
Molluscan	—	—	3.9	2.9	5.7	—	3.6

the feeding frequency by food-group and by size in *Lepidotrigla microptera* caught during the cruise in June 1959. With the increase in size, the percentages of large shrimps and fishes grow higher, while those of small shrimps and amphipods gradually decrease. Small crustaceans were represented by only two groups of gammaridean amphipods and cumaceans.

Table 8. Feeding frequency of triglid fishes caught during Sept. 1957 to July-Aug. 1958, by season and by food-group.

	Sept. '57	Dec. '57	Jan.-Feb. '58	May-June '58	July-Aug. '58
Fish	5.5	11.0	2.9	1.8	9.1
Squid	6.3	1.3	—	7.3	2.5
Shrimp	70.8	91.9	80.9	87.9	84.4
Crab	3.3	2.3	10.3	1.5	3.6
Stomatopod	1.4	3.9	1.5	—	0.4
Small crustacean	19.6	13.3	19.1	37.1	13.8
Polychaete	1.4	6.1	—	6.6	1.8
Molluscan	0.3	6.1	—	3.0	—
Echinoderm	—	0.3	—	—	0.4
Others	—	1.0	—	0.5	—
Undet. contents	7.2	—	2.9	2.3	8.7
Numbers of feeding individuals	363	235	53	396	275

On the other hand, the feeding frequency of triglid fishes caught in the period from Sept. 1957 to July-Aug. 1958, by season and by food-group, is shown in Table 8. The feeding frequency for shrimps was highest throughout, and that of small crustaceans was always relatively higher than those of other prey-groups excepting shrimps. Figure 48 shows the seasonal change of the feeding frequency for small crustaceans given in Table 8, together with that for gammaridean amphipods eaten by various fishes living on the

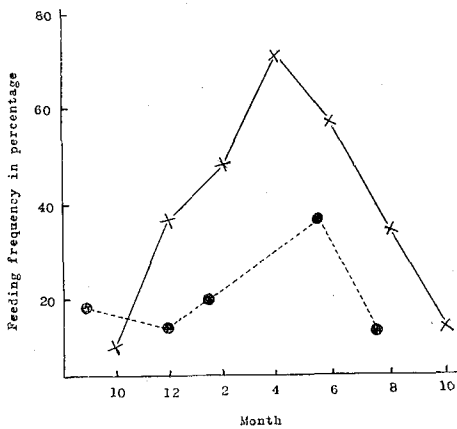


Fig. 48. The seasonal change of the feeding frequency for small crustaceans (---) and for gammaridean amphipods (—). The dotted line refers to that of triglid fishes given in Table 8, while the solid line concerns that of the various fishes living on the *Zostera* belt near the low-water mark in Mihara Bay.

Zostera-belt of Mihara Bay (KITAMORI, NAGATA et KOBAYASHI 1959, fig. 8). Amphipods are the largest component of small crustaceans found in the stomach of triglid fishes treated in Table 8, and therefore it is very interesting that the two curves shown in Figure 48 indicate a similar tendency; one refers to the offshore areas, while the other concerns the inshore region near the low-water mark. Results of many surveys in Mihara Bay indicate that the seasonal change of the feeding frequency for gammaridean amphipods agrees fairly well with the seasonal variation in the quantity of the amphipods themselves in that habitat. And this means nothing but that triglid fishes

in the Seto Inland Sea feed relatively well on small crustaceans.

Now throughout the five-month data shown in Table 8, the percentage composition of the total small crustaceans found in the stomach contents of triglid fishes is given as follows:

Amphipoda	
Gammaridea	54.1
Caprellidea	5.4
Cumacea	24.4
Ostracoda	9.6
Mysidacea	5.6
Brachyura & Macrura larvae	5.6
Isopoda	0.09
Nebaliacea	0.09

More than half of small crustaceans consist of gammaridean amphipods, of which several dominant species are given below together with the percentage composition:

<i>Ampelisca brevicornis</i>	}	23.2
<i>Ampelisca cyclops</i>		
<i>Ampelisca bocki</i>		
<i>Ampelisca misakiensis</i>		
<i>Ampelisca miharaensis</i>		
<i>Ampelisca naikaiensis</i>		
<i>Byblis japonicus</i>		17.5
<i>Pontocrates altamarinus</i>		11.7

<i>Eurystheus utinomii</i>	}	37.5
<i>Eurystheus japonicus</i>		
<i>Photis longicaudata</i>	}	0.3
<i>Photis reihardi</i>		
<i>Liljeborgia japonica</i>		0.4
<i>Podocerus inconspicuus</i>		3.4
Other species		5.9

It is seen that 89.9 percent of the total are occupied by 10 species of the genera *Ampelisca*, *Byblis*, *Pontocrates*, and *Eurystheus*. The conjecture that these species important as prey-animals must be inhabiting abundantly on the offshore floor is supported actually by two benthos-collections shown in Tables 4 and 5, namely the above 10 species account for 78.6 percent of the total individuals in Area XI-a (Table 4) and for 96.2 percent in Area XI-b (Table 5).

REFERENCES

- ALDERMAN, A. L. 1936. Some new and little known amphipods of California. Univ. Calif. Publ. Zool., 41 (7): 53-74, 51 text-figs.
- BARNARD, J. L. 1952. Some Amphipoda from Central California. Wasmann Jour. Biol., 10 (1): 9-36, 9 pls.
- 1954. A new species of *Microjassa* (Amphipoda) from Los Angeles Harbor. Bull. So. Calif. Acad. Sci., 53 (3): 127-130, pls. 35-36.
- 1954a. Marine Amphipoda of Oregon. Oregon State Monog., Zool., 8: 1-103, pls. 1-33.
- 1954b. Amphipoda of the family Ampeliscidae collected in the eastern Pacific Ocean by the Veleró III and Veleró IV. Allan Hancock Pacific Expeds., 18 (1): 1-137, pls. 1-38.
- 1955. Gammaridean Amphipoda (Crustacea) in the collections of Bishop Museum. Bishop Mus., Bull. 215: 1-46, text-figs. 1-20.
- 1958. Index to the families, genera, and species of the gammaridean Amphipoda. Allan Hancock Found., Occ. Pap. No. 19: 1-148.
- 1959. The number of species of gammaridean Amphipoda (Crustacea). Bull. So. Calif. Acad. Sci., 58 (1), p. 16.
- 1959a. Liljeborgiid amphipods of Southern California coastal bottoms, with a revision of the family. Pacific Naturalist, 1 (4): 12-28, text-figs. 1-12, 1 tab., 2 charts.
- 1959b. Generic partition in the amphipod family Cheluridae, marine wood borers. Ibid., 1 (3): 1-12, text-figs. 1-5.
- 1959c. Ecology of Amphipoda and Polychaeta of Newport Bay, California. Allan Hancock Found. Publ., Occ. Pap. No. 21: 1-106, pls. 1-14.
- 1960. Common pleustid amphipods of Southern California, with a projected revision of the family. Pacific Naturalist, 1 (17): 37-48, 6 text-figs.
- 1960a. The amphipod family Phoxocephalidae in the eastern Pacific Ocean, with analyses of other species and notes for a revision of the family. Allan Hancock Pacific Expeds., 18 (3): 169-375, pls. 1-75, 14 tabs., 1 chart.
- 1961. Gammaridean Amphipoda from depths of 400 to 60000 meters in scientific results of the Danish Deep-Sea Expedition round the world 1950-52. Galathea Report, vol. 5: 23-128, text-figs. 1-83, 8 tabs.
- 1962. Benthic marine Amphipoda of Southern California: families Amphilochidae, Leucothidae, Stenothoidae, Argissidae, Hyalidae. Pacific Naturalist, 3 (3): 116-163, text-figs. 1-23, 1 table.

- 1962a. Benthic marine Amphipoda of Southern California: families Tironidae to Gammaridae. *Ibid.*, 3 (2): 73-115, text-figs. 1-23, 2 tables.
- 1962b. Benthic marine Amphipoda of Southern California: families Aoridae Photidae, Ischyroceridae, Coropiidae, Podoceridae. *Ibid.*, 3 (1): 3-72, text-figs. 1-32.
- BARNARD, K. H. 1916. Contributions to the crustacean fauna of South Africa. 5.—The Amphipoda. *Ann. So. African Mus.*, 15 (3): 105-302, pls. 26-28.
- 1925. Contributions to the crustacean fauna of South Africa—No. 8. Further additions to the list of Amphipoda. *Ann. Soc. African Mus.*, 20 (5): 319-380, pl. 34.
- 1930. Amphipoda. British Antarctic ("Terra Nova") Expedition, 1910, London. *Nat. Hist. Repts., Zool.*, 8: 307-454, 63 text-figs.
- 1932. Amphipoda. *Discovery Repts.*, 5: 1-326, pl. 1, 174 text-figs.
- 1935. Report on some Amphipoda, Isopoda, and Tanaidacea in the collections of the Indian Museum. *Rec. Indian Mus.*, 37: 279-319, 21 text-figs.
- 1937. Amphipoda. John Murray Exped. 1933-34, *Sci. Repts. Brit. Mus. (Nat. Hist.)*, 4 (6): 131-201, 21 figs.
- 1940. Contributions to the crustacean fauna of South Africa, XII. Further additions to the Tanaidacea, Isopoda, and Amphipoda, together with keys for the identification of the hitherto recorded marine and fresh-water species. *Ann. So. African Mus.*, 32 (5): 381-543, 35 text-figs.
- 1955. Additions to the fauna-list of South African Crustacea and Pycnogonida. *Ann. So. African Mus.*, 43 (1): 80-99, text-figs. 38-49 (Amphipoda).
- BULYCHEVA, A. I. 1952. Novye vidy bokoplavov (Amphipoda, Gammaridea) iz Japonskogo Morja. *Akad. Nauk SSSR, Trudy Zool. Inst.*, 12: 195-250, 39 figs.
- 1955. Novye vidy bokoplavov (Amphipoda, Gammaridea) iz Japonskogo Morja. II. *Ibid.*, 21: 193-207, 6 text-figs.
- CHEVREUX, E. 1900. Amphipodes provenant des campagnes de l'*Hirondelle* (1885-1888). *Res. Camp. Sci. Albert Ier, Monaco*, 16: I-IV, 1-195, pls. 1-18.
- 1901. Amphipodes. Mission Scientifique.....Alluaud aux Iles Séchelles. *Soc. Zool. France, Mém.*, 14: 388-438, 65 text-figs.
- 1907. Amphipodes recueillis dans.....l'Océanie par M. Seurat. *Ibid.*, 20 (4): 470-527, 35 text-figs.
- 1908. Sur trois nouveaux amphipodes méditerranéens appartenant au genre *Corophium* Latreille. *Bull. Soc. Zool. France*, 33: 69-76, 6 text-figs.
- 1911. Campagnes de la *Melita*. Les amphipodes d'Algérie et de la Tunisie. *Mém. Soc. Zool. France*, 23 (3): 145-275, pls. 6-20, 17 text-figs.
- CHEVREUX, E. and L. FAGE. 1925. Amphipodes. *Faune de France*, 9: 1-448, 438 text-figs.
- CHILTON, C. 1911. The Crustacea of the Kermadec Islands. *Trans. N. Z. Inst.*, 43: 544-573, 4 text-figs.
- 1920. Some New Zealand Amphipoda: No. 1. *Ibid.*, 52: 1-8, 5 text-figs.
- 1921. Report on the Amphipoda obtained by the F.I.S. "Endeavour" in Australian Seas. *Biol. Res. "Endeavour"*, 5 (2): 33-92, 16 text-figs.
- 1921a. Fauna of the Chika Lake. Amphipoda. *Mem. Indian Mus.*, 5: 519-558, 12 text-figs.
- 1925. Zoological results of a tour in the Far East. The Amphipoda of Tale Sap. *Mem. Asiat. Soc. Bengal*, 6: 531-539, 3 text-figs.
- CRAWFORD, G. I. 1937. A review of the amphipod genus *Corophium*, with notes on the British species. *Journ. Mar. Biol. Assoc. United Kingdom*, 21 (2): 589-630, 4 text-figs.
- DAHL, E. 1944. Amphipoda of the family Ampeliscidae from Professor Sixten Bock's Expedition to Japan, 1914. *Arkiv för Zool.*, 36A (1): 1-18, 10 text-figs.
- 1959. Amphipoda from depths exceeding 6000 meters. *Galathea Rep.*, 1: 211-241, 18 figs.

- DELLA VALLE, A. 1893. Gammarini del Golfo di Napoli. Fauna und Flora des Golfes von Neapel, 20: xi plus 948 pp., 61 pls.
- DUNBAR, M. J. 1954. The amphipod Crustacea of Ungava Bay, Canadian Eastern Arctic. Journ. Fish. Res. Board Canada, 11 (6): 709-798, 42 text-figs., 1 table.
- ENEQUIST, P. 1949. Studies on the soft-bottom amphipods of the Skagerrak. Zool. Bidrag, fran Uppsala, 28: 297-492, 67 text-figs., 6 charts.
- GURJANOVA, E. 1951. Bokoplavi morei SSSR i sopredel'nyx vod (Amphipoda-Gammaridea). Opred. po Faune SSSR, Izd. Zool. Inst. Akad. Nauk, 41: 1-1031, 705 figs.
- 1962. Bokoplavi severnoj chasti Tikhogo Okeana. Opred. po Faune SSSR, Izd. Zool. Inst. Akad. Nauk, 74: 1-441, 143 text-figs.
- HOWES, N. H. 1939. Observations on the biology and post-embryonic development of *Idotea viridis* (Slabber) (Isopoda, Valvifera) from New England Creek, South-East Essex. Journ. Mar. Biol. Assoc. United Kingdom, 23: 279-310, 14 figs., 2 tables.
- HURLEY, D. E. 1954. Studies on the New Zealand amphipodan fauna. No. 9. The families Acanthonotozomatidae, Pardaliscidae and Liljeborgiidae. Trans. Roy. Soc. N.Z., 82 (3): 763-802, 14 text-figs.
- 1954a. Studies on the New Zealand amphipodan fauna. No. 7. The family Corophiidae, including a new species of *Paracorophium*. Ibid., 82 (2): 431-460, 7 text-figs.
- 1957. Studies on the New Zealand amphipodan fauna. No. 14. The genera Hyale and Allorchestes (family Talitridae). Ibid., 84 (4): 903-933, 9 text-figs.
- IRIE, H. 1956. Tube-building amphipods occurring at the "wakame" (a species of brown algae: *Undaria pinnatifida*) grounds of Simabara, Nagasaki Prefecture. Bull. Fac. Fish., Nagasaki Univ., 4: 1-6, 6 figs.
- 1959. Studies on pelagic amphipods in the adjacent seas of Japan. Ibid., 8: 20-42, 4 figs., 11 tables.
- IWASA, M. 1934. A new amphipod (*Parhyale kurilensis*, n. sp.) from Urup. Journ. Fac. Sci. Hokkaido Imp. Univ., ser. 6, Zool., 3 (1): 1-7, pls. 1-2.
- 1939. Japanese Talitridae. Ibid., ser. 6, Zool., 6 (4): 255-296, pls. 9-22, 27 text-figs.
- KITAMORI, R., K. NAGATA, and S. KOBAYASHI. 1959. The ecological study on "Moba" (Zone of *Zostera marina* L.). (II) Seasonal changes. Bull. Naikai Reg. Fish. Res. Lab., 12: 187-199, 13 figs., 2 tables. (In Japanese).
- NAGATA, K. 1959. Notes on five species of the amphipod genus *Ampelisca* from the stomach contents of the triglid fishes. Publ. Seto Mar. Biol. Lab., 7 (2): 263-278, 11 text-figs.
- 1960. Preliminary notes on benthic gammaridean Amphipoda from the *Zostera* region of Mihara Bay, Seto Inland Sea, Japan. Ibid., 8 (1): 163-182, pls. 13-17, 2 text-figs.
- 1961. A new atylid amphipod from Japan. Annot. Zool. Japon., 34 (4): 216-218, 2 text-figs.
- 1961a. Two new amphipods of the genus *Eurystheus* from Japan. Publ. Seto Mar. Biol. Lab., 9 (1): 31-36, 2 text-figs.
- OLIVEIRA, L. P. H. 1953. Crustacea Amphipoda do Rio de Janeiro. Mem. Inst. Oswaldo Cruz, 51: 289-376, 27 text-figs.
- PIRLOT, J. M. 1936. Les amphipodes de l'expédition du Siboga. Siboga-Exped., Mon. 33e: 237-328, text-figs. 101-146.
- 1938. Les amphipodes de l'expédition du Siboga. Siboga-Exped., Mon. 33f: 329-359, text-figs. 147-161.
- REID, D. M. 1951. Report on the Amphipoda (Gammaridea and Caprellidea) of the coast of tropical West Africa. Atlantide Rpt., Copenhagen, 2: 189-291, 58 text-figs.
- RUFFO, S. 1950. Studi sui crostacei Anfipodi. XXII—Anfipodi der Venezuela raccolti dal G. Marcuzzi. Mem. Mus. Civ. Stor. Nat. Verona, 2 (2): 49-65, 5 text-figs.
- 1959. Contributions to the knowledge of the Red Sea. No. 13. Bull. Sea Fish. Res. Stat., Haifa, 20: 1-26, 6 text-figs.

- SARS, G. O. 1895. Amphipoda. An account of the Crustacea of Norway with short descriptions and figures of all the species, 1: i-viii, 1-711, 240 pls., 8 suppl. pls.
- SCHELLENBERG, A. 1926. Die Gammariden der Deutschen Südpolar-Expedition 1901-03. Deutsche Südpolar-Exp., Berlin, 18: 235-414, 68 text-figs.
- 1926a. Die Gammariden der Deutschen Tiefsee-Expedition. Wiss. Erg. D. Tielsee-Exp. "Valdivia", 23 (5): 195-243, 28 text-figs., pl. 5.
- 1927. Amphipoda des nordischen Plankton. Nordisches Plankton, 20 (6): 589-722, 104 text-figs.
- 1928. Amphipoda in Cambridge Expedition to Suez Canal. Trans. Zool. Soc. London, 22: 633-692, 12 text-figs.
- 1931. Gammariden und Caprelliden des Magellangebietes, Sudgeorigens und der Westantarktis. Further Zool. Res. Swedish Antarctic Exped. 1901-03, 2 (6): 1-290, 1 pl., 136 text-figs.
- 1936. Zwei Neue Amphipoden des Stillen Ozeans und zwei Berichtigungen. Zool. Anz., 116: 153-156, 1 text-fig.
- 1937. Schlüssel und Diagnosen der dem Süsswasser-Gammarus nahestehenden Einheiten ausschliesslich der Arten des Baikalsees und Australiens. Ibid., 117: 267-280, 4 text-figs.
- 1938. Litorale Amphipoden des tropischen Pazifiks. Kgl. Svenskapskad. Handl., (3) 16 (6): 1-105, 48 text-figs.
- 1942. Krebstiere oder Crustacea IV: Flohkrebse oder Amphipoda. Die Tierwelt Deutschlands, Jena, 40: 1-252, 204 text-figs.
- SEXTON, E. W. & D. M. REID 1951. The life-history of the multiform species *Jassa falcata* (Montagu) (Crustacea Amphipoda) with a review of the bibliography of the species. Linn. Soc. London, Jour. (Zool.), 42 (283): 29-91, pls. 4-30.
- SHEARD, K. 1938. The amphipod genera *Euonyx*, *Syndexamine* and *Paradexamine*. Rec. So. Austr. Mus., 6 (2): 169-186, 9 text-figs.
- 1939. Studies in Australian Gammaridea. (I) The genus *Ceradocus*. Ibid., 6 (3): 275-295, 8 text-figs.
- SHIINO, S. 1948. Studies on marine crustaceans III. On a new boring amphipod, *Chelura brevicauda*, sp. n. Misc. Rept. Res. Inst. Nat. Resources, 12: 25-28, 3 text-figs. (In Japanese).
- SHOEMAKER, C. R. 1930. The Amphipoda of the Cheticamp Expedition of 1917. Cont. Canad. Biol. Fish., 5 (10): 221-359, 54 text-figs.
- 1933. Two new genera and six new species of Amphipoda from Tortugas. Carnegie Inst. Wash., Pap. Tortugas Lab., 28: 245-256, 8 text-figs.
- 1942. Amphipoda crustaceans collected on the Presidential cruise of 1938. Smithson. Misc. Coll., 101 (11): 1-52, 17 text-figs.
- 1945. The amphipod genus *Photis* on the east coast of North America. Charleston Mus. Leafl., 22: 1-17, 5 text-figs.
- 1947. Further notes on the amphipod genus *Corophium* from the east coast of America. Journ. Wash. Acad. Sci., 37 (2): 47-63, 12 text-figs.
- 1949. The amphipod genus *Corophium* on the west coast of America. Ibid., 39 (2): 66-82, 8 text-figs.
- 1955. Amphipoda collected at the Arctic Laboratory, Office of Naval Research, Point Barrow, Alaska, by G. E. MacGinitie. Smithson. Misc. Colls., 128 (1): 1-78, 20 text-figs.
- 1956. Observation on the amphipod genus *Parhyale*. Proc. U.S. Nat. Mus., 106 (3372): 345-358, 4 figs.
- STEBBING, T. R. R. 1888. Amphipoda. Rept. "Challenger" Exped., Zool., vol. 29.
- 1897. Amphipoda from Copenhagen Museum and other sources. Trans. Linn. Soc. London, (2), Zool., 7: 25-45, pls. 6-14.

- 1899. Amphipoda from Copenhagen Museum and other sources. Part 2. *Ibid.*, 7: 395-432, pls. 30-35.
- 1906. Amphipoda I. Gammaridea. *Das Tierreich*, 21: 1-806, 127 text-figs.
- 1910. Crustacea. Part 5. Amphipoda. *Sci. Res. Trawling Exped. H.M.C.S. "Thetis"*. *Mem. Austr. Mus.*, 4, vol. 2, (12): 565-658, pls. 47-60.
- STEBBING, T. R. R. & D. ROBERTSON 1891. On four new British Amphipoda. *Trans. Zool. Soc. London*, 13: 31-42, pls. 5-6.
- STEPHENSEN, K. 1915. Isopoda, Tanaidacea, Cumacea, Amphipoda (excl. Hyperidea). *In Report of the Danish Oceanographical Expedition, 1908-10, to the Mediterranean and adjacent seas. vol. 2, Biology, D. 1*: 1-53, 33 text-figs.
- 1923. Crustacea Malacostraca. V (Amphipoda I). *The Danish Ingolf-Expedition*, 3 (8): 1-100, 22 text-figs., charts.
- 1925. Crustacea Malacostraca. VI (Amphipoda II). *Ibid.*, 3 (9): 101-178, text-figs. 23-53, charts.
- 1932. Some new amphipods from Japan. *Annot. Zool. Japon.*, 13 (5): 487-501, 5 text-figs.
- 1933. *Ceinina japonica* (n. gen., n. sp.), a new aberrant species of the amphipodan family Talitridae from Japan. *Trans. Sapporo Nat. Hist. Soc.*, 13 (2): 63-68.
- 1935. Indo-pacific terrestrial Talitridae. *Bernice P. Bishop Mus., Occas. Pap.*, 10 (23): 1-20, 2 tables.
- 1938. *Gradidierella japonica* n. sp., a new amphipod with stridulating (?) organs from brackish water in Japan. *Annot. Zool. Japon.*, 17 (2): 179-184, 2 text-figs.
- 1938a. The Amphipoda of N. Norway and Spitsbergen with adjacent waters. *Tromsø Mus. Skrifter*, 3 (2): 141-278, text-figs. 20-31.
- 1940. Marine Amphipoda. *The Zoology of Iceland*, 3 (26): 1-111, 13 text-figs., 2 tables.
- 1940a. The Amphipoda of N. Norway and Spitsbergen with adjacent waters. *Tromsø Mus. Skrifter*, 3 (3): 279-362, text-figs. 32-52.
- 1942. The Amphipoda of N. Norway and Spitsbergen with adjacent waters. *Ibid.*, 3 (4): 363-526, text-figs. 53-78.
- 1944. Some Japanese amphipods. *Vidensk. Medd. fra Dansk naturh. Foren.*, 108: 25-88, 33 text-figs.
- 1944a. Crustacea Malacostraca. VIII (Amphipoda IV). *The Danish Ingolf-Expedition*, 3 (13): 3-51, 38 text-figs.
- 1944b. *The Zoology of East Greenland. Amphipoda. Meddel. om Grønland.*, 121 (14): 1-165, 18 text-figs., 3 tables.
- TATTERSALL, W. M. 1922. Zoological results of a tour in the Far East. Part 8. Amphipoda with notes on an additional species of Isopoda. *Mem. Asiatic Soc. Bengal*, 6: 435-459, pls. 18-21.
- THOMSON, G. M. 1879. New Zealand Crustacea, with descriptions of new species. *Trans. N.Z. Inst.*, 11: 230-248, pl. 10.
- 1879a. Addition to the amphipodous Crustacea of New Zealand. *Ann. Mag. Nat. Hist.*, (5) 4 (23): 329-333, pl. 16.
- 1880. New species of Crustacea from New Zealand. *Ibid.*, (5) 6: 1-6, pl. 1.
- 1881. Recent additions to and notes on New Zealand Crustacea. *Trans. N.Z. Inst.*, 13: 204-221, pls. 7-8.
- UENO, M. 1933. Freshwater Crustacea of Iturup. *Annot. Zool. Japon.*, 14: 109-113, 1 fig.
- 1935. Crustacea collected in the lakes of Southern Sakhalin. *Ibid.*, 15 (1): 88-94, 4 figs.
- UTINOMI, H. 1947. Caprellidae of Japan and adjacent waters. *Seibutu, Suppl.*, 1: 68-82, 8 text-figs. (In Japanese).

- WALKER, A. O. 1898. Crustacea collected by W. A. Herdman, F.L.S., in Puget Sound, Pacific coast of North America, Sept. 1897. Proc. Trans. Liverpool Biol. Soc., 12: 268-287, pls. 15-16.
- 1904. Report on the Amphipoda collected by Professor Herdman, at Ceylon, in 1902. Ceylon Pearl Oyster Fisheries, Suppl. Rept., 17: 229-300, 8 pls.
- 1909. Amphipoda Gammaridea from the Indian Ocean, British East Africa, and the Red Sea. Trans. Linn. Soc. London, (2), Zool., 12: 323-344, pls. 42-43.
- WATKIN, E. E. 1939. The pelagic phase in the life history of the amphipod genus *Bathyporeia*. Journ. Mar. Biol. Assoc. United Kingdom, 23: 467-481, 2 text-figs., 4 tables.