Descriptions and Records of Marine Harpacticoid Copepods from Hokkaido, V[1)]

By

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(With 47 Text-figures)

In the present paper nine species of marine harpacticoid copepods are reported from several localities of Hokkaido. The species, four of which are new to science, belong to the five known genera and one new genus of five different families, namely *Zaus* Goodsir (Harpacticidae Sars), *Eudactylopus* A. Scott and one new genus (Thalestridae Sars, Lang), *Diosaccus* Boeck (Diosaccidae Sars), *Paralteutha* T. Scott (Peltidiidae Sars) and *Heterolaophonte* Lang (Laophontidae T. Scott). Since the new genus of the family Thalestridae seems to be related to the genus *Latiremus* recently proposed by Bozic (1969) together with the family Latiremidae, several important problems among them and some other related genera will be discussed in a phylogenetical point of view.

The specimens were collected from Oshoro near Otaru on the Japan Sea coast, Akkeshi and Muroran, both on the Pacific coast of Hokkaido. Detailed sampling data for each species will be given in the text. The type specimens were deposited in the Zoological Institute, Faculty of Science, Hokkaido University. The surface structure of two species of the genus *Zaus* was examined with a scanning electron microscope, Model JSM-1 of Japanese Electron Optics Laboratory, at an accelerating voltage of 25 kilovolts. Prior to this examination, specimens preserved in a formalin-sea water solution were rinsed well with distilled water, dryed in air, mounted on sample stages with Dotaite cement containing conductive silver paint, and were coated with carbon and gold in a vaccum evaporator, Model JEE-4B.

Before going further I express my sincere thanks to Professor Mayumi Yamada of Hokkaido University for his guidance and reading the manuscript. Sincere gratitude is also due to Dr. Sh. Gamo of Yokohama National University, Yokohama, who kindly sent me some harpacticoid specimens from France. The specimens of *Zaus spinatus* from France used in the present study were selected from his sample. I am also indebted to Mr. M. Sakaguchi of Takasago High School, Takasago, formerly of Akkeshi Marine Biological Station of Hokkaido University, who collected some specimens from Daikoku-jima Islet, Akkeshi, and kindly offered me all of them for this study. The examination of the surface structure of *Zaus* with a scanning electron microscope was kindly assisted by

1) Studies on marine harpacticoid copepods from Hokkaido, VI.

Mr. Y. Nodasaka of the School of Dentistry, Hokkaido University, and by Mr. Y. Ogawa of the School of Medicine, Hokkaido University, to whom I am much obliged, without their helps I could not perform the study on the minute structure of the so-called brush-like claws of the first pair of legs in several species of the genus *Zaus*.

Zaus intermedius Nicholls

(Figs. 1~3)

Zaus intermedius Nicholls 1939, p. 253, fig. 5; *Zaus aurelii* Poppe: Nicholls 1942 (in part), p. 122, fig. 1-d; Lang 1948 (in part), p. 350, fig. 160-d.

Female. Body (Fig. 1–1) about 0.62 mm in length, rostrum and furcal setae excluded. Nauplius eye present. Color was not examined. Rostrum (Fig. 1–4) much wider than long, nearly trapezoid, with a setula on both anterior corners and with a pair of fine hairs on dorsal surface; anterior rim between two setulae well chitinous. Cephalothoracic somite a little wider than long, and about as long as succeeding four free thoracic somites combined; hyaline membrane along posterior margin well developed (Fig. 1–2); many sensilae scattered along base of hyaline membrane; dorsal surface ornamented with many minor pits and less number of hairs. First three thoracic segments about as wide as greatest width of cephalothoracic somite; each lateral corner of epimeral plate of third thoracic somite well expanded posteriorly. Fourth thoracic somite much reduced in size. Genital double-somite (Fig. 1–3) subdivided by a chitinous suture ventrally and laterally, while this suture is scarcely recognizable in about middle dorsal part; both lateral margins furnished with many spinules; a pair of reduced leg 6 were not detected. Antepenultimate somite with less number of spinules and a setula on both posterior lateral edges. Penultimate somite with no particular ornamentation. Anal segment clearly bipartite posteriorly, with several spinules on both lateral posterior edges and with many delicate spinules ventrally along base of each furcal ramus. Furcal ramus about as long as wide; outer end clearly produced posteriorly; outer edge with one fine setula and two juxtaposed setae, both accompanied with several spinules basally; one seta on a slight protuberance of inner posterior corner; one setula, which is geniculate basally, on dorsal surface near inner edge; principal terminal setae well developed.

Antennule (Fig. 1–4) nine-segmented; anterior edge of first segment with some spinules; second segment with three dorsal setae near distal end; third one about as long as preceding one, with many setae on anterior distal edge; fourth one slightly produced at anterior distal corner and with a slender aesthetasc terminally; apical five segments much smaller than others; sixth one clearly longer than any segment of apical five ones. The last mentioned characteristic is very important for considering the relation to other spicies of the genus. *Antenna* (Fig. 1–5). Coxa very short. Allobasis with one hairy seta on about two-thirds the length of anterior edge and several spinules anteriorly. Exopodite two-segmented; first segment slightly thickened distally, and with two setae, distal one of which is hairy;

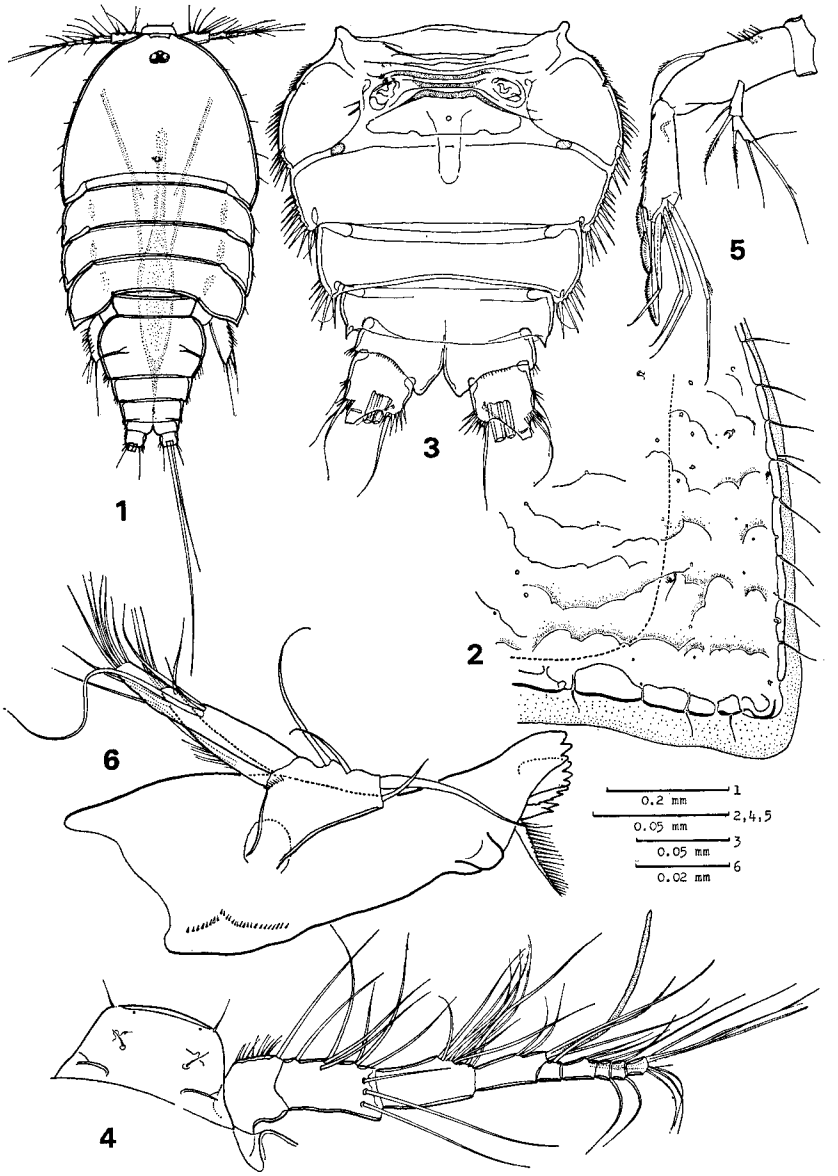

Fig. 1. *Zaus intermedius*. Female. 1. dorsal view; 2. postero-lateral part of cephalothorax; 3. abdomen, ventral; 4. rostrum and antennule; 5. antenna; 6. mandible.

second one a little shorter than first, with two marginal and two terminal setae, one of the latters is very delicate and rather hair-like. *Mandible* (Fig. 1–6). Praecoxa with a row of spinules on surface near proximal corner; pars incisiva apparently tridentate; pars molaris well developed. Coxa-basis much widened distally, with several spinules near base of exopodite; inner distal corner furnished with one short seta and one remarkably thick seta; two slender setae on distal edge, both apparently inclined outwards. Exopodite one-segmented, cylindrical and furnished with one long seta on about one-fourth the length near outer edge, two subdistal setae and three juxtaposed terminal setae. Endopodite one-segmented, fairly longer than exopodite segment; middle inner edge with three setae, one of which is strikingly elongate and exceeds the length of the segment; six (or seven ?) slender setae of almost same length on distal end. *Maxillula* (Fig. 2–1). Arthrite of praecoxa furnished with seven claws, some of which are spinulose, on inner end and two thick spinulose setae on dorsal inner corner; two parallel bare setae on about middle surface; one arched spinular row on surface near proximal end; several spinules along dorsal edge and on inner edge close to inner claws. Distal end of cylindrical process of coxa attaining about middle arthrite of praecoxa, and furnished with four more or less spinulose or hairy setae. Basis with four spinulose or hairy setae on inner end and two bare setae on ventral inner corner; several spinules on and near dorsal margin. Exopodite well developed, about four times as long as greatest width and furnished with much elongate hairs along both margins, and one spinulose thick seta on inner subdistal corner and three bare setae on distal end; boundary between exopodite and basis, apparently inclined inwards; three rather short setae on distal end and less number of hairs along outer margin. *Maxilla* (Fig. 2–2). Syncoxa furnished with three cylindrical endites, each with three more or less spinulose thick setae terminally. Inner part of basis forming into a strikingly thick claw accompanied with one setula on dorsal edge and three pairs of close setae, of which the ventralmost one is the thickest and hairy. *Maxillipede* (Fig. 2–5). Outer distal part of coxa less spinulose. Basis about as long as coxa, tapering distally, with one seta on inner distal corner; a transverse row of very delicate spinules near proximal inner corner; circularly arranged hairs on outer surface. This arrangement of hairs can not be recognized in frontal or back view (see Figs. 2–3, 4). First endopodite segment about as long as preceding segment, roughly ovoidal in shape; several spinules on outer edge near proximal corner, and one spinule on about one-third the length of outer margin; inner distal half spinulose. Second endopodite segment represented by an arched claw swollen basally.

Leg 1 (Fig. 2–6). Boundary between coxa and basis scarcely inclines. Coxa a little wider than long, slightly swollen outwards; outer part traversed by a short row of several spinules at about one-third the length; nearly whole outer margin furnished with very slender spinules, in which longer ones attain two-thirds the greatest width of the segment. Basis longer than coxa, gradually tapering distally; one thick spinulose seta on about one-third the length of outer margin, a

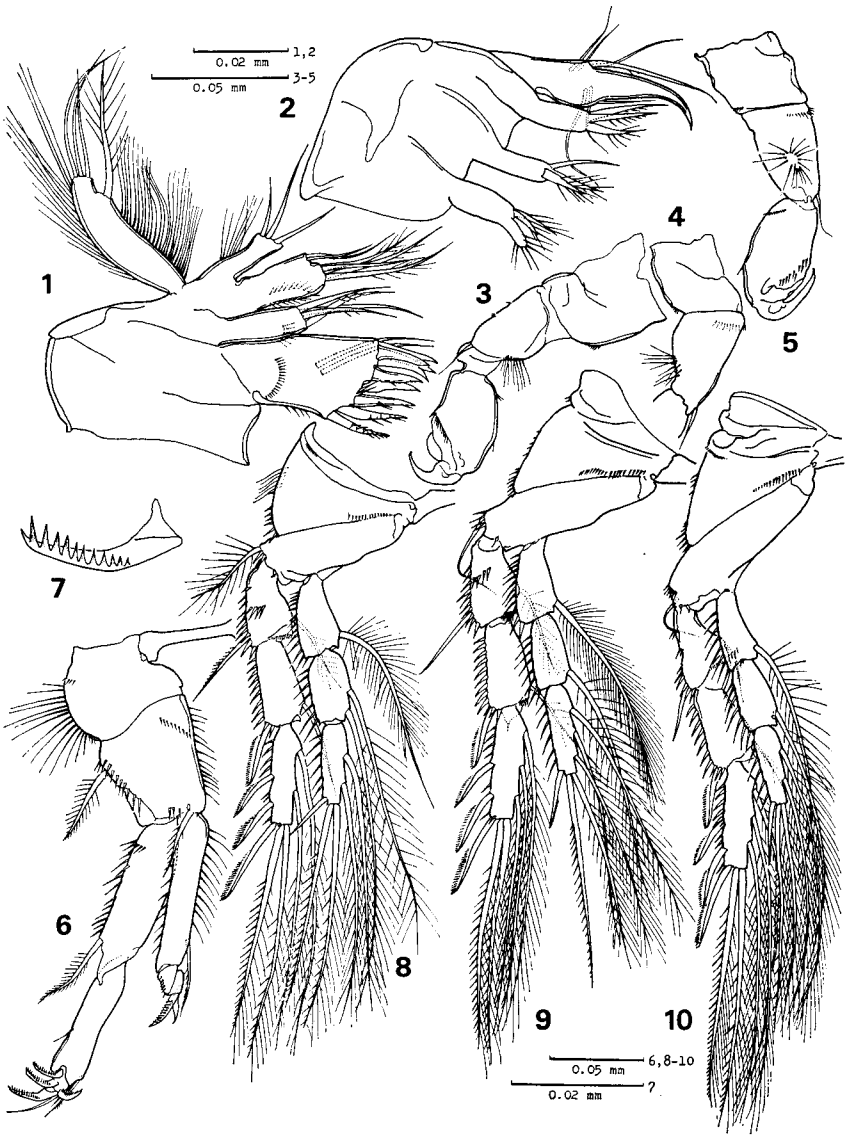

Fig. 2. *Zaus intermedius*. Female. 1. maxillula; 2. maxilla; 3~5. maxillipede, first two of same specimen; 6. leg 1; 7. terminal claw of last exopodite segment of leg 1; 8. leg 2; 9. leg 3; 10. leg 4.

spinular row extending on anterior surface from proximal base of outer seta described above to distal corner; an oblique spinular row on anterior surface of inner proximal part; whole inner margin spinulose; one spinulose seta on distal end just inside inner edge, close to base of endopodite. Exopodite three-segmented, about 1.5 times as long as coxa and basis combined; distal part of first segment transformed into a distally tapering lamina which covers the anterior base of second segment and fairly extends along outer margin; first segment furnished with one thick spinulose seta on outer distal corner, a transverse row of less number of spinules near outer proximal corner, and several spinules along outer margin between spinulose seta and spinular row described; second segment a little shorter and slender than first, with no spinular ornamentation, but with one setula on about two-thirds the length of outer margin, and one very delicate setula and one minutely hairy seta near inner distal corner; third segment much reduced, with one seta and four strong claws. The last mentioned claws are furnished with a row consisting of about ten spinules along each anterior ventral margin (see Fig. 2–7). Endopodite much smaller than exopodite, about as long as coxa and basis combined, three-segmented; first segment about as long as first exopodite segment, furnished with some rigid spinules along whole outer margin, many flexible, longer spinules along inner margin, and one spinulose seta near inner distal corner; second one represented by a small triangular segment demarcated basally by a distinct suture and ornamented with a longitudinal row of less number of spinules just inside outer margin; third segment much dwarfed, slightly inserted into triangular protuberance of first segment, with one spinulose claw and one bare, acutely sharpened claw. *Leg 2* (Fig. 2–8). Coxa nearly triangular, with several hairs near middle outer edge, some spinules along distal half of outer margin, a short row of delicate spinules on anterior surface near outer proximal corner; a spinular row along demarcation between coxa and basis on inner half of anterior surface. Basis conspicuously protruded outwards and ending in one plumose seta accompanied with less number of spinules basally; a blunt protuberance formed between both rami which are three-segmented as in all the known species of the genus. Exopodite; each outer margin of all segments ornamented with some rigid spinules; first segment clearly widened distally, with one spinulose outer seta and one plumose inner seta near base of serrate hyaline membrane, and with a transverse row of less number of spinules on about middle anterior surface of outer half; second one slightly widened distally, with one pectinate spine on distalmost outer end and one plumose inner seta; third one much slender and a little longer than proximal two, and furnished with three pectinate outer spines, two long terminal setae, outer one of which is densely spinulose along outer edge and another is sparsely spinulose, and with two plumose inner setae. Endopodite; each outer margin of all segments spinulose; inner seta of first segment densely plumose; second segment with two plumose setae, each on about middle inner edge and near inner distal corner; third segment, of which distal end does not reach to distal end of last exopodite segment, with one bare (or finely ciliate ?) spine on

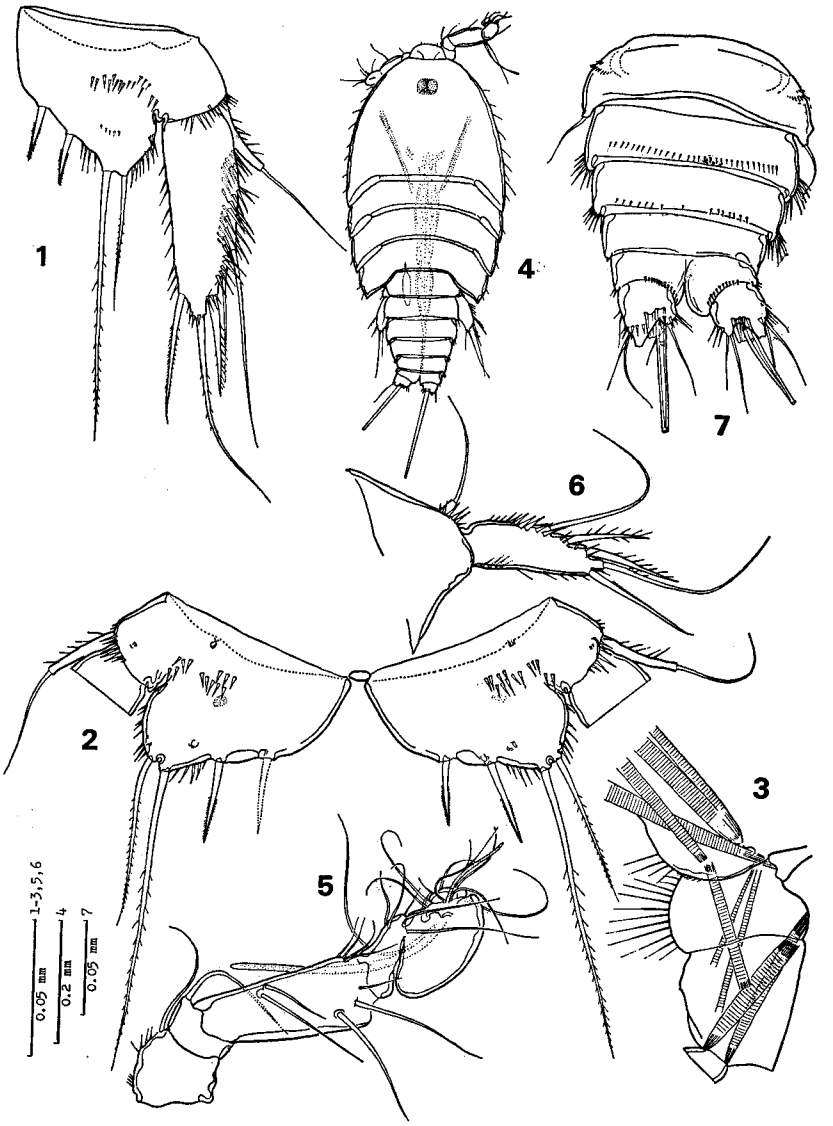

Fig. 3. *Zaus intermedius*. Female. 1. leg 5; 2. leg 5 of another specimen; 3. basal part of leg 1, with major muscles. Male. 4. dorsal view; 5. antennule; 6. leg 5; 7. leg 6 and abdomen.

outer distal corner, two terminal setae, which are sparsely spinulose along outer margin, and are hairy along inner margin and with two plumose inner setae. *Leg 3* (Fig. 2–9). Coxa and basis together much taller than those of leg 2. Outer margin of coxa with no hair but several spinules. Basis strikingly expanded outwards and ventrally, with one bare outer seta. Exopodite; first two segments almost as in leg 2; third segment with three plumose inner setae. Endopodite; second segment with one inner seta; third one with three inner marginal setae of about same intervals; inner terminal seta of third segment not spinulose but hairy. *Leg 4* (Fig. 2–10). Coxa and basis much extended ventrally. Outer seta of basis very slender. Ornamentation of exopodite and first two endopodite segments as in leg 3. Third endopodite segment with two plumose inner setae. Distal end of last endopodite segment scarcely reaching to middle of last exopodite segment. *Leg 5* (Fig. 3–1). Baseoendopodite; basal width about 1.2 times as long as greatest height; anterior surface ornamented with more than ten spinules rather irregularly arranged and extending from center to rim near inner proximal corner of exopodite; inner expansion very prominent, of which outer rim is seemingly perpendicular to basal margin of the segment, and distal end reached to two-sevenths the length of exopodite segment, and furnished with four setae, of which inner two are short and finely ciliate, the next one is the longest and nearly twice as long as the greatest height of the segment, and the outermost one is rather close to the former, slender and about as high as the segment; less number of spinules between second seta and third one, counting outwards, some spinules along outer edge of inner expansion and along demarcation between this segment and exopodite; one cylindrical and spinulose process on outermost corner bearing very slender bare seta on its tip. Five delicate spinules were recognized on posterior surface of inner expansion in this figured specimen. Exopodite about three times as long as wide, tapering distally, with one finely spinulose seta on inner edge near distal end, one long, sparsely hairy seta on distal end of cylindrical apex, and three outer marginal setae, outermost one with one thick and spinulose, and other two very slender and bare; whole inner margin spinulose; many thick spinules along outer margin and just inside both anteriorly and posteriorly.

Male. Body (Fig. 3–4) about 0.5 mm in length. Rostrum conspicuous in dorsal view. Abdomen more slender than in female. First abdominal somite (Fig. 3–7) with a pair of leg 6 ornamented with several delicate spinules laterally; second and third abdominal somites with a transverse spinular row on each ventral surface near posterior end.

Antennule (Fig. 3–7) chirocer. First two segments rather short and with one bare seta on each anterior distal edge; third one longest, about 1.5 times as long as proximal two combined; fourth one small, triangular in dorsal view; fifth one swelling, with one thick aesthetasc. Segmentation and any structure of apical part can not be explained. *Leg 5* (Fig. 3–6). Baseoendopodite represented by a blunt triangular plate with one bare outer seta on short cylindrical process accompanied with several spinules basally; inner margin as well as surface unornamented.

Exopodite about three times as long as wide, with five setae situated as in female; distalmost outer seta thick and spinulose, other four setae as in female. *Leg 6* (Fig. 3–7) represented by one bare setula on a small cylindrical process on both lateral posterior edges of first abdominal somite.

Variability. Three females and two males were dissected. In one female, demarcation between coxa and basis in leg 1 was a little inclined rather than in the specimen illustrated. In females the spinules on posterior surface of inner expansion of baseoendopodite of leg 5 were recognized in only one specimen as already mentioned in the previous text, but no such spinules were found in other two (see Fig. 3–2). The spinules on anterior surface of the segment above mentioned were certainly present while the number of spinules was slightly variable between specimens or between legs in one specimen (I am convinced that the number and each situation of those spinules illustrated are very precise). In one male, a spinulose lobe (Fig. 3–3) was recognized on dorso-outer side of coxa of leg 1. I can't decide whether this lobe is a part of coxa or not. This lobe seems to be usually disjointed during dissection for examination. No other difference was detected except for inconsiderable variation in size.

Remarks. The original description of *Zaus intermedius* was based on only one female specimen collected from the St. Lawrence, Canada, by Nicholls (1939). His description and figures except for of oral appendages show with no doubt that his species is quite identical with the present specimens from Oshoro. The species proposed by Nicholls, however, was withdrawn by himself as to be synonimous with *Z. aurelii* Poppe 1884, together with *Z. caeruleus* Campbell 1929, with little hesitation (Nicholls, 1942). Lang (1948) also treated them to be synonimous in his monograph, but recently he has claimed the justice of synonimy within the species *Z. aurelii*, particularly after considering relationship between *Z. intermedius* and *Z. caeruleus* (Lang, 1965).

Although three species, *Z. aurelii*, *Z. caeruleus* and *Z. intermedius*, are no doubt alike together in many respects, *Z. intermedius* seems to be discernible at least from *Z. aurelii* reported by Poppe himself in some characteristics described below. The baseoendopodite of leg 5 in female in *Z. aurelii* is furnished with no surface spinules, which are very conspicuous and indeed easily detectable in *Z. intermedius*. In this character *Z. caeruleus* is alike to *Z. aurelii* (henceforth *Z. aurelii* without the author name means the species described by Poppe himself). If Poppe's figure of the fifth leg is correct, the outer rim of inner expansion is quite straight and perpendicular to the base of the segment. For the time being there is no reason to doubt this characteristic in Poppe's species since the same is also recognizable in a new species described later and further in *Z. serratus* Monk which is clearly distinguished from *Z. aurelii* as well as *Z. caeruleus* in the ornamentation of the last endopodite segment of leg 1 (see Lang 1965, p. 124), while the rim is not straight, but is apparently curved in *Z. intermedius*. The outermost seta of inner expansion of baseoendopodite of leg 5 far exceeds the distal end of the exopodite of the segment in *Z. aurelii*, but never exceeds in *Z. intermedius*. In

this respect *Z. caeruleus* and *Z. aurelii* sensu Willey are alike to *Z. intermedius*.

The second endopodite segment of leg 1 was explained by Poppe as "Das zweite krallenartig nach aussen gebogene Glied ist sehr kurz und mit einigen Dornen besetzt". Correctness of his description is fairly supported by his figure, in which the segment is certainly *krallenartig* in appearance. Such structure is regarded as not the second segment but an accessory of the first segment by Lang (1965). This discrepancy will be discussed later. While the second segment is clearly sharpened and protruded outwards in *Z. aurelii*, that is represented by a spinulose triangular segment and is not protruded in *Z. intermedius*. Distinctly protruded status of the segment in *Z. aurelii* is more alike to that appearing in *Z. spinatus* (see p. 568) rather than in *Z. intermedius*.

Although these two species, *Z. aurelii* and *Z. intermedius*, have been so far regarded as synonimous, it proves to be obvious that so many discrepancies are present between them as mentioned above. It is not appropriate to ascribe this great discrepancy to the misconception or incorrect illustrations by Poppe. Only *Z. intermedius*, therefore, is treated as a varid species in the present paper leaving certain systematic position of *Z. caeruleus* and *Z. aurelii* sensu Willey (1923) untouched. About these two species, *Z. caeruleus* and *Z. aurelii* sunsu Willey, I am scarcely able to say they are rather allied to *Z. intermedius* than *Z. aurelii* if the surface ornamentation of baseoendopodite of leg 5 in the female is disregarded.

Specimens examined. Three females and one male (21–IV–'71), and one male (2–IV–'71) collected from Oshoro by algal rinsings (Itô leg.).

Zaus robustus n. sp.

(Figs. 4∼7)

Female. Body (Fig. 4–1) much flattened dorso-ventrally, robust in appearance, about 0.72 mm in length, rostrum and furcal setae excluded. Nauplius eye present. Coloration of whole body (see Fig. 7–7) not conspicuous, rather pale; a small purple patch slightly anterior to nauplius eye; each rim of anterior lateral part of cephalothoracic somite tinctured with purple; an obscurely U-shaped brown patch on mid dorsal surface of cephalothoracic somite; first three thoracic somites pale brown, but each posterior rim much darkened; fourth thoracic somite with a narrow brown stripe transversely; coloration of each abdominal somite scarcely recognizable to be brownish. Rostrum (Fig. 5–1) almost square; anterior margin slightly rounded, both lateral margins rather straight; three small concavities on dorsal surface; two pairs of sensilae, each on anterior edge and on dorsal surface. Cephalothoracic somite shorter than greatest width, furnished with thin hyaline membrane laterally and posteriorly and with some well-developed hairs along lateral margins on just dorsal edge of basal margin of hyaline membrane described, and less number of minor hairs, each inserted into a pit arranged near posterior edge (Fig. 4–2). First three thoracic somites combined shorter than

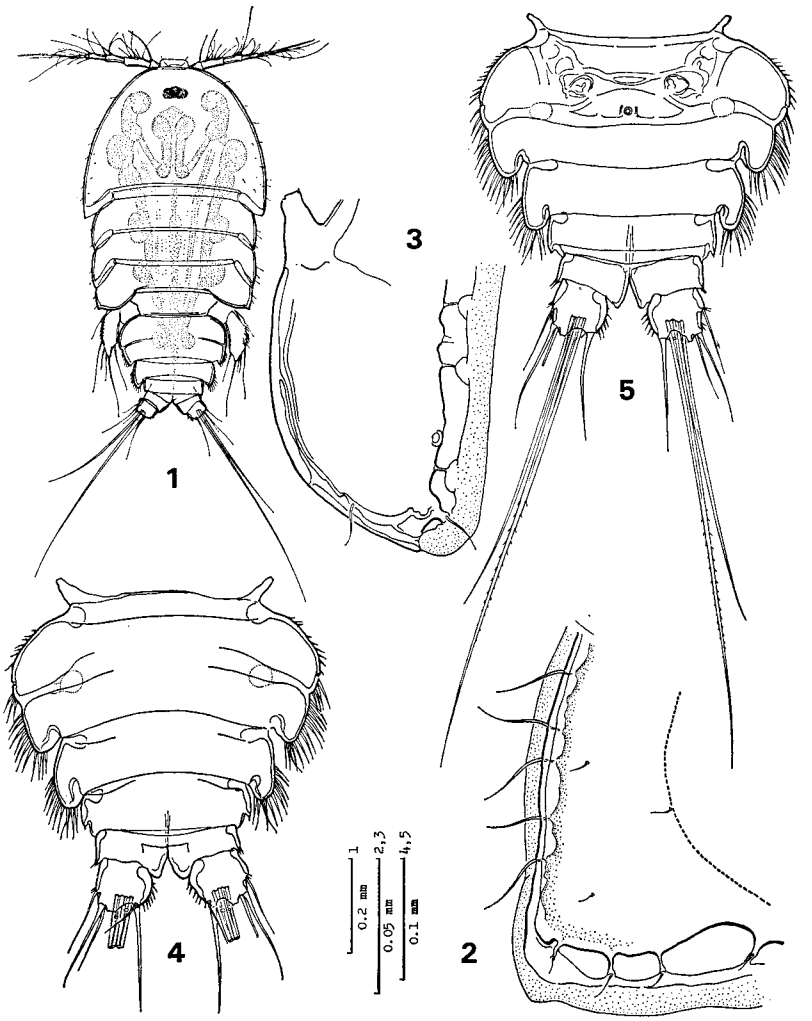

Fig. 4. *Zaus robustus* n. sp. Female. 1. dorsal view; 2. postero-lateral part of cephalothorax; 3. lateral part of epimeron of second free thoracic somite; 4. abdomen, dorsal; 5. abdomen, ventral.

cephalothoracic somite, scarcely reduced in widths, of first and second thoracic somites each anterior lateral rim of epimeron remarkably chitinous; a well developed hair near middle outer margin and outer posterior corner; posterior margin ending in a hyaline membrane; epimeron of third thoracic somite forming into a lobe at lateral posterior part. Fourth thoracic somite small. Abdomen,

furcal setae excluded, about as long as cephalothoracic somite, clearly tapering posteriorly. Genital double-somite more than twice as long as width, clearly subdivided into two parts by a transverse chitinous stripe ventrally and laterally; both posterior lateral parts protruded behind; both lateral margins ornamented by many spinules, some of which near anterior edge are much dwarfed. Antepenultimate somite much protruded posteriorly at both lateral parts, and with some spinules and a setula on each lateral posterior end. Penultimate somite with no particular ornamentation. Anal somite clearly bipartite, with less number of spinules on both outer posterior ends. Furcal rami divergent; each ramus about as long as wide, and a little longer than anal somite; inner part slightly rounded and spinulose; inner distal corner with one long bare seta dorsally accompanied by a setula which is geniculated at base (Fig. 4–4); one slender seta on middle outer edge and two juxtaposed setae near outer distal corner; principal terminal setae well developed.

Antennule (Fig. 5–1) segmented and ornamented almost as in *Z. intermedius*, but more sclerotic in appearance with much thickened rim of each segment.
Antenna (Fig. 5–2). Coxa very short. Allobasis tapering distally, about 2.5 times as long as wide, with one hairy seta on anterior edge near middle, and several spinules near base. Exopodite much slender in appearance, attached on just middle of allobasis, composed of two segments of equal length; first segment with two long setae, each on and near distal corner; second with two rather short hairy setae, each on near proximal and on about two-thirds the length, and ending in two juxtaposed setae, one of which is longer and with a hair midst, and another is much dwarfed and hair-like. Endopodite gradually thickened distally, with three serrate spines, three geniculate spines, one non-geniculate but acutely sharpened spine, and two setulae; inner edge with a row of some spinules. *Mandible* (Fig. 5–3). Pars incisiva distinctly tridentate. Coxa-basis incurved, widened distally; one bare seta and one thick, spiniform seta on inner dorsal corner; two, widely separate setulae on distal end; ventral edge with several spinules along base of endopodite. Both rami directed to opposite side of cutting edge of praecoxa. Exopodite about five times as long as wide, with one slender seta at one-fifth the length just inside inner (or ventral) edge; two close setae near distal corner on inner edge; three juxtaposed setae on distal end. Endopodite much longer than exopodite segment, with one setula and two juxtaposed setae along inner margin near middle; two juxtaposed setae on inner distal corner and two pairs of three juxtaposed setae on distal end. *Maxillula* (Fig. 5–4). Arthrite of praecoxa with six bare or, more or less spinulose claws, one bare setula and two spinulose thick setae along inner edge; one hairy seta and a spinule on dorsal edge near inner end; a pair of parallel setae on middle surface. Coxa forming inwards into a cylindrical process, of which tip reaches middle of arthrite of praecoxa, and is furnished with four setae. Inner process of basis much elongate than in coxa, with one bare and three hairy setae at tip, and two juxtaposed bare setulae near ventro-distal corner; dorsal edge near tip scarcely spinulose. Both rami confluent to basis at each base.

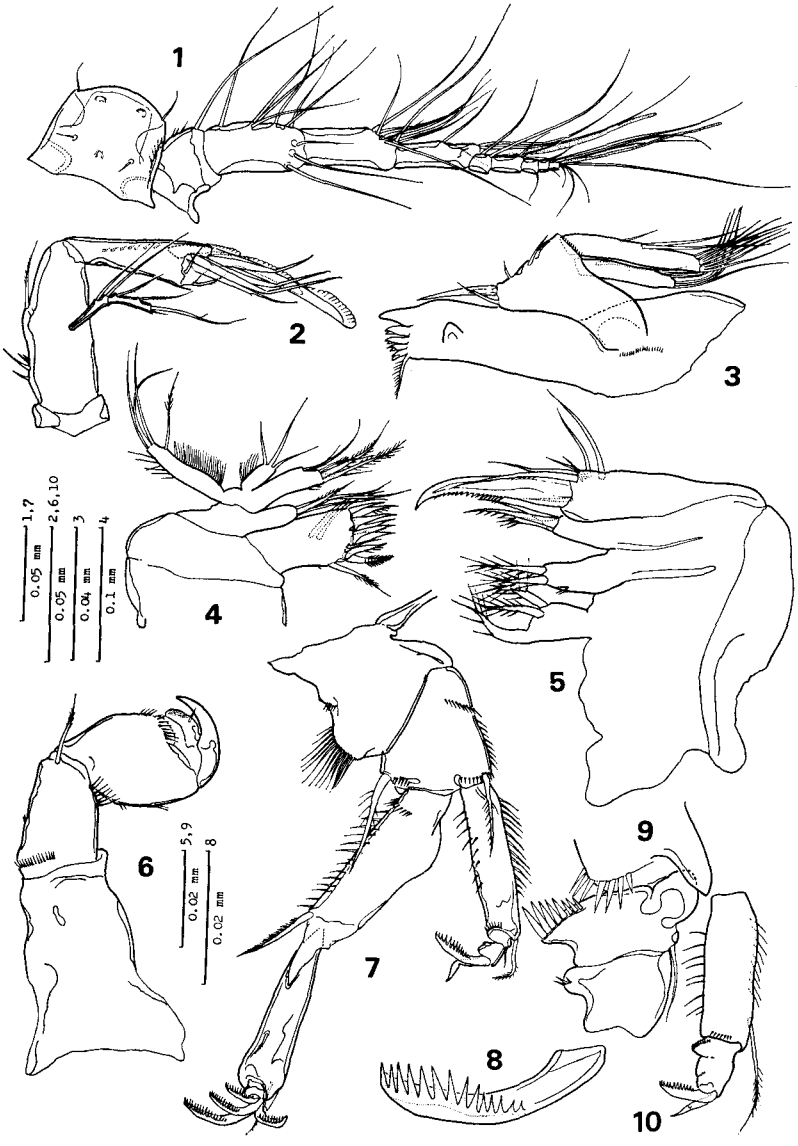

Fig. 5. *Zaus robustus* n. sp. Female. 1. rostrum and antennule; 2. antenna; 3. mandible; 4. maxillula; 5. maxilla; 6. maxillipede; 7. leg 1; 8. terminal claw of last exopodite segment of leg 1; 9. distal part of endopodite of leg 1. Fifth copepodid female. 10. endopodite of leg 1.

Exopodite much elongate, more than twice as long as endopodite segment, with three bare terminal setae; inner margin densely hairy between base and one hairy seta near distal corner; distal half of outer margin sparsely spinulose. Endopodite small, with three bare setae terminally, and some hairs along outer margin. *Maxilla* (Fig. 5–5). Outer part of syncoxa thickly sclerotized; three endites, proximal one with three spinulose setae, of which the apicalmost one is much thickened and confluent to this endite; middle endite with several spinules on middle dorsal edge and three spinulose setae; distal endite three more or less spinulose spines. Basis furnished with one very strong claw, of which dorsal edge of apical half is finely serrate; one bare seta near lateral base of claw; two setae on ventral edge near inner corner. *Maxillipede* (Fig. 5–6). Basal half of coxa not sclerotized, tapering distally. Basis much smaller than coxa, with a transverse spinular row near base of inner half, one hairy seta near inner distal corner, and several hairs or slender spinules on outer distal corner. First endopodite segment somewhat oval, with two groups of several spinules on outer edge, an oblique row of several spinules on inner part, a well sclerotized knob on inner distal corner; one setula or hair arising from side of knob mentioned. Second endopodite segment forming into a strong claw.

Leg 1 (Fig. 5–7). Demarcation between coxa and basis remarkably inclined. Coxa a little lower than greatest width, with a short row of less number of spinules on middle outer edge; distal half of outer margin much swollen, and densely furnished with many well-developed hairs, or rather flexible elongate spinules, which are a little shorter than half of the greatest width of the segment even in longer ones; inner rim conspicuously sclerotized, of which distal corner provides an attachment of a long muscle arising from inner proximal corner of the first exopodite segment. Basis scarcely smaller than coxa; inner margin rather straight, and more than twice as long as outer margin, and with some spinules along distal half; one strikingly thick, sparsely hairy seta on just middle outer edge; a row of less number of spinules arising from base of outer seta to near proximal outer corner of first exopodite segment; an oblique row of some spinules on anterior surface near inner proximal corner; one spinulose seta just inside inner distal corner, accompanied with several spinules along distal end on anterior surface from its base to a small chitinous thickening near outer proximal corner of first endopodite segment. Exopodite three-segmented; first segment conspicuously swelling out at about one-third the length of bare inner margin, and ending in a membranous formation which extends over one-third the length along anterior surface of the second segment and tapers distally; a transverse spinular row arising from outer edge near proximal corner to about middle anterior surface; some rigid spinules along and just inside outer margin; one finely spinulose, thick seta on outer base of membranous formation described; second segment thickened distally, with one hairy, much dwarfed setula on outer part at about two-thirds the length, and one hairy seta near inner distal corner on posterior surface, and with a hyaline membranous expansion on inner distal end, which is very obscure

and slightly covers inner part of the third segment; third segment much dwarfed but surely recognized, furnished with four spinulose claws (see Figs. 5–8 and 15–1), three of which orient outwards and the rest inwards. Endopodite three-segmented, almost as long as first exopodite segment, apical membranous formation excluded; first segment about four times as long as greatest width, furnished with one spinulose seta near inner distal corner, many rather flexible spinules along nearly whole inner margin, and some shorter spinules along and just inside outer margin sparsely, and with a transverse row of less number of spinules on outer distal corner; second segment much dwarfed, of which inner base is transformed into a sclerotized nodule partly covered with a mambranous expansion on the inner extremity of the first segment (Fig. 5–9), and with one bare setula on inner distal corner and a row of several juxtaposed spinules which are orientated rather dorsally and are arranged along outer rim slightly protruded; third segment small as in second, with one strong spinulose claw and one bare, geniculate spine on distal end, with less number of spinules on a small protuberance of outer edge. *Leg 2* (Fig. 6–1), *leg 3* (Fig. 6–2) and *leg 4* (Fig. 6–3) are of the same segmentation and nearly the same ornamentation as shown in *Z. intermedius*, but are much robust in appearance. *Leg 2*; coxa with a longitudinal row of some rigid spinules on anterior surface just inside outer margin; distal protuberance of basis between both rami rather spur-shaped; outer spine of third endopodite segment spinulose. *Leg 3*; outer seta of basis very slender and strikingly elongated; terminal seta on third endopodite segment, of which outer one is spinulose and the rest is plumose. *Leg 4*; outer seta of basis shorter than that of leg 3; outer spine of third endopodite segment scarcely spinulose. *Leg 5* (Fig. 7–1). Baseoendopodite rather widened laterally, with an outer process ending very slender bare seta; inner expansion rather moderate, and furnished with two finely ciliate setae of an equal size and two elongate setae on inner distal edge, of which outer one is finely ciliate and about twice as long as exopodite segment, and the rest is hairy (or with very fine spinules) and little longer than exopodite segment; outer rim of inner expansion rather straight and perpendicular to basal margin of its segment. Exopodite tapering distally, about 2.5 times as long as greatest width, densely spinulose along outer margin and on outer part of posterior surface; one finely ciliate seta inserted at two-thirds the length of inner margin; outer margin with one bare, strikingly elongate seta on three-fifths the length, one bare short outer seta at same level of inner seta, and one thick hairy seta accompanied with several spinules basally; distal part rather cylindrical, ending in one very elongate seta, of which base is slightly thickened and accompanied with less number of spinules; inner margin between base and inner seta sparsely spinulose.

Male. Body about 0.6 mm in length, transparent and nearly colorless, but each dorsal surface of about middle of cephalothorax and of three succeeding thoracic somites tinctured with very pale brown as shown in the figure (Fig. 7–2). Both lateral margins of cephalothorax with many hairs. First abdominal somite with an oblique row of some spinules on both lateral edge (Fig. 7–5). Each lobe-

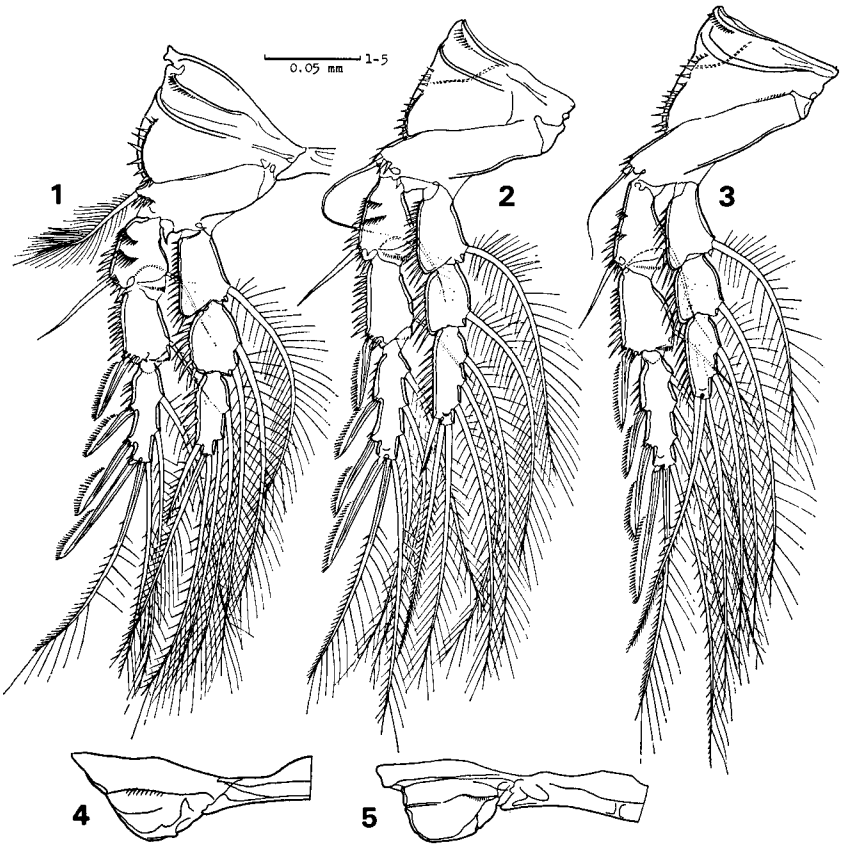

Fig. 6. *Zaus robustus* n. sp. Female. 1. leg 2; 2. leg 3; 3. leg 4; 4. abnormal basal segments of leg 2; 5. abnormal basal segments of leg 3.

like protuberance of second and third abdominal somites well developed and with many slender spinules laterally and a setula near posterior extremity. Rostrum (Fig. 7–3) almost trapezoid, with a pair of sensory hairs. Spermatophore (Fig. 7–6) as shown in the figure.

Antennule (Fig. 7–3) chirocer. Eight segments at least were recognized. First segment remarkably spinulose. *Leg 5* (Fig. 7–4). Baseoendopodite very small, with a cylindrical outer process ending in one bare seta, accompanied with some spinules basally. Exopodite about twice as long as greatest width, furnished with five setae, of which inner one is hairy along inner margin and ciliate along outer, terminal one bare and long, distal two of outer setae are of about equal length, hairy and rather spiniform, and the rest is the longest and bare; outer margin spinulose, and inner margin with many very long and slender, rather

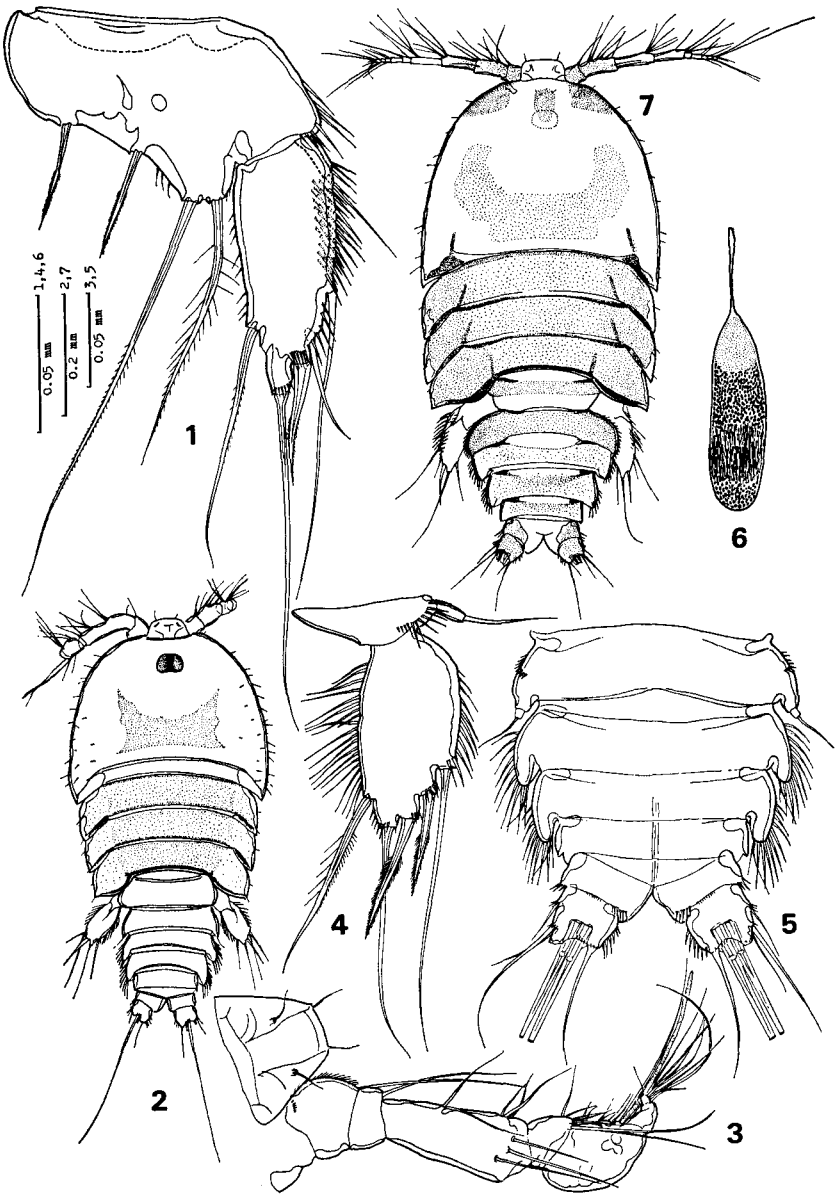

Fig. 7. *Zaus robustus* n. sp. Female. 1. leg 5. Male. 2. dorsal view; 3. rostrum and antennule; 4. leg 5; 5. leg 6 and abdomen; 6. spermatophore. Female. 7. dorsal view of a specimen from Oshoro.

flexible spinules. *Leg 6* (Fig. 7–5) represented by one short bare seta on a small process of first abdominal somite.

Variability. Among six female and three male specimens examined particular variation was not recognized. One female from Akkeshi, however, represents an abnormal structure in each the second and third thoracic leg, of which the right leg is without both rami and only consists of dwarfed coxa and basis, while the left one differentiates normally.

Remarks. This new species is remarkably alike to *Zaus aurelii* Poppe, 1884 (not other authors) in the shape and ornamentation of leg 5 in female, but is clearly discernible from the latter in the shape of leg 1. In the Poppe's figure, the demarcation between coxa and basis of leg 1 is very obscure, though we can safely surmise it from the mascular arrangement in the segments. That the distalmost inner corner of coxa provides an attachment of the muscle arising from the inner proximal corner of the first exopodite segment has been already confirmed in the present new species and also in *Z. intermedius* (see Fig. 3–3). Therefore the demarcation in *Z. aurelii* should be extended from outer edge providing such attachment of the muscle to the distalmost edge of the hairy swelling on outer basal half. Consequently the coxa is much shorter than the basis and the demarcation is not so inclined in *Z. aurelii*. The shape of basal segments of *Z. aurelii* seems to be more alike to that of *Z. intermedius* rather than of the present new species. The conspicuous swelling of first exopodite segment near basal part of inner edge as shown in the present species is not recognized in *Z. aurelii* and all other species within the genus as far as I know. The swelling essentially differs from any inner proximal rim slightly curved as shown in all other species. The present new species is distinguishable from *Z. aurelii* also in the shape of the second endopodite segment of leg 1, which will be restated particularly on the basis of the fifth copepodid stage (see p. 579).

Syntypes. Four females and two males collected from Akkeshi, off Akkeshi Marine Biological Station (1 ♀, 8–VII–'68; 1 ♀, 8–VII–'69; 2 ♀♀, 11–VII–'71; 2 ♂♂, 11–VII–'71. Itô leg.). Two females and one male from Oshoro (17–II–'72. Itô leg.). All the specimens were collected from algal rinsings. The figures except for Fig. 7–2 and Fig. 7–7 were based on the specimens from Akkeshi.

***Zaus spinatus spinatus* Goodsir**

(Figs. 8～11)

Zaus spinatus Goodsir 1845, p. 326, pl. XI, fig. 1～8. *Zaus spinosus* Claus 1863, p. 146, pl. XXII, fig. 25, and pl. XXIII, fig. 1～10. *Zaus spinatus*: Sars 1904, p. 57, pl. XXXI; Monk 1941, p. 80; Lang 1948, p. 347, figs. 158–1 and 159–1; Klie 1949, p. 112; Lang 1965, fig. 72b～h; Wells 1970, p. 257.

Complete bibliographic survey was not attempted, since a precise synonimic list for this species common in Europian seas was already given by Lang (1948). Although the original description by Goodsir gives us only very poor information

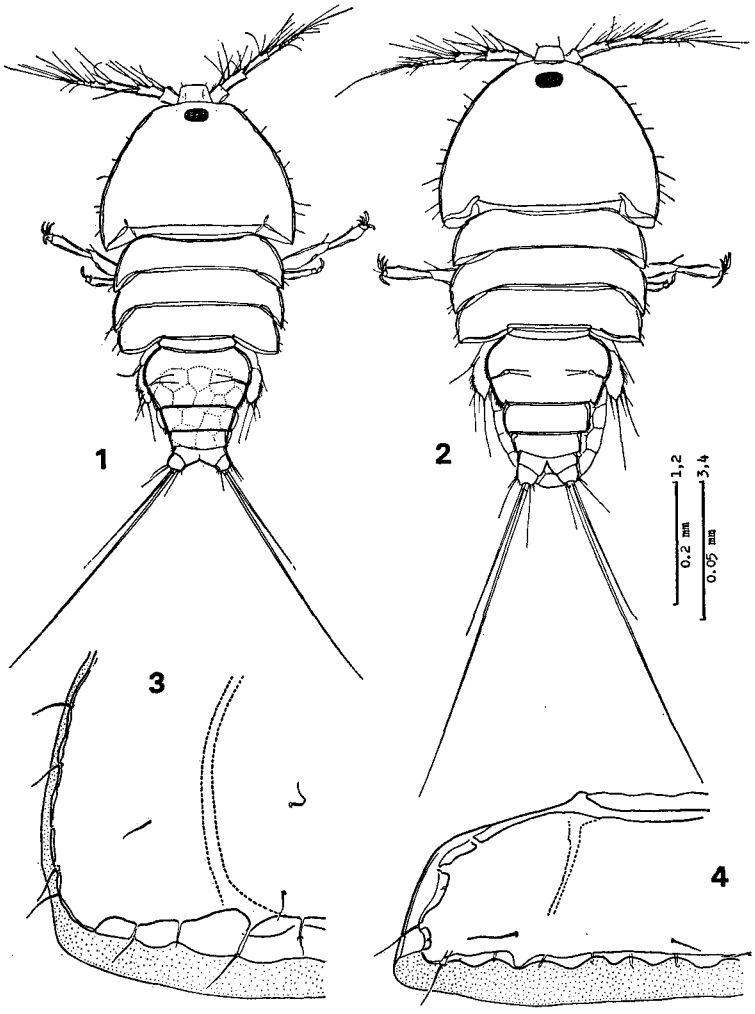

Fig. 8. *Zaus spinatus spinatus.* Female. 1. smaller specimen, dorsal view; 2. larger specimen, dorsal view; 3. postero-lateral part of cephalothorax; 4. epimeron of first free thoracic somite.

on this species, we can accept the total characteristics of the species from the excellent figures by Sars and also from the additional description and figures recently reported by Lang (1965). The Japanese form primarily seemed to be distinct in several structures from *Z. spinatus* in comparison based on the descriptions and figures above mentioned. However, an immediate comparison between the Japanese form and the specimens from France shows no difference

between them. The Japanese form, therefore, is safely identifiable with *Z. spinatus spinatus*, and is here redescribed to facilitate the recognition of the distinctive characters for the next new species which is apparently allied to this species.

Female. Body (Fig. 8–1) 0.56 mm in length, rostrum and furcal setae excluded. Nearly whole body yellowish, with no particular color pattern. Nauplius eye present. Rostrum (Fig. 9–2) trapezoid, with two pairs of fine sensilae. Cephalothorax slightly longer than succeeding three thoracic somites combined, with a hyaline membrane marginally (Fig. 8–3) and scattering some hairs as shown in figure. Lateral rim of epimeron of each first three thoracic somite well sclerotized (Fig. 8–4). Genital double-somite (Fig. 9–1) subdivided by a chitinous suture ventrally and laterally; anterior half furnished with many minor spinules along nearly whole margins and a pair of hairs on each lateral extremity of chitinous suture; posterior half with less number of spinules and a hair on each lateral posterior end which is scarcely protruded. Antepenultimate somite with an oblique row of very delicate spinules ventrally, which is very difficult to detect even in the highest magnification of microscope in some specimens, and with several spinules and a hair on each lateral posterior part. Penultimate somite a little shorter than previous somite, with no particular ornamentation. Anal somite with several spinules on each lateral posterior edge. Furcal ramus about as long as wide, with one hair-like seta and two juxtaposed setae near outer corner, one basally geniculate setula on dorsal surface near inner corner, and one seta on inner terminal edge; principal terminal setae well-developed.

Antennule (Fig. 9–3). Anterior edge of first segment spinulose. Sixth segment scarcely longer than fifth. *Antenna* (Fig. 9–4). Coxa very short. Allobasis about three times as long as wide, with two juxtaposed spinules and one spinulose seta on one-third and on two-thirds the length of anterior edge, respectively. Exopodite two-segmented; first segment remarkably longer than second; ornamentation as in previous two species described. Endopodite with four geniculate, elongate spines, of which the outermost one is the shortest, rather seta-like, and spinulose along proximal half; three thick spines each with a fan-shaped serrate membrane; two setulae on distal end; anterior margin sparsely spinulose. *Mandible* (Fig. 9–5). Praecoxa strikingly elongated inwards, with a roughly arched row of many delicate spinules near base of coxa-basis. Coxa-basis much widened distally, with two setae, of which distal one is thicker, on inner distal corner, one minute setula and one seta on distal end. Exopodite about five times as long as greatest width, with one seta on surface at one-third the length, one outer seta at about one-fourth the length, and four terminal setae. Endopodite longer than exopodite, with one inner seta midst, two close inner setae at one-fourth the length, and four terminal setae. Endopodite longer than exopodite, with one inner seta midst, two close inner setae at one-fourth the length, and two pairs of four juxtaposed setae. *Maxillula* (Fig. 9–6). Arthrite of praecoxa furnished with a pair of bare setae on middle surface, seven more or less spinulose

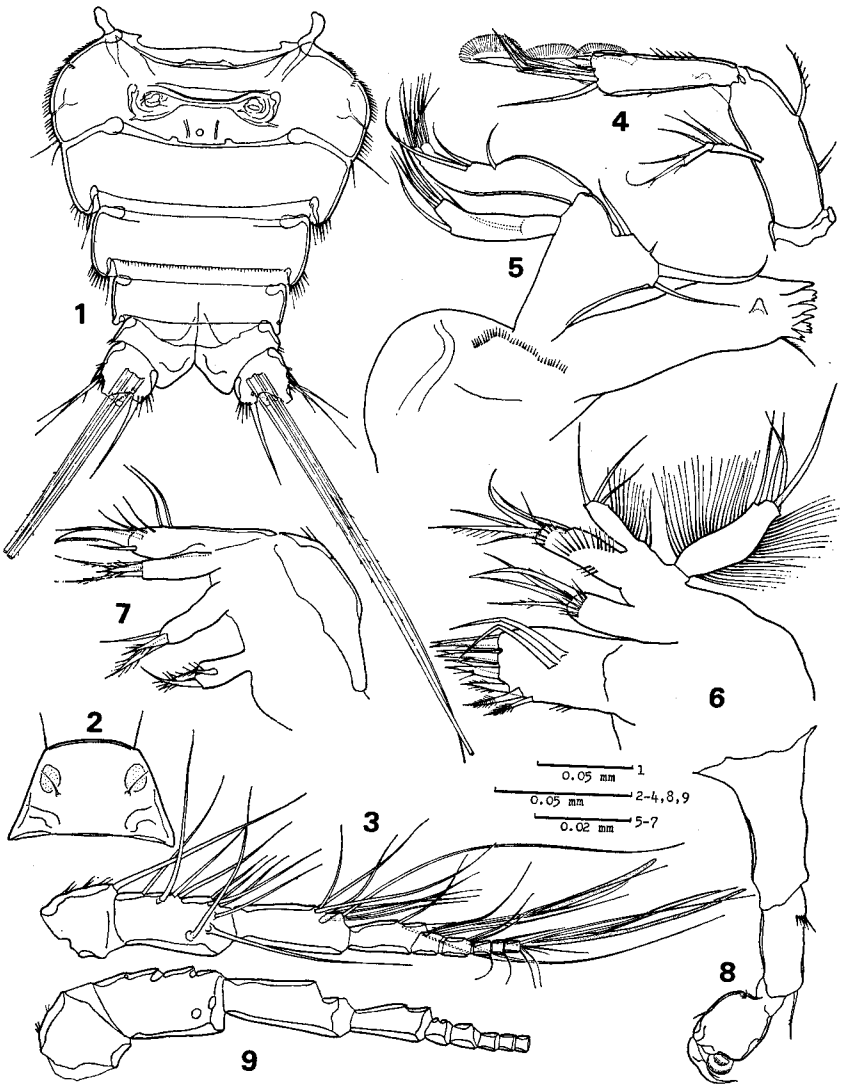

Fig. 9. *Zaus spinatus spinatus.* Female. 1. abdomen, ventral; 2. rostrum; 3. antennule; 4. antenna; 5. mandible; 6. maxillula; 7. maxilla; 8. maxillipede; 9. antennule, based on a specimen from France.

claws along inner edge, two spinulose setae near dorsal inner corner, and several spinules on middle dorsal edge. Coxa forming into a cylindrical process inwards, of which the distal end reaches to middle of arthrite of praecoxa, with four

less hairy setae accompanied with several slender spinules basally. Basis much extended inwards, with four apical and two ventral setae; surface ornamented with many spinules as shown in figure. Endopodite not demarcated basally, small, remarkably inclined inwards with three apical setae; outer margin hairy. Exopodite about twice as long as endopodite segment, with one inner and three apical setae; both margins ornamented with many strikingly elongate hairs. *Maxilla* (Fig. 9–7). Syncoxa with three widely separate endites, each with three more or less spinulose setae; several spinules on ventral outer edge. Basis furnished with one strong, pectinate claw accompanied with two bare setae, each dorsally and ventrally; one slender spine on just inside of base of claw; two lateral (juxtaposed ?) setulae on opposite side of spine described; a pair of setae on ventral edge. *Maxillipede* (Fig. 9–8). Coxa much elongated, not so sclerotized and with no particular ornamentation. Basis shorter than coxa, nearly cylindrical, with a short transverse row of less number of spinules on one-third the length of inner margin, and with one hairy seta distally. First endopodite segment with a well sclerotized globule on inner distal edge. Second endopodite segment forming into a rather weak spine accompanied with a setula laterally.

Leg 1 (Fig. 10–1). Demarcation between coxa and basis remarkably inclined as shown in figure. Coxa a little shorter than wide, with some slender spinules along outer margin; inner rim well sclerotized. Basis much longer than coxa, slightly tapering distally; inner margin about 1.5 times as long as outer, nearly straight, with many rather flexible spinules along whole length; one spinulose thick seta at two-fifths the length of outer margin; a nearly longitudinal row of some rigid spinules, arising inwards from base of outer seta and immediately directed distally on anterior surface; an oblique row of less number of spinules on about one-third the length near inner edge; one spinulose seta on anterior extremity near outer corner. Exopodite three-segmented, about 1.5 times as long as coxa and basis combined; first segment apically transformed into a thin membranous shape, and its tip reaching about one-third the length of second segment, sparsely spinulose along outer margin between base and one hairy outer seta, and with a short transverse row of several spinules on anterior surface near outer proximal corner; second segment a little shorter than first, arising from just opposite side of outer seta of first segment, thickened distally, well sclerotized marginally, and with one setula on about two-thirds the length of outer margin, and one spinulose seta near inner distal corner; third segment smallest, furnished with four strong, serrate claws (see Fig. 10–7 and Fig. 15–3) and a bare setula. Endopodite three-segmented, shorter and more slender than first exopodite segment; first segment with several rigid spinules along outer margin, a transverse row of some spinules on anterior surface along distal end; one (hairy or spinulose ?) seta near inner distal corner, and several rather flexible spinules along inner margin; second segment shortest, transformed into a well sclerotized nodule on inner end, which is partly covered with a slightly extended part of first segment, and conspicuously protruded outwards, and furnished with some slender spinules arising from outer

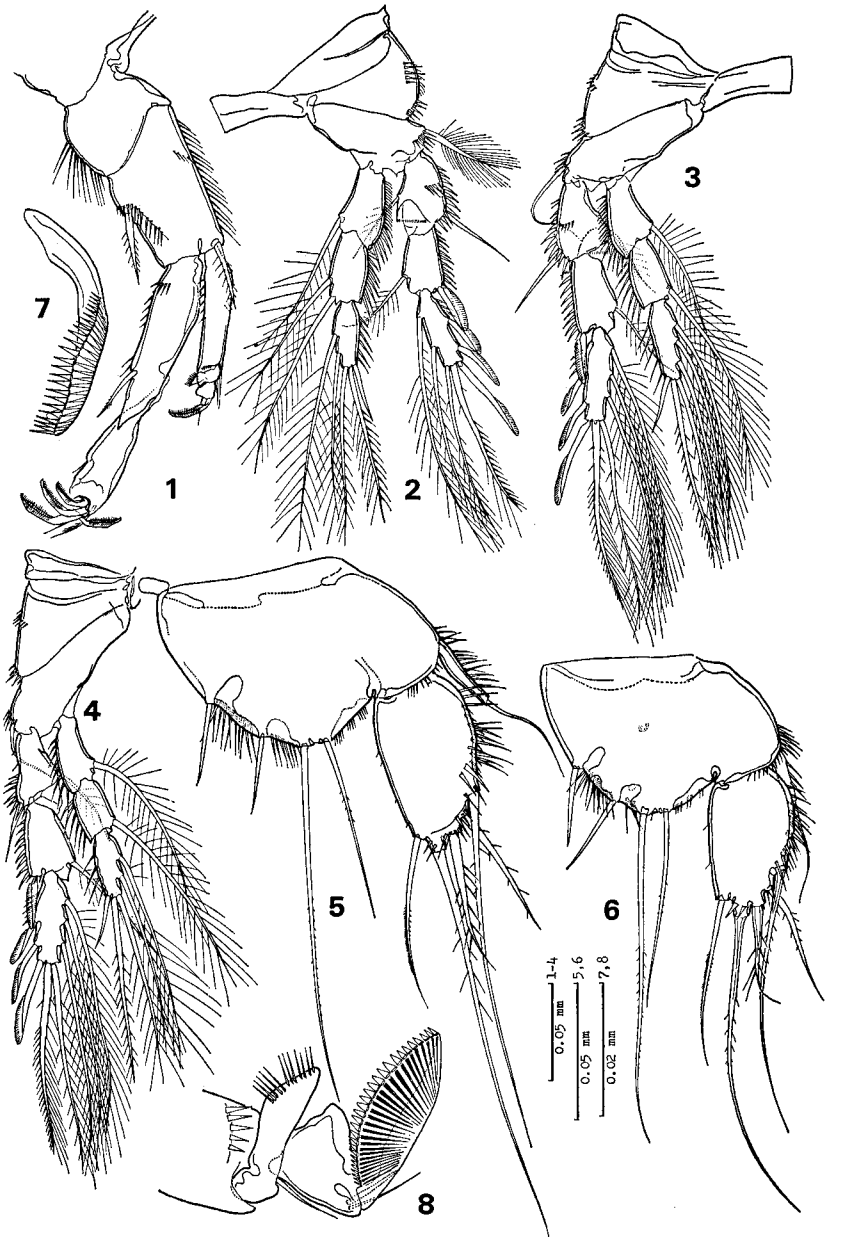

Fig. 10. *Zaus spinatus spinatus*. Female. 1. leg 1; 2. leg 2; 3. leg 3; 4. leg 4; 5. leg 5 in larger specimen; 6. leg 5 in smaller specimen; 7. terminal claw of last exopodite segment of leg 1, based on a specimen from France; 8. distal part of endopodite of leg 1, ditto.

edge, rather directing dorsally, and one bare setula on inner distal end close to inner base of third segment; third segment almost triangular, ending in one strong claw which is furnished with a well developed, fan-shaped, serrate membrane, and with one spine and one setula, each arising from posterior surface near distal end, being close together (see Fig. 10–8). *Leg 2* (Fig. 10–2), *leg 3* (Fig. 10–3) and *leg 4* (Fig. 10–4) almost as in previous two species described in their spinal and setal ornamentations. In leg 2, coxa with some hairs along middle outer margin, a longitudinal short row of spinules inside outer margin on anterior surface and several spinules near outer distal corner; spinules on about proximal half of outer margin of first endopodite segment very slender, rather hair-like. *Leg 5* (Fig. 10–6). Inner expansion of baseoendopodite slightly protruded; outer edge between outermost seta and inner basal corner of exopodite not perpendicular to basal margin, but clearly inclined, with four setae, of which the outermost is a little longer than exopodite segment, and the next is the longest, about twice as long as exopodite segment; inner two setae rather spiniform. Exopodite not attaining a length twice as long as greatest width, scarcely spinulose along inner margin, and with five more or less spinulose setae, of which the longest one arised from distal end is more than twice as long as the segment.

Male (Fig. 11–1). Body about 0.45 mm in length. Cephalothorax fringed with some hairs. Abdomen (Fig. 11–2) slender in appearance; first abdominal somite with many delicate spinules along both lateral margin; second and third somites, each with a transverse spinular row on ventral surface. *Antennule* chirocer. *Leg 5* (Fig. 11–3). Coxa small, with one bare outer seta on a short, spinulose process. Exopodite with five more or less spinulose setae, of which the proximalmost one is nearly bare.

Variability. Five females and two males were dissected. The body length in the females examined is fairly variable. The largest specimen (Fig. 8–2) as far as I examined attains a length of 0.64 mm. The setal and spinal ornamentation is essentially the same in all the specimens except for some inconsiderable differences in the length of setae and in the number of spinules (cf. Fig. 10–5 and Fig. 10–6).

Remarks. The present specimens as a representative for the Japanese form of the species completely accord with the Europian form, as far as I could examine, which was based on the specimens, two females and one male, collected from Concarneau, France, by Dr. Sh. Gamo (13–III–'72). Some minor differences, however, were recognized between the present and other previously reported forms. For example, in the exopodite of antenna reported by Sars (1904), the situation of the demarcation between both segments apparently differs from that of the present. The situation appeared in the figure by Lang (1965, Fig. 72, c) is the same as in the present. The terminal seta on the inner expansion of leg 5 in the female by Sars is too short, while the seta is apparently longer, more than twice as long as the exopodite segment in the present specimens and also in the specimens from France. Such setal length has not always been as yet regarded to be of

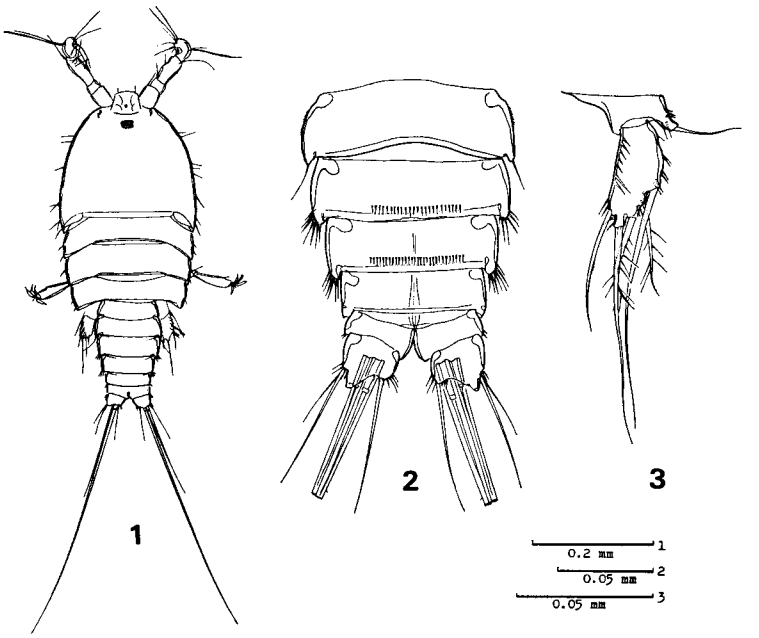

Fig. 11. *Zaus spinatus spinatus.* Male. 1. dorsal view; 2. leg 6 and abdomen, ventral; 3. leg 5.

specific importance because of its variation, though it should be significant to classify certain species (cf. the next new species).

A remarkable discrepancy about the segmentation of endopodite of leg 1 now appears between the species here described and the same species as well as several others reported by Lang (1965) who said that ".... the ramus... is two-segmented", and "The middle segment is nothing but a lamella at the end of the first segment, and it is of the same nature as the triangular prominence at the end of the first exopodite-segment", while of the specimens from Hokkaido and France it is distinctly three-segmented (cf. Fig. 10–8 for a specimen from France and the Lang's Fig. 72, f1). This discrepancy between our statements will be harmonized in a later section (see p. 578).

Specimens examined. Five specimens collected from Akkeshi by algal rinsing (1 ♀, 5–VII–'68; 2 ♀♀, 8–VII–'69; 1 ♀, 11–VII–'71; 1 ♂, 11–VII–'71, Itô leg.). One female and one male collected from Muroran in a surface plankton sample (11–VI–'72, Itô leg.).

Zaus unisetosus n. sp.

(Figs. 12~14)

Female. Body (Fig. 12–1) 0.58 mm in length, rostrum and furcal setae

excluded. Rostrum (Fig. 13–1) trapezoid, with two pairs of very fine sensilae; a minor lacuna on dorsal surface near middle proximal edge. Hairy ornamentation around cephalothorax not so conspicuous, much longer than three succeeding thoracic somites combined. Genital double-somite (Fig. 13–2) about twice as wide as mesal length, subdivided into two parts by a chitinous suture ventrally and laterally; both lateral margins of anterior half with many delicate spinules;

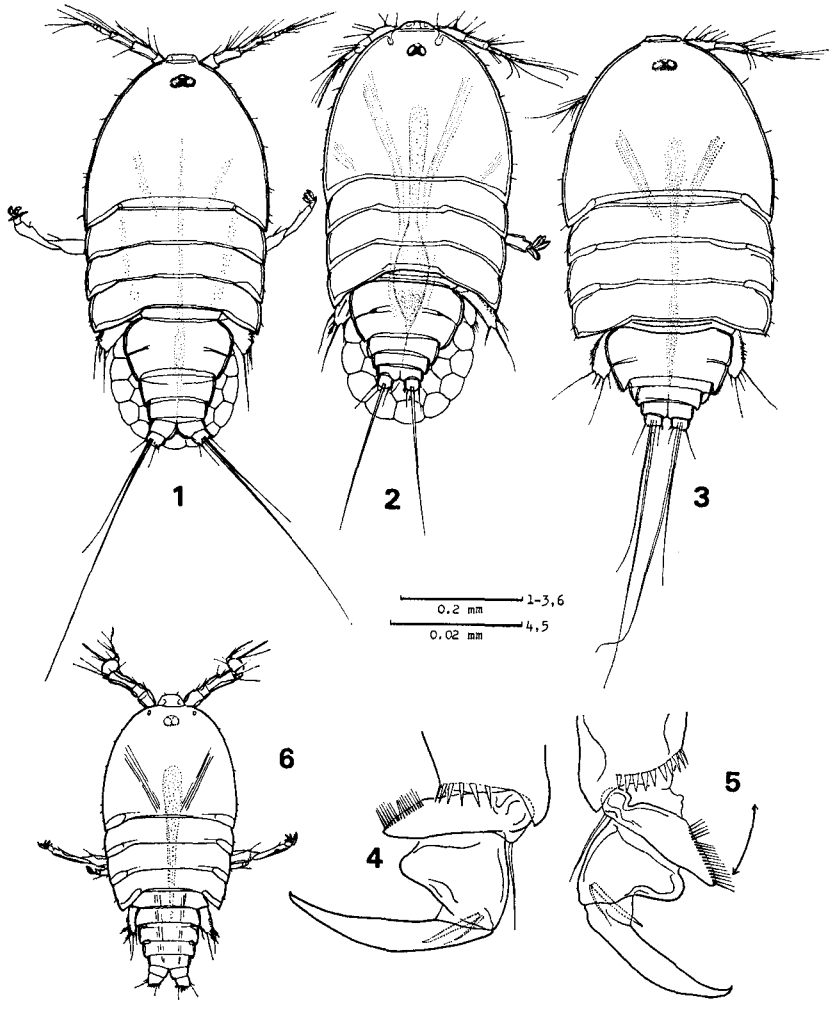

Fig. 12. *Zaus unisetosus* n. sp. Female. 1~3. dorsal view; 4, 5. distal part of endopodite of leg 1, serrate lamella of terminal claw omitted. Male. 6; dorsal view.

posterior lateral end with a setula and some spinules. Posterior lateral corner of antepenultimate abdominal somite not so protruded behind, with less number of spinules and a setula. Penultimate abdominal somite with no particular ornamentation. Anal somite small, clearly divaricate posteriorly. Furcal ramus about as long as wide; ornamentation nearly as in *Z. spinatus spinatus* previously described.

Antennule (Fig. 13-3). First segment with some spinules on anterior edge and one seta; third one slightly longer than second; sixth nearly as long as fifth; an aesthetasc arising from each distal extremity of fourth and apical segments. *Antenna* (Fig. 13-4). Coxa short. Basis a little longer than twice as long as greatest width; anterior seta rather slender and spinulose; several spinules near anterior edge about one-third the length, arranged longitudinally; posterior part less sclerotized. Exopodite composed of two slender segments of nearly equal length; first segment with two hairy setae and second with three hairy setae and a hair-like seta. Endopodite a little shorter than allobasis, furnished with three claws with serrate membrane, four geniculate elongate spines, and one (or two?) seta. *Mandible* (Fig. 13-5). Praecoxa with tridentate pars incisiva. Coxa-basis with one setula and one thick, hairy seta on inner distal corner, two parallel setulae directed ventrally on middle distal edge. Exopodite segment a little shorter than endopodite segment, with one seta on about one-third the length just inside margin, one outer marginal seta on four-fifths the length, and three terminal setae. Endopodite slightly thicker than exopodite, with one setula and two setae on just inside of inner middle margin, three setae and two juxtaposed setae on and near distal end. *Maxillula* (Fig. 13-6). Arthrite of praecoxa well elongated inwards, with five (?) claws on inner edge, and one thick spine and two spinulose setae on inner dorsal corner, several spinules on dorsal edge, and two elongate, spiniform setae on middle surface. Inner end of coxa reaching about middle arthrite of praecoxa, and ending in four more or less spinulose setae; a row of less number of spinules near inner end. Basis with four more or less spinulose or hairy setae on inner extremity and two bare setae near ventral corner. Exopodite directed outwards, nearly confluent with basis, with one marginal and three terminal setae, and some long hairs along ventral (or inner) margin sparsely. Endopodite small, confluent with basis, with three terminal setae, and some hairs along outer margin. *Maxilla* (Fig. 13-7). Syncoxa with three endites, each furnished with three spinulose, thick setae on and near inner end. Basis forming into a strong, pectinate claw; one spinulose spine arising from lateral base of claw, accompanied with one setula; two juxtaposed setae on opposite side of claw; two setae on ventral edge. *Maxillipede* (Fig. 13-8). Coxa not so sclerotized, much elongate (in the appendage illustrated some short length of basal part seems to be broken off during dissection), about twice as long as basis, and with no particular ornamentation. Basis with a slightly arched, spinular row transversely, several spinules being distinctly separate from spinular row, one less hairy or bare seta on inner distal corner, and several hairs on opposite surface of spinular row near seta. First endopodite seg-

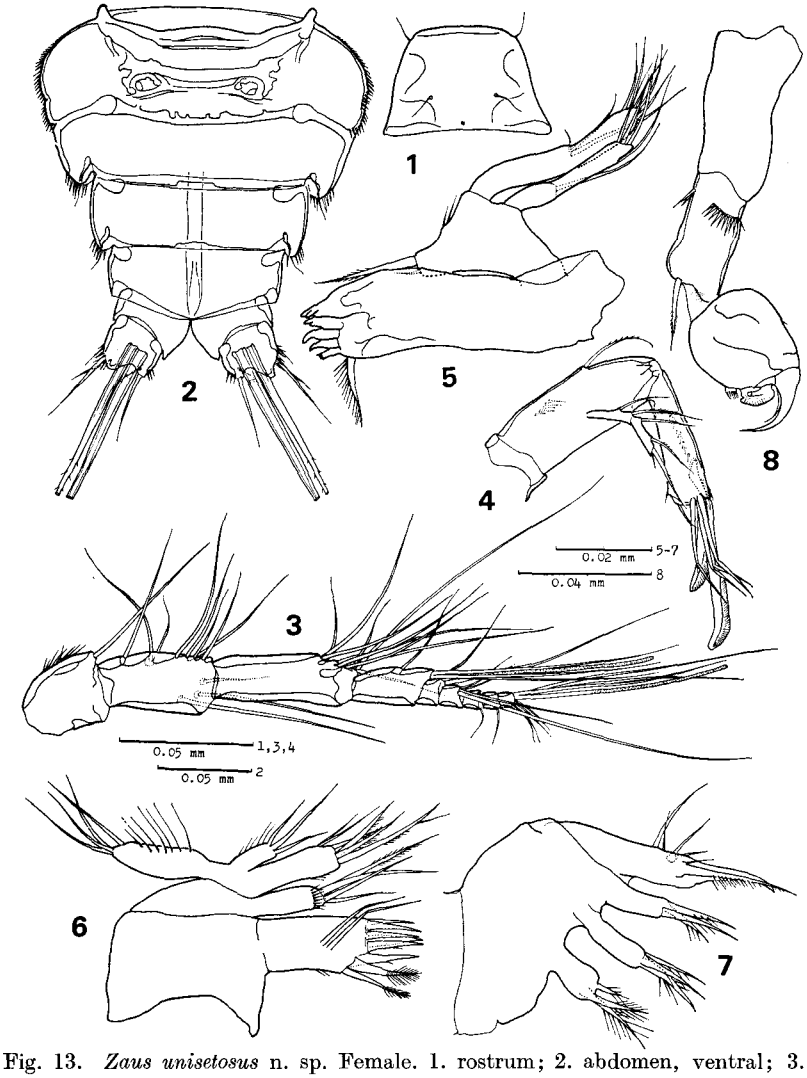

Fig. 13. *Zaus unisetosus* n. sp. Female. 1. rostrum; 2. abdomen, ventral; 3. antennule; 4. antenna; 5. mandible; 6. maxillula; 7. maxilla; 8. maxillipede.

ment rather spherical, with a spinule on middle outer edge, and with a small serrate formation near a sclerotized globule. Second endopodite segment transformed into a sharp claw accompanied with a bare setula near base.

Leg 1 (Fig. 14–1). Demarcation between coxa and basis much inclined. Coxa much shorter than basis, almost triangular in appearance, with some rigid, not so long, spinules along distal half of outer margin; inner rim fairly sclerotized. Basis

with one thick hairy seta on middle outer margin; inner margin rather straight, about 1.5 times as long as outer, with many shorter spinules along nearly whole length; an oblique spinular row arising from about one-third the length of inner margin on anterior surface; one spinulose short seta near inner distal corner; a row of some rather rigid spinules arising from outer edge near base of outer seta, directing inwards and distally. Exopodite three-segmented, a little longer than coxa and basis combined; first segment distally forming into a tapering lamella which extends to about one-third the length of the second segment along its anterior surface, with a transverse spinular row near outer proximal corner on anterior surface, one hairy seta on outer base of distal lamella, and some spinules along outer margin between spinular row and seta described; second segment about as long as first, distal lamella excluded, gradually thickened from base to three-fourths the length, and rest distal part reduced in width; two hairy setulae, each on inner distal corner and on outer edge; third segment small, with four strong claws, all of which are furnished with a serrate hyaline membrane (Fig. 14–2) directing anteriorly, and with one bare seta. Endopodite three-segmented; first segment almost as long as first exopodite segment, distal lamella excluded, with some rigid spinules along outer margin sparsely and transversely near distal end of anterior surface (Fig. 12–4), and with one hairy seta near inner distal corner; second segment shortest, conspicuously protruded outwards, forming into a well sclerotized nodule at inner part, and with many slender spinules along outer dorsal edge and one bare setula on inner distal corner; third segment slightly produced outwards, with one strong terminal claw, which is furnished with a fan-shaped serrate membrane, and one spine and one setula on posterior surface near distal end. *Leg 2* (Fig. 14–3). Coxa with a short spinular row arising from middle outer margin obliquely, and several spinules along distal outer margin. Distal edge between both rami forming into a blunt protuberance. Setal and spinal ornamentation of both rami same as in *Z. spinatus* previously described, except for of second endopodite segment which is furnished with only one seta on inner distal corner. *Leg 3* (Fig. 14–4) and *Leg 4* (Fig. 14–5) nearly same as in *Z. spinatus*. *Leg 5* (Fig. 14–6). Baseoendopodite much shorter than wide, with one outer seta arising from a cylindrical process with some spinules; inner expansion scarcely protruded, with four setae, inner two of which are shorter than outer two which are about as long as exopodite and ciliate; some shorter spinules along distal margin except for a short rim between outer two setae. Exopodite about as long as greatest length of baseoendopodite segment, with one densely ciliate seta on inner distal corner, one less spinulose elongate seta terminally, and three outer setae, of which the proximalmost one is about 1.5 times as long as the segment and less spinulose, the middle is smallest, and the distalmost is the thickest and is conspicuously spinulose; inner margin with some delicate spinules; a number of spinules along outer margin and on outer part of posterior surface.

Male. Body (Fig. 12–6) about 0.42 mm in legnth, of top-heavy appearance. Cephalothorax remarkably longer than three succeeding thoracic somites com-

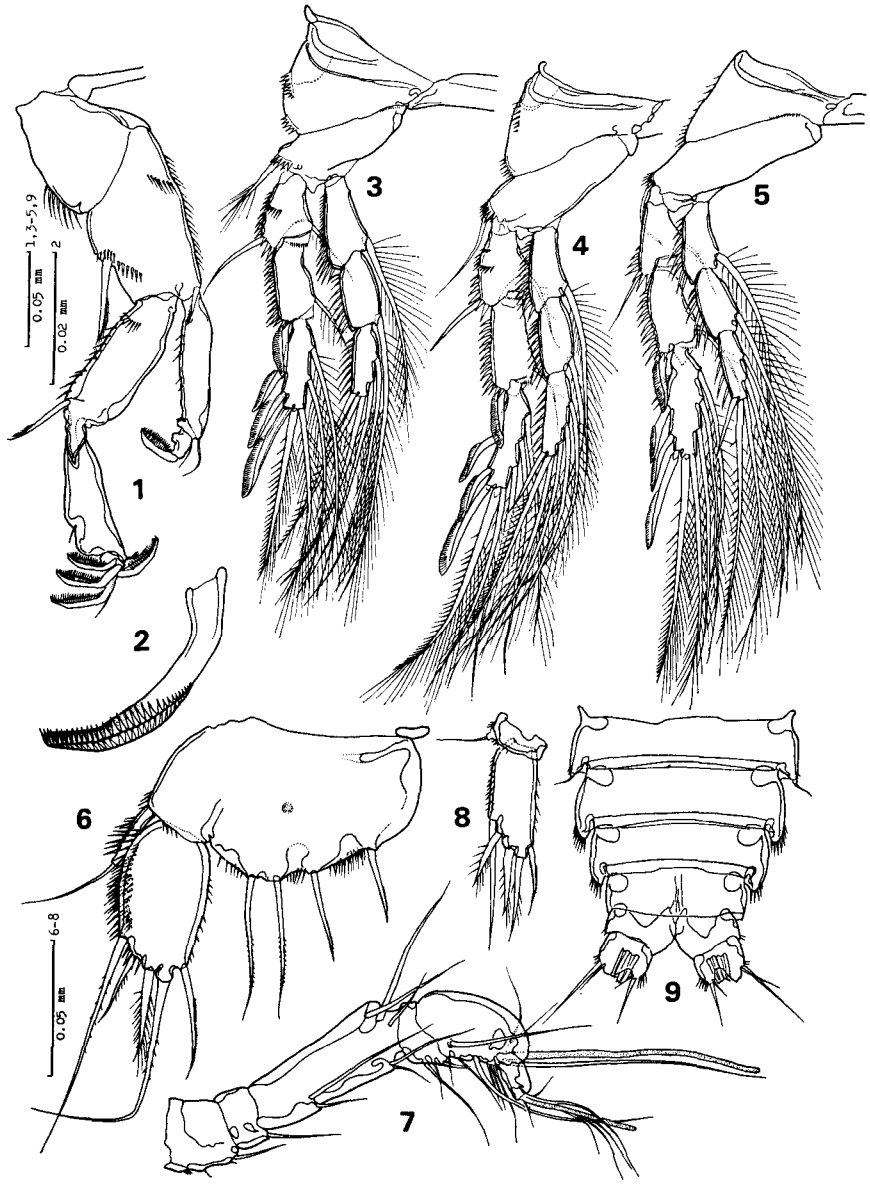

Fig. 14. *Zaus unisetosus* n. sp. Female. 1. leg 1; 2. terminal claw of last exopodite segment of leg 1; 3. leg 2; 4. leg 3; 5. leg 4; 6. leg 5. Male. 7. antennule; 8. leg 5; 9. leg 6 and abdomen, dorsal.

bined, with less and inconspicuous hairs along whole margin. First abdominal somite with some delicate spinules laterally; leg 6 represented by one bare seta arising from a small process on each lateral posterior corner; succeeding two somites remarkably protruded behind at both lateral ends with several spinules. *Antennule* (Fig. 14–7) well sclerotized, chilocer; fifth and last segments each with an aesthetasc. *Leg 5* (Fig. 14–8). Coxa with one outer seta arising from a very small process. Basis about 2.5 times as long as greatest width; inner margin rather straight, with several spinules, and with five more or less spinulose setae, of which the terminal seta and the proximalmost outer seta are much elongate, more than twice as long as the segment (these setae in the figure are broken off at about distal half).

Variability. Eight females and two males were dissected. The body length seems to be fairly stable among them, while the general appearance of whole body is slightly variable (cf. Figs. 12–1, 2, 3). The most impressive characteristic given by the second endopodite segment with only one inner seta in leg 2 was confirmed to be with no exception in all the specimens of both sexes examined. The outer two setae on inner expansion of baseoendopodite of leg 5 in female are scarcely elongate more than the length of the exopodite segment. The two spinular rows of coxa in leg 2 are sometimes confluent together into one continuous row (cf. Fig. 14–3). One female with strikingly abnormal structure was recognized. In the female the last exopodite segment of the right leg 2 is furnished with two outer spines instead of three, and further, its outer terminal seta is transformed into a bulbiform swelling basally, while the corresponding segment of the left is entirely normally ornamented.

Remarks. The present new species differs from all the species so far known of the genus in the unique characteristic that the second endopodite segment of leg 2 is furnished with only one inner seta, while in all the other species the corresponding segment is with two inner setae. The species name, *unisetosus*, was derived from this characteristic. The shape of the baseoendopodite segment of leg 5 in female is alike to that in *Zaus spinatus hopkinsi* reported by Lang (1965) from California, though the longest terminal seta of the segment is more developed rather than in the present and attains a length about 1.7 times as long as the outermost seta in the Lang's subspecies. The shape and relative length of coxa and basis of leg 1 in the present is almost the same as in *Z. spinatus spinatus*, but the spinules along outer margin of coxa in the present are shorter and of more rigid appearance than in the latter. The distal part of endopodite of leg 1 is hardly discernible between the present and *Z. spinatus spinatus* except for the number of spinules on the second segment. As far as the status of the leg 1 is concerned, *Z. biunguiferus* and *Z. spinatus hopkinsi* by Lang (op. cit) seem to be allied to the present new species and *Z. spinatus spinatus* (see p. 577).

Syntypes. Eight females and one male collected from Oshoro by algal rinsing (1 ♀, 23–VII–'71; 4 ♀♀, 25–XI–'71; 2 ♀♀, 17–II–'72; 1 ♀, 29–VIII–'71; 1 ♂, 29–VIII–'72 Itô leg.) and one male collected from Muroran by plankton haul (11–VII–'72 Itô leg.). The

description and nearly all the figures were based upon one female (25–XI–'71) and one male (29–VIII–'72) from Oshoro.

Concluding remarks for the genus Zaus. According as the present study on the four species of the genus progressed, some important characteristics for the taxonomy within the genus proved to be so far overlooked or underestimated by several former investigators. Since some of them were thoroughly examined again after the ordinary taxonomic study was nearly completed, they are explained here, as far as I have been able to clarify, together with some morphological problems arising from a comparison among the species described in the present paper and several other species previously known.

The terminal claws of the last segment of the first pair of legs have been yet explained as "apical claws bordered on one side with a dense comb-like series of cilia" by Sars (1904) for *Z. spinatus*, or "brush-like claw" by Lang (1965) for *Z. biunguiferus* and *Z. spinatus hopkinsi*. At the first glance for me under a light microscope, such claws of *Z. spinatus spinatus* and of *Z. unisetosus* appeared to be strong claws with two parallel rows of very delicate spinules on each lengthwise. On the contrary, those of *Z. intermedius* and also of *Z. robustus* were furnished with one row of some spinules which were even more easily countable rather than of the former two species (cf. Fig. 2–7, Fig. 5–8, Fig. 10–7, Fig. 14–2). This difference between these two types in the ornamentation of the claws is precisely recognizable with the aid of a scanning electron microscope as shown in the figures (Figs. 15–1, 2 and 3). The claws in *Z. spinatus spinatus* are marginally transformed into a thin lamella which is finely serrated along distal part, and the serration is clearly bent. The claws in *Z. robustus*, contrary, are scarcely with such lamella, but are immediately serrated marginally as if they are spinulose. An obscure shallow groove arising among each base of 'spinules' extends to the opposite edge of the claw in *Z. robustus*, while the corresponding grooves in *Z. spinatus spinatus* are strikingly conspicuous from the base of serration to the opposite edge through the lamellar part continuously. Henceforth these two different types of claws are cited as the spinatus-type and the robustus-type claws, respectively. And further, both *Z. biunguiferus* and *Z. spinatus hopkinsi* have probably spinatus-type claws as far as judging from the figures by Lang (1965. Fig. 70, a. 2 and Fig. 74, c. 1). The claws of *Z. serratus* and of *Z. latiremus* seem to be slightly distinguished from each other in the figures by Monk (1941, pl. 1, figs 4 and 10) who explained the claws of the latter species as "pectinate claw". That the claws are robustus-type in the former species and spinatus-type in the latter is supposed rather safely. Of *Z. schäferi* Klie (1949) and *Z. aurelii* Poppe (1884) I can't state anyway. Campbell explained the claws of *Z. caeruleus* as "bordered on one side with dense comb-like rows of cilia" and he gave a figure (1929, pl. III, fig. 1). The claws of *Z. caeruleus* seem to be a little alike to spinatus-type, though I can't decide. It is fairly conceivable from the figure by Sars (1904, pl. XXXIV) that the claws of *Z. abbreviatus* are spinatus-type, and of *Z. goodsiri* are not spinatus-type but robustus-type or usual spinulose ones. *Z. sarsi* Nicholls 1952 (=*Z. aurelii* sensu Sars 1909)

Fig. 15. 1, 2. distal part of exopodite of leg 1, *Zaus robustus*; 3. ditto, *Zaus spinatus spinatus*; 4. distal part of endopodite of leg 1, based on *Z. spinatus spinatus* from France. 1~3 by scanning electron microscope, and 4 by light microscope with phase contrast. Each bar represents 0.01 mm.

seems to have robustus-type claws as far as judging from the figure (cit. Lang 1948). At present it is rather dubious whether the claws in question of all the species within the genus are distinguishable into these types precisely or not, since in so many species the structure remains uncertain.

On the other hand, the second endopodite segment, in three segments, of the first pair of legs was distinctly recognized in all the species reported in the present paper. The second, however, was regarded as a mere lamella arising from distal edge of the first segment by Lang (1965). It was not easy to define such the small, spinulose protuberance on the endopodite to be the true second segment, particularly in *Z. spinatus spinatus* as well as *Z. unisetosus*, though it was fairly easy task in *Z. robustus* and *Z. intermedius*. The fact on the differentiation of the segment in a younger stage seems to show an indisputable reason to explain that the segment is not an appendix of the first segment. That is the fifth copepodid stage

of *Z. robustus*, of which the both rami of the first pair of legs are clearly two-segmented and of the second to the fourth legs are three-segmented. As shown in the figure (Fig. 5–10) the distal endopodite segment of the first pair of legs is clearly protruded outwards at basal part and is furnished with a row of some spinules directing dorsally. This protruding basal part is slightly demarcated by a shallow groove from distal part which is furnished with some declicate spinules on and near outer edge. The anterior surface of the proximal segment is ornamented with a transverse spinular row near distal edge as in the adult (cf. Fig. 5–7). The distal segment composed of two morphologically discernible parts in the fifth copepodid stage differentiates into the apical two segments in the three-segmented endopodite in the adult. Therefore the second segment in the adult is derived from the distal segment, not from the proximal segment which is quite identical in the ornamentation with the first segment in the adult. The third segment is seemingly immovable, firmly attached onto the second. On the contrary, the second segment is well movable on the first as shown in *Z. unisetosus* (cf. Figs. 12–4 and 5). When it moves, the inner sclerotized nodule of the second segment together with the protruding part of the distal end of the first segment is regarded as a fulcrum in a hinge functionally, and probably anatomically. In the latter case, the protruding part of the first segment is referable to a so called acetabulum. A thin articulation membrane is recognized between the first two segments (see Fig. 12–5). On the metamorphosis of harpacticoid copepods, such the phenomenon that the second segment in the three-segmented ramus is derived from the distal segment in the two-segmented ramus in younger stage has been already known in several species (Itô, 1970, 1971). If such species with this second segment completely fused to the first in adult is found in this genus, it may be due to secondary transformation.

In the antennule in female, the relative lengths of the fifth and sixth segments clearly differ among four the species described. The sixth segment is much longer than the fifth in *Z. intermedius and Z. robustus*, while it is nearly the same in *Z. spinatus spinatus* and *Z. unisetosus*. On this respect a thorough re-examination in other species is strongly expected.

The shape and relative length, and the ornamentation of coxa and basis in the first pair of legs are apparently very important and good species character. Even by only this character, all the species from Hokkaido are easily discernible from each other quite correctly. The shape and ornamentation of the fifth pair of legs has been regarded as the most important species character in the female, but it is scarcely useful for the taxonomy in the male within the genus. *Zaus spinatus hopkinsi* was well distinguished from *Z. spinatus spinatus* in this character of leg 1 even in the males (Lang, 1965). Therefore the character in the first pair of legs, which is not different in sexes, is of particular importance.

Eudactylopus andrewi Sewell

(Figs. 16~27)

? *Dactylophusia latipes* (T. Scott): Thompson et A. Scott 1903, pp. 238, 268. *Eudactylopus latipes* (T. Scott): A. Scott 1909, p. 219, pl. 63, fig. 8–14; Lang 1948 (in part), p. 561, fig. 227; Tanaka et Hue 1968, p. 65, fig. 4. *Eudactylopus latipes* f. *andrewi* Sewell 1940, p. 201, fig. 31~33. *Eudactylopus andrewi andrewi*: Vervoort 1964, p. 154, fig. 56~59.

Female. Body (Figs. 16-1, 2) about 1.5 mm in length, rostrum and furcal setae excluded, almost cylindrical in appearance, and tinctured with purple on nearly whole body surface except for some colorless and transparent parts, i.e., distal part of each appendage, a pair of spherical spots above nauplius eye, a transverse zone a little behind eye, a spot on both about middle lateral parts, and three rather elongate spots near posterior end of cephalothorax, a semicircular part

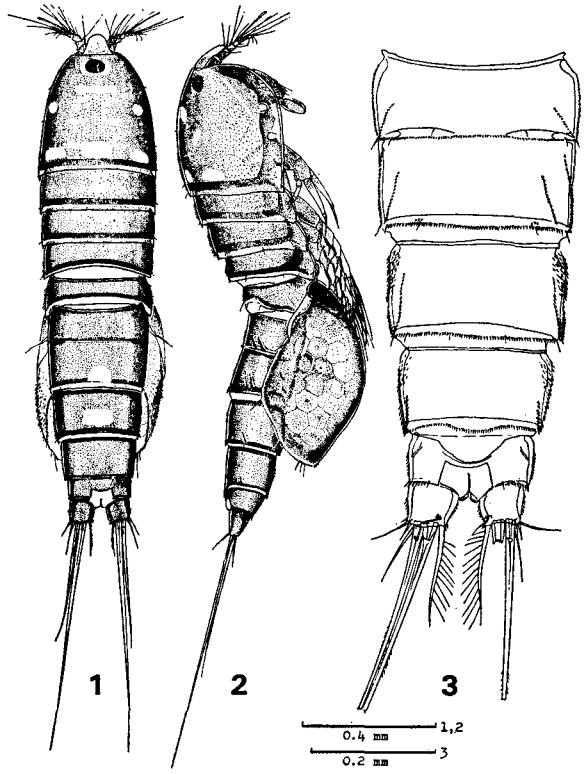

Fig. 16. *Eudactylopus andrewi.* Female. 1. dorsal view; 2. lateral view; 3. abdomen, dorsal.

of middle dorsal end of genital double-somite, an elliptical part on middle dorsal surface of antepenultimate somite, anal area, and distal half of principal terminal setae of furcal rami. Posterior margins of all somites each fringed with a more dark purple band which is slightly diffused and obscured laterally and ventrally, and each the band of cephalothorax and third free somite is very conspicuous. A white, opaque, *traubenförmig* formination under each of five colorless parts on cephalothorax, three near posterior edge and two lateral, and some other yellowish green clusters scattering in cephalothorax as well as other somites. Rostrum (Fig. 18–1) prominent, clearly defined at base, as long as first three antennular segments, with a pair of sensilae. Cephalothorax almost as long as succeeding three thoracic somites combined, tapering apically in dorsal view, with many delicate hairs on posterior surface. Thoracic somites (Fig. 17–3) furnished with many elongate hairs along base of hyaline membrane, and many shorter, delicate hairs arranged into many short transverse rows, several spatulate elongate sensilae and small slender ones, each arising from center of a circular thickning. Abdomen a little flattened dorso-ventrally, and gradually tapering behind, with one or two oblique spinular rows on both lateral surface of each somite except for last one. Genital double-somite (Fig. 16–3) subdivided into two parts by a transverse row of very delicate spinules dorsally and laterally; posterior end, except for ventral edge, fringed with great number of spinules and several hairs; ventro-posterior margin ending in a hyaline frill with no spinule, but with a pair of hairs; leg 6 represented

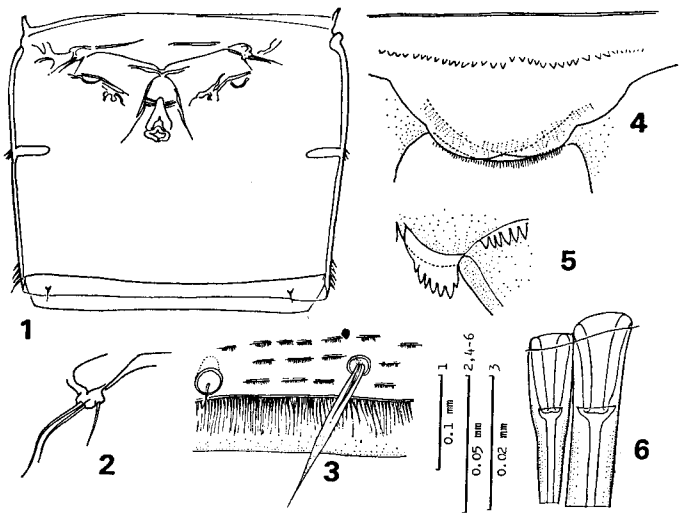

Fig. 17. *Eudactylopus andrewi*. Female. 1. genital double-somite, ventral; 2. leg 6 on genital double-somite; 3. posterior part of epimeron of second free thoracic somite; 4. pseudoperculum and anal operculum; 5. serrate plate of anal somite, ventral; 6. proximal part of principal terminal setae of furcal ramus.

by a pair of small protuberances with three bare setulae on genital area. Posterior end of antepenultimate somite with a circumambient spinular row and several hairs; both lateral surfaces of anterior half spinulose. Penultimate somite forming into pseudoperculum (Fig. 17–4) composed of a protruding cuticle at middle dorsal end, with a circumambient spinular row, and without hairs. Anal somite shorter than preceding one, with a pair of serrate plate (Fig. 17–5) between furcal rami, and some spinules along posterior edge; anal operculum nearly covered with pseudoperculum. Furcal ramus a little shorter than wide, slightly tapering behind, with two short setae on outer distal corner, one seta on ventral edge near outer corner, one dorsal setula which is geniculate basally and accompanied with several spinules, and one longer seta which is hairly along inner edge; principal terminal setae (Fig. 17–6) well developed, and finelly ciliate.

Antennule (Fig. 18–2) seven-segmented; first segment thickened distally, with some spinules on anterior edge and one seta; fourth one furnished with a long aesthetasc which is about as long as all the antennular segments combined; fifth and sixth segments each with two (or three?) setae on anterior distal corner; last one longer than preceding, furnished with a trifurcate seta terminally. *Antenna* (Fig. 18–3). Coxa small and bare. Allobasis almost twice as long as wide, with one spinulose seta at about two-thirds the length of anterior edge, middle part of anterior edge spinulose. Exopodite two-segmented; first segment with two hairy setae; second one much shorter than first, with three hairy setae. Endopodite about as long as proximal two segments combined, furnished with five strong claws, two elongate, geniculate spines, one short spiniform seta and three slender setae. *Labrum* (Fig. 18–4) fairly sclerotized, with a number of hairs. *Mandible* (Fig. 18–5). Praecoxa with several long hairs (spinules?) near base of coxa-basis, thick pars incisiva, lacinia mobilis well defined at base, one apically serrate spine, and a spinulose seta on cutting edge. Coxa-basis with two spinulose setae on inner distal corner. Exopodite represented by a small protuberance of outer distal corner of coxa-basis, with two setae. Endopodite shorter than coxa-basis, with one inner seta at about middle edge, and five terminal setae, all more or less spinulose. *Maxillula* (Fig. 18–6). Arthrite of praecoxa with at least six strong claws and one spinulose seta along inner edge; ventral part of praecoxa near base of coxa spinulose. Coxa clearly swelling midst, with one slender and three thick setae on inner end, and two thick setae on ventral edge near inner end, all setae remarkably plumose. Basis with two low lobules ventrally, which are probably dwarfed exopodite and endopodite; two thick plumose setae on inner extremity. Exopodite with two terminal setae, of which outer one is bare and the rest plumose. Endopodite much wider than exopodite segment, with four thickset plumose setae terminally. *Maxilla* (Fig. 18–7). Syncoxa with an oblique row of many spinules roughly arranged on lateral surface near base, and some spinules on and near outer distal corner, and with three endites; proximal endite smallest, rather bulbiform, with two hairy setae; middle one with round apex ending in two serrate claws; distal one remarkably widened inwards, with one serrate and two pectinate claws.

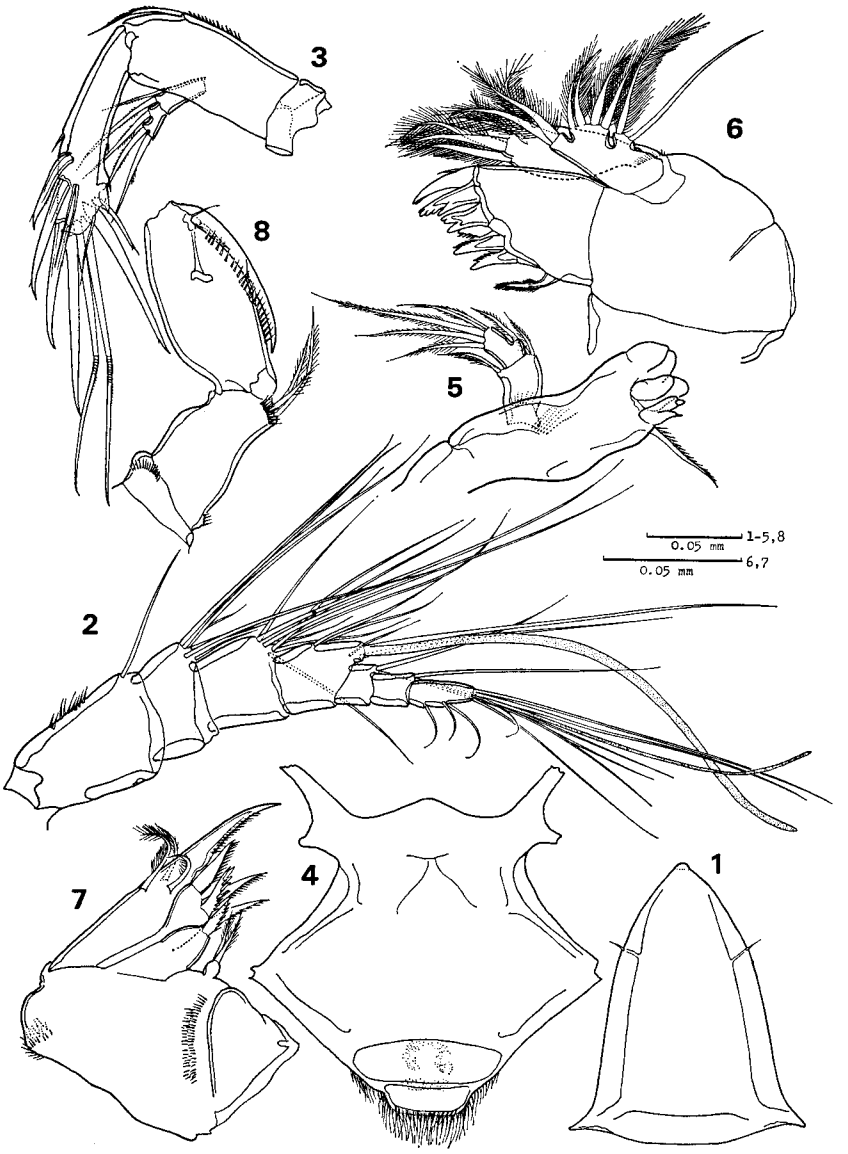

Fig. 18. *Eudactylopus andrewi*. Female. 1. rostrum; 2. antennule; 3. antenna; 4. labrum; 5. mandible; 6. maxillula; 7. maxilla; 8. maxillipede.

Basis forming into a strong claw which is finely spinulose along dorsal edge and accompanied with three hairy setae near base. *Maxillipede* (Fig. 18–8). Coxa very short, with an arched row of spinules near outer corner. Basis with three spinulose setae on inner distal corner accompanied with some spinules basally, and several spinules on inner edge near proximal end. First endopodite segment much longer than basis, with a spinular row along inner margin, and two bare setulae, each arising from middle inner edge and near base of second segment which formes into a strong claw accompanied with a bare setula at base.

Leg 1 (Fig. 19–1). Coxa much widened, clearly bipartite; outer margin of proximal half bare; several oblique spinular rows on anterior surface of distal half which is furnished with many spinules along outer margin and on anterior distal edge near inner corner; inner rim smoothly rounded, well sclerotized. Basis shorter than coxa, furnished with one strong outer claw on distal corner; an oblique spinular row on anterior surface near inner proximal corner; distal half of inner margin spinulose; one strong claw on anterior distal edge just inside inner corner, accompanied with several spinules basally; outer edge and anterior distal edge spinulose. Exopodite a little shorter than coxa and basis combined; first segment of triangular shape, with one outer spine near distal corner, and some spinules along anterior distal edge and outer margin; second one about twice as long as greatest length of first segment, with one spine at three-fifths the length of spinulose outer margin, one hairy seta near inner distal corner, and several spinules on inner proximal edge; third one smallest, as long as wide, with two outer claws, one strong terminal claw which attains a length of the second segment and one elongate geniculate, terminal spine. Endopodite two-segmented; first segment fairly longer than three exopodite segments combined, about four times as long as greatest width, with one spinulose thick seta at about middle inner edge; second one small, forming into a sclerotized globule at inner proximal part, with several spinules outwards, a bare setula on inner distal corner, and two strong terminal claws, of which longer one attains a length about twice as long as the rest. *Leg 2* (Fig. 19–2). Anterior surface of coxa with two oblique spinular rows near outer edge. Basis lowered outwards, forming into a triangular plate between both rami and into an acutely sharpened process at inner distal corner, with one thickset outer spine, several spinules along base of each ramus. Exopodite a little longer than endopodite; first segment forming into a triangular protuberance at outer distal corner demarcated by an oblique spinular row arising from base of outer spine, and furnished with one plumose inner seta on distal corner, a row of some spinules on anterior surface, arising from outer proximal edge, and many rigid spinules along outer margin; second one almost as long as first, forming into a triangular process at both distal corners, with one outer spine and one plumose inner seta, and some hairs along inner margin; third one longer than second, forming into a small spiniform protuberance at outer distal corner, with three outer spines, one spine and one seta on distal end, and two inner setae. Endopodite; inner margin of each segment spinulose; first segment much shorter than wide,

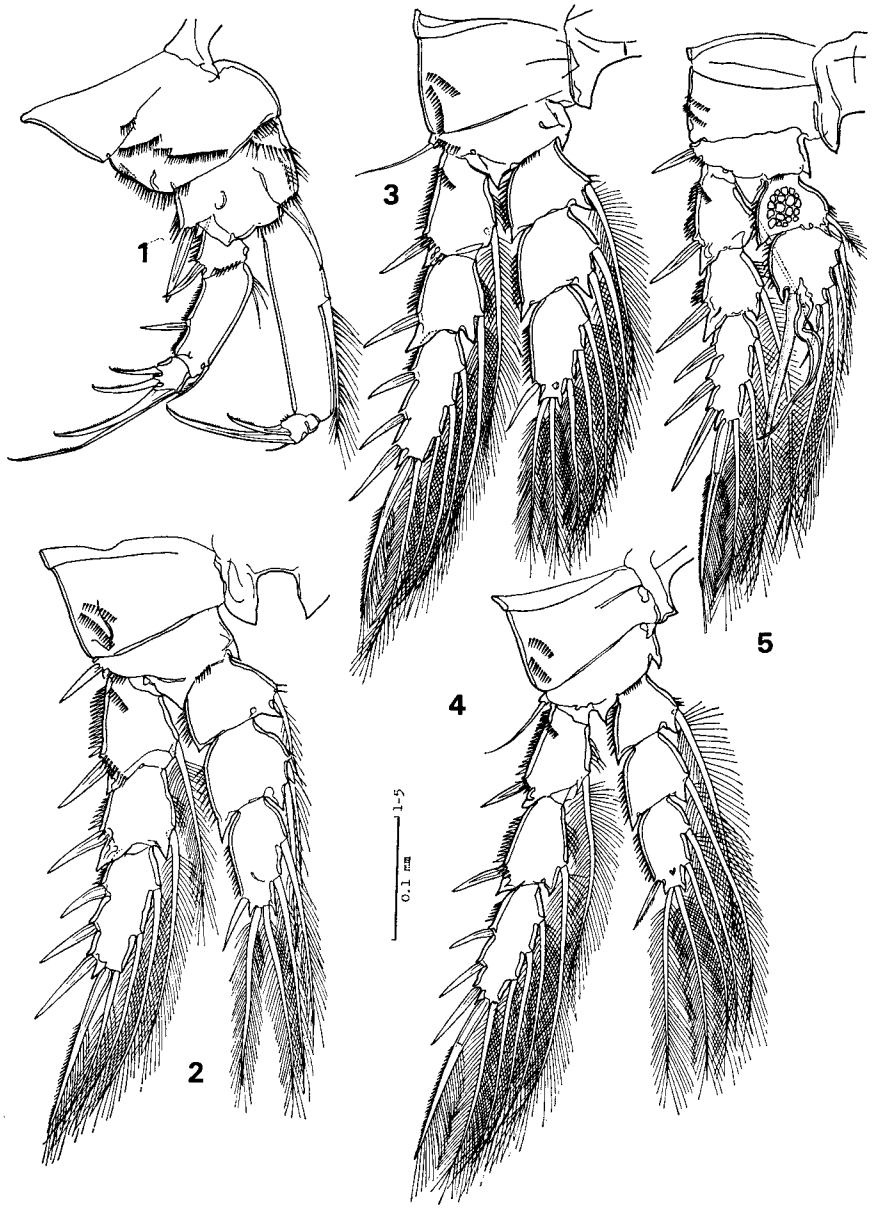

Fig. 19. *Eudactylopus andrewi*. Female. 1. leg 1; 2. leg 2; 3. leg 3; 4. leg 4. Male. 5. leg 2.

forming into a sharp protuberance at inner distal corner, with one short hairy inner seta accompanied with several spinules basally; second one longer than first, forming into a sharp protuberance at both distal corners, with two inner setae; third one slender and tapering distally, forming into a small spiniform protuberance at both distal corners, with one outer spine near distal end, two terminal and two inner marginal setae. *Leg 3* (Fig. 19–3). Ornamentation of coxa as in leg 2. Basis with one bare seta, instead of spine, on a small process on outer edge; triangular protuberance between both rami remarkably sharpened. Third exopodite segment as well as third endopodite segment furnished with three inner marginal setae instead of two. *Leg 4* (Fig. 19–4). Coxa and basis as in leg 3. Ornamentation of exopodite as in leg 3. Endopodite much smaller than exopodite; second segment with one inner seta instead of two, and third with two inner setae instead of three in leg 3. *Leg 5* (Fig. 20–1) strikingly foliaceous and broad, forming into an egg pouch under abdomen together with both legs (see Fig. 16–2). Both rami ventrally convex particularly around basal part. Ventral surfaces of both rami are covered with a great number of fine hairs, but I can not illustrate them precisely. Baseoendopodite of almost triangular appearance, forming into a short process which is fringed with some spinules along anterior edge and with one bare seta on its apex; one hairy setula at about two-thirds the length of inner side, one longer and three short setae around distal margin; inner margin from base to inner seta bare; distal part of inner margin fringed with a number of longer hairs, and outer margin with short hairs. Exopodite broader than baseoendopodite, rather rectangular, connected with outer basal corner of baseoendopodite at its anterior extremity; anterior inner side almost straight, and if roundness of inner distal corner disregarded it being nearly at right angles with distal inner side fringed with many hairs; distalmost corner with a bare setula; anterior outer margin spinulose and forming into a tubular lobule with one seta; outer distal margin hairy and with one setula midst, and two setulae and one seta, these three are close together and arising from about middle edge between former setula and distalmost one.

Male. Body (Fig. 20–2) about 1.3 mm in length, slightly slender in appearance. Color pattern almost as in female. *Antennule* (Fig. 20–3) haplocer, seven-segmented; a pair of well developed aesthetascs arising from fourth segment which is furnished with a triangular chitinous formation near middle anterior edge. *Leg 2* (Fig. 19–5). Coxa, basis and exopodite as in female. Endopodite two-segmented; first segment as in female; second one conspicuously modified, longer than first, forming into an acutely sharpened process at distal end; outer margin spinulose and ending in a spiniform protuberance; two elongate spines arising from distal outer corner, of which outer one is nearly straight but the other fairly winding its way and tapering apically; four inner marginal setae, of which proximal two are much shorter than others. *Leg 5* (Fig. 20–4). A pair of legs represented by one wide plate, but both legs clearly demarcated by a longitudinal groove (or chitinous thicknings?) at middle. Inner expansion of baseoendopodite with one

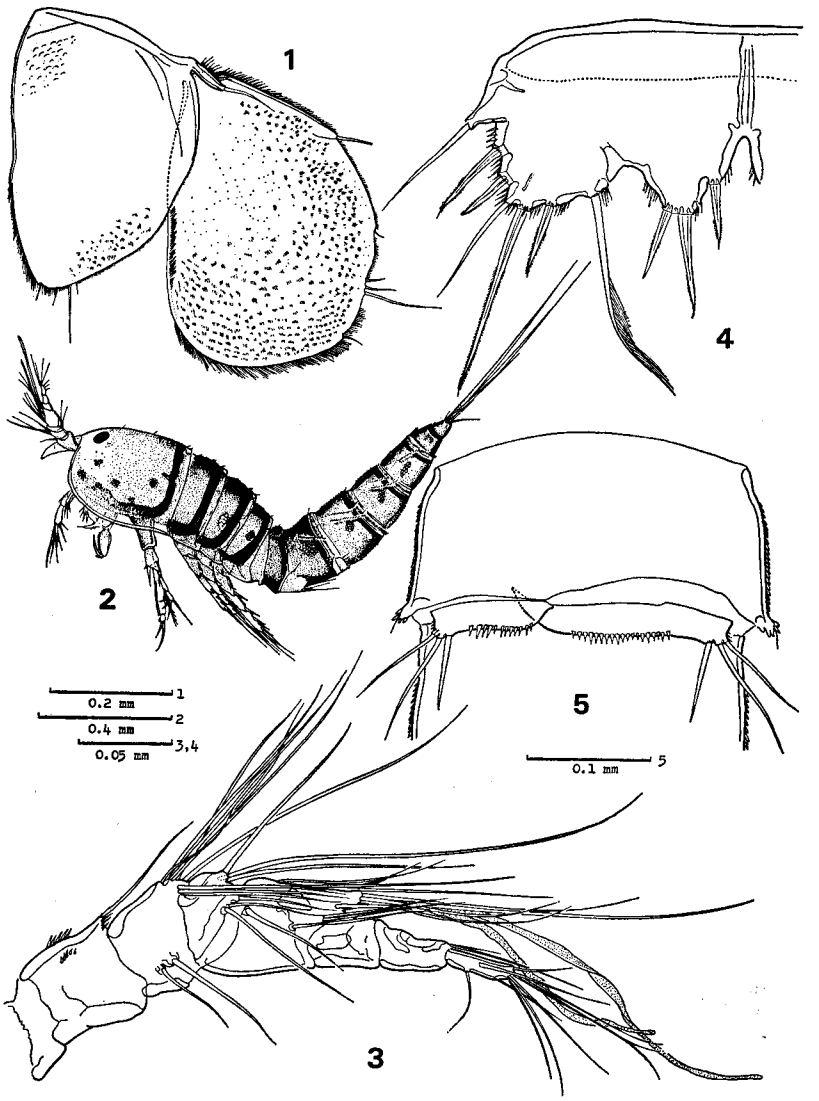

Fig. 20. *Eudactylopus andrewi.* Female. 1. leg 5. Male. 2. lateral view; 3. antennule; 4. leg 5; 5. leg 6.

inner and two distal spines, all finely ciliate. Exopodite with two outer spines, one terminal bare seta, two inner spines, distal one of which is much elongate, and one hairy seta near inner proximal edge. Outer seta of baseoendopodite bare, arising on a short process. *Leg 6* (Fig. 20–5) represented by a wide, but short,

plate with one ciliate spine (thick seta?) and two bare setae on outer corner, and some spinules along distal edge. In the specimen illustrated, the left leg is furnished with 19 spinules and the rest with 12 spinules along each distal margin.

Variability. Among three adult females dissected, no particular difference was recognized except for the number and situation of the yellowish green *traubenförmig* formations.

Remarks. This is the northernmost record for the distribution of this Indo-Pacific form. The present species has rather complex history for its citation because of confusion with another species, which had been cited as *E. latipes* f. *typica*. The latter, however, was recently treated as a subspecies, *E. andrewi atlanticus*, by Vervoort (1964). I regard it as a distinct species, since it is completely discernible from the main species described in many major characters. A list is compiled for bibliographic comparison as given below:

Eudactylopus atlanticus Vervoort

Dactylopus latipes T. Scott 1893 (non Boeck), p. 99, pl. 10, fig. 38~43.
? *Dactylophusia latips* (T. Scott): Thompson et A. Scott 1903, p. 238.
Eudactylopus latipes (T. Scott): A. Scott 1909 (in part), p. 219; Lang 1948 (in part), p. 561, fig. 227; Carvalho 1952, p. 158, pl. 2, fig. 63~67.
Eudactylopus latipes f. *typica* Sewell 1940, p. 201; Lang 1965, p. 217, fig. 121~124.
Eudactylopus andrewi atlanticus Vervoort 1964, p. 162.

* *Eudactylopus latipes* f. *typica* sensu Noodt (1955) was identified with *E. spectabilis* (Brian) by Lang (1965).

The seven-segmented antennule in female in *E. andrewi* has been so far regarded as the most important characteristic for the species. Its great significance certainly remains unchanged at the present, but notwithstanding this it is indispensable to clarify and enumerate further distinguishing characters from other related species.

In the fifth pair of legs in female, the inner proximal seta of baseoendopodite in *E. andrewi* fairly approaches the middle while in *E. atlanticus* it is set rather distally. Therefore the interspace between the inner proximal seta and the next in *E. andrewi* is more widened than in *E. atlanticus* in appearance (cf. Fig. 20–1, A. Scott 1909 and Tanaka et Hue 1968, for the former and Lang 1965, for the latter). The inner proximal seta was overlooked by T. Scott (1893) in *E. atlanticus* and also by Vervoort (1965) in *E. andrewi*.

The inner part of exopodite is well cornered in *E. andrewi* as clearly shown in this paper and also in the figures by A. Scott (1909), Sewell (1940) and Tanaka et Hue (1968). On the contrary this part in *E. atlanticus* by Lang (1965) is scarcely cornered, but is moderately rounded. The figure by T. Scott (1893) for *E. atlanticus*, however, shows nearly the same appearance as *E. andrewi*. The shape of this ramus in *E. andrewi* as well as *E. atlanticus* by T. Scott is quite unique in

the genus, since all other species and Lang's form have more or less elongate droplet-shaped rami (see Lang, 1948, 1965; Sewell, 1940). In this respect, *E. atlanticus* by Lang as the first exact record of the eastern Pacific form slightly differs from the Atlantic form.

On the other hand, the inner seta of the first endopodite segment of leg 1 arises from nearly middle margin of the segment in the present material and also in the specimen reported by Tanaka et Hue from Kyushu, and its situation is a little translocated proximally, but not so different from the former two in the specimens by A. Scott, Sewell and Vervoort. Contrary to these, the seta arises from at basal one-third the length in *E. atlanticus* by T. Scott and Lang. The same nature of this inner seta as in *E. andrewi* from Japan is also recognized in *E. fasciatus* Sewell (Sewell 1940, fig. 38, G). Among precisely reported representatives of *E. andrewi*, the three reported from tropical seas between Lat. 10°N and 10°S (A. Scott, 1909, east coast of Aru Islands; Sewell, 1940, Nankauri Harbour, Nicobar Islands and Addu Atoll, Maldive Archipelago; Vervoort, 1964, Ifaluk Atoll, Caroline Islands) are identical with one other in the situation of this inner seta, while slightly differ from the two reported from temperate seas of Japan (the present record, Hokkaido; Tanaka et Hue, 1968, Kyushu), the last mentioned two are quite identical with each other in this respect. Therefore it is probable that the presence of several local forms within the species is clarified by further thorough studies.

Specimens examined. Three females and one male collected from Oshoro by algal rinsings. (2 ♀♀, 27-VII-'71; 1 ♀, 30-IX-'71; 1 ♂, 7-IX-'73 Itô leg.).

In the present species, the fifth copepodid stage was already described by Sewell (1940) who reported also some younger stages of other species within the genus. For further comparative study, the outline of metamorphosis through all copepodid stages is here reported, since many specimens of all copepodid stages were collected from Oshoro (7-IX-'73).

The first copepodid stage

Body (Fig. 21-1) about 0.35 mm in length, composed of five somites. Cephalothorax longer than three succeeding somites combined. Epimera of first two thoracic somites well differentiated. First abdominal somite, which differentiates into the third thoracic somite in adult, slightly protruded behind at both lateral corners, and with several oblique rows of spinules on each antero-lateral surface. Second abdominal somite (Fig. 22-5) about as long as width, tapering distally, with two outer setae accompanied with some spinules basally, one dorsal seta near distal end, one basally geniculate seta near middle inner edge accompanied with several spinules; distal edge remarkably spinulose; principal terminal setae confluent together basally. *Antennule* (Fig. 22-1) composed of three segments of almost equal length; first segment with one seta on anterior distal corner and several spinules; second furnished with a slender aesthetasc; third fairly tapering

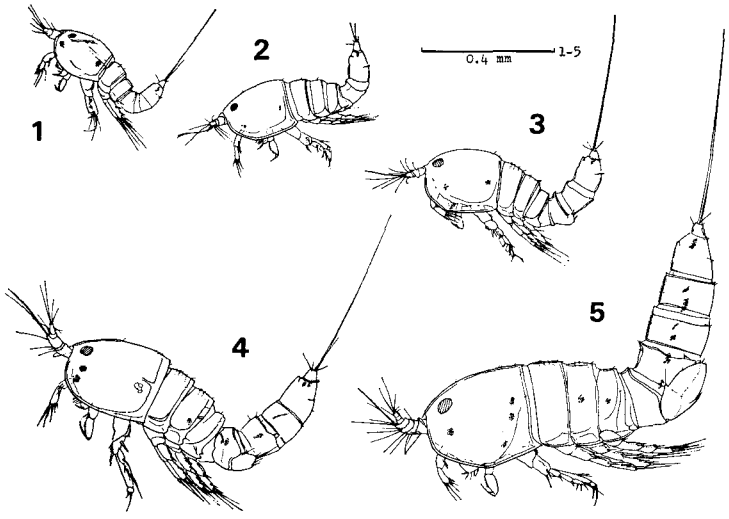

Fig. 21. *Eudactylopus andrewi*. 1～5. first to fifth copepodid stages. 1～3, sex unknown; 4, 5, female.

apically. *Antenna* scarcely differs from that in adult, except for exopodite. Exopodite (Fig. 22–2) equaly two-segmented; first segment with one bare small seta midst and one spinulose, thickset seta distally; second with two spinulose marginal setae and ending in four bare, slender setae which confluent together basally in appearance. Oral appendages as in adult.

Leg 1 (Fig. 22–3). Coxa with a short spinular row arising from outer margin inwards on anterior surface, one spinule on outer distal edge. Basis furnished with one strong outer seta accompanied with some spinules basally, two oblique spinular rows on anterior surface, each near inner proximal corner and inner distal part, and some spinules along base of endopodite. Both rami one-segmented. Exopodite slightly swelling inwards, with an oblique spinular row arising from outer edge near base, three small outer spines, one claw on outer distal corner, one ciliate strong claw a little longer than this ramus and one geniculate, elongate spine on distal end. Endopodite about as long as exopodite, with four groups of several spinules along outer margin, one short spine on outer distal corner; one hairy short inner seta on one-third the length; distal edge remarkably inclined, with one thick spine, spinulose outwards and hairy inwards, accompanied with a setula at inner base. *Leg 2* (Fig. 22–4). Coxa much bigger than basis, with a short spinular row arising from outer edge on anterior surface transversely. Basis forming into two triangular protuberances, each between both rami and on inner corner, furnished with one outer spine accompanied with several spinules basally. Both rami one-segmented. Exopodite about as long as basal two seg-

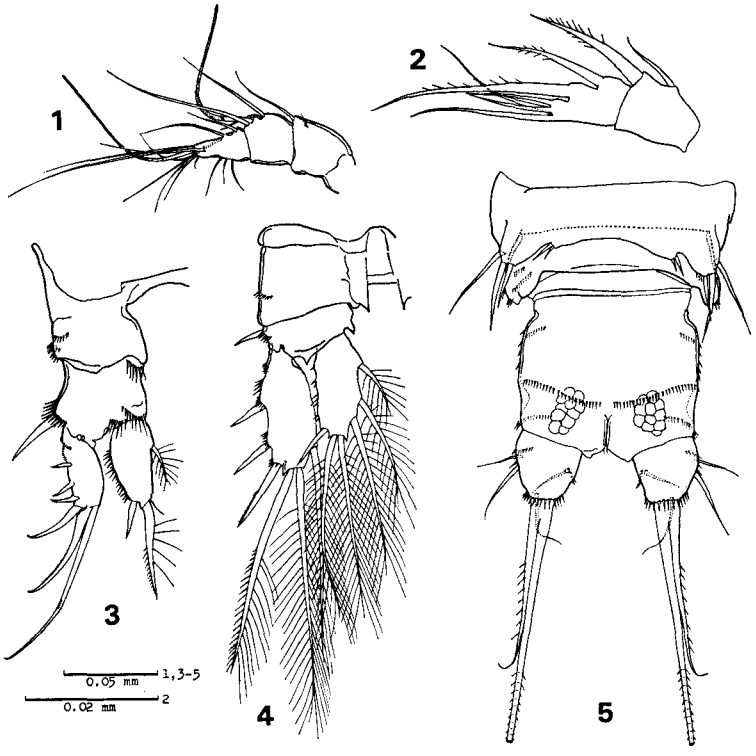

Fig. 22. *Eudactylopus andrewi*. First copepodid stage. 1. antennule; 2. antennal exopodite; 3. leg 1; 4. leg 2; 5. leg 3 and abdomen, ventral.

mentes combined, with three outer spines, one spiniform seta and one plumose seta on distal end, and one inner seta; outer edge somewhat spinulose. Endopodite shorter than exopodite, with several spinules along outer margin, one spine at outer distal corner, two plumose setae on distal end, and three inner marginal setae, of which proximalmost one is fairly short. *Leg 3* (Fig. 22–5) represented by a wide protuberance along posterior ventral edge of second thoracic somite, forming into a conspicuous lobe at each lateral end, terminating with two bare spiniform setae, and one bare outer seta near outer distal corner; two close setulae on inner base of lobe, directing outwards.

The second copepodid stage.

Body (Fig. 21-2) about 0.45 mm in length, composed of six somites. Epimera of three thoracic somites well differentiated. First abdominal somite with an oblique spinular row on each lateral surface. Anal somite about as long as wide,

with a transverse spinular row on ventral surface, several short spinular rows on each lateral surface of anterior half, and a pair of serrate plates at anal area between furcal rami. The ornamentation of furcal rami in the illustrated specimen is rather abnormal. In another normal specimen, the furcal rami are apparently differentiated as in adult. *Antennule* (Fig. 23–1) four-segmented; second segment longest, apparently protruded at anterior distal corner, and furnished with an aesthetasc; third one shortest, differentiated from distal part of second segment in previous stage. *Antenna* (Fig. 23–2). Proximal exopodite segment elongated, about twice as long as second, bearing two setae as in previous stage. Distal exopodite segment with one hairy marginal setae, and two thick setae terminally, one of which is hairy and the rest is relatively slender and bare.

Leg 1 (Fig. 23–4). Coxa almost as in previous stage. One strong spine added to basis near inner distal corner. Both rami two-segmented. First segment of exopodite rather triangular, with one outer spine; second one fairly bigger than first, with three outer spines, one claw and one genuculate, elongate spine terminally, and one bare inner setula. Endopodite not so different from that in adult; first segment much longer than two exopodite segments combined, with one hairy, short seta on just middle inner margin; second one forming into a sclerotized globule at inner basal corner, with one spine and one elongate claw on distal end, and a setula arising from inner distal corner. *Leg 2* (Fig. 23–5). Coxa with two spinular rows on anterior surface. Basis almost as in previous stage. Both rami two-segmented. Exopodite longer than endopodite; first segment conspicuously swelling inwards, protruding into a spiniform process at outer distal corner, with one outer spine, some hairs along inner margin; second one a little longer than first, with two spinular rows along outer margin, two outer spines, one spiniform seta and one plumose seta on distal end, and two inner setae. First endopodite segment acutely protruding at both distal corners, with one shorter inner seta; second one about 1.5 times as long as first, with two spinular rows along outer margin, one spine on outer distal corner, two terminal and two inner marginal setae. *Leg 3* (Fig. 23–6). Anterior surface of coxa with a short spinular row arising from middle outer edge transversely. Basis forming into a small cylindrical process with one slender bare seta at outer edge. Both rami one-segmented. Exopodite about as long as basal two segments combined, swelling midst, with one outer spine at about middle, two outer spines rather distally, two terminal and two inner marginal setae arising from fairly distal part; a short oblique row near outer basal corner; an obscure notch on inner edge at same level of proximalmost outer spine. Endopodite smaller than exopodite, with one outer spine at distal corner, two terminal and three inner marginal setae; four groups of several spinules scattering along outer margin; a slight notch at middle outer edge. *Leg 4* (Fig. 23–7) not so different from leg 3 in previous stage in ornamentation.

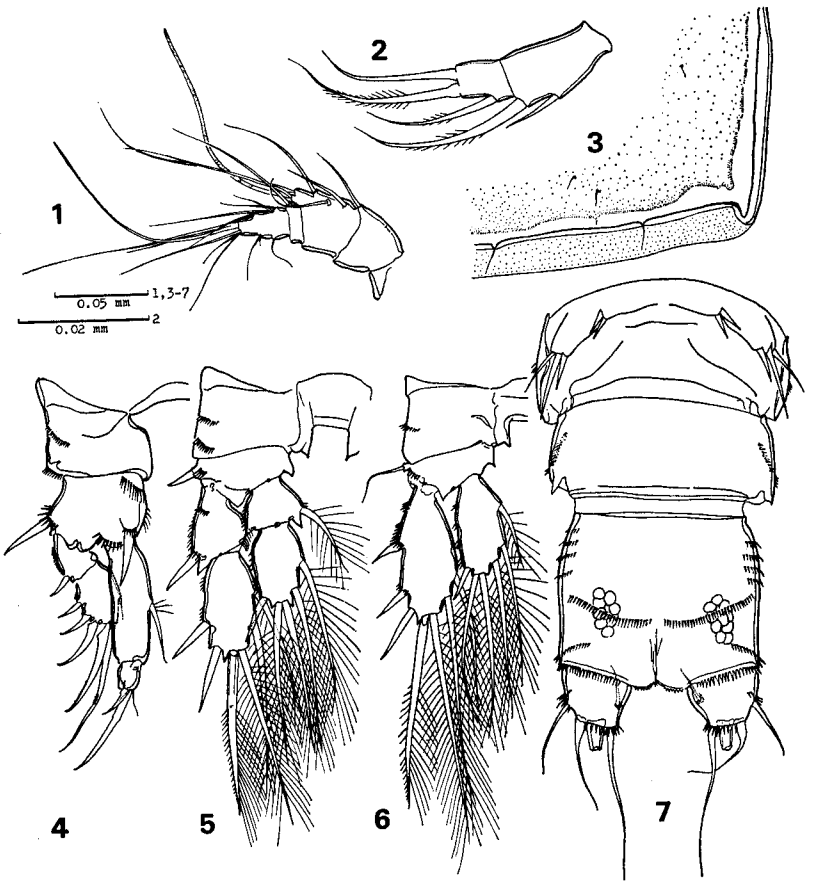

Fig. 23. *Eudactylopus andrewi*. Second copepodid stage. 1. antennule; 2. antennal exopodite; 3. postero-lateral part of cephalothorax; 4. leg 1; 5. leg 2; 6. leg 3; 7. leg 4 and abdomen, ventral.

The third copepodid stage.

Body (Fig. 21–3) about 0.55 mm in length, composed of seven somites. Epimera of first three thoracic somites well differentiated, while that of fourth thoracic somite scarcely developed. Last two abdominal somites nearly as in previous stage. *Antennule* (Fig. 24–1) four-segmented; second segment a little elongated, and much setigerous than in previous stage. Antenna and oral appendages as in previous.

Leg 1 (Fig. 24–2). Left leg in the illustrated specimen is quite abnormal, but right leg is normally differentiated as in other specimens of this stage examined.

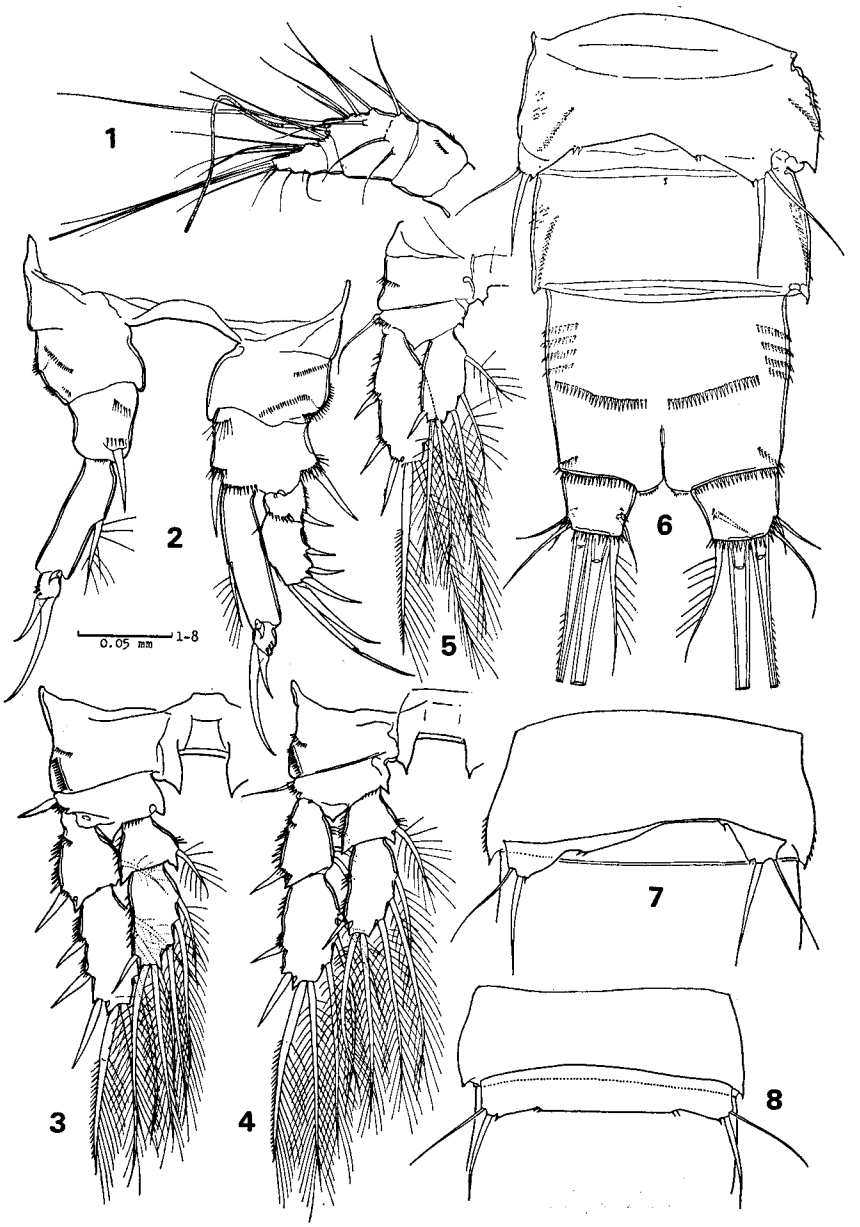

Fig. 24. *Eudactylopus andrewi*. Third copepodid stage. 1. antennule; 2. a pair of leg 1; 3. leg 2; 4. leg 3; 5. leg 4; 6. leg 5 and abdomen, ventral; 7, 8. leg 5 *in situ*.

Coxa with two long spinular rows on anterior surface; outer margin of distal half spinulose. Shape and ornamentation of basis nearly same as in adult. Both rami almost as in previous stage, but rather elongate in whole appearance; one spinular row on anterior surface near distal edge of first exopodite segment; distal segment of exopodite a little elongated. The apical setula on distal end of second endopodite segment was not detected in all the specimens of this stage examined. *Leg 2* (Fig. 24–3). Distal spinular row of coxa arranged nearly longitudinally along outer margin. Both rami two-segmented and with almost same ornamentation as in previous stage except for several additional structures. Exopodite; one inner seta added to first segment; one outer spine and one inner seta added to second. Endopodite; one inner seta added to distal segment. *Leg 3* (Fig. 24–4). Coxa with two spinular rows arranged as in leg 2. Protuberance of inner corner of basis acutely sharpened. Both rami two-segmented. Exopodite much longer than endopodite; first segment widened distally, with one outer spine accompanied with some spinules basally; several hairs along inner margin; second one a little longer than first, with two outer spines, two terminal and three inner marginal setae. Endopodite nearly same as in leg 2. *Leg 4* (Fig. 24–5) almost same as in leg 3 in previous stage in segmentation as well as ornamentation. *Leg 5* (Fig. 24–6) represented by a wide plate fairly concaved midst, forming into a clear lobe at each lateral part; two spinule-like formations on inner base of each lobe, and a spinule, one thick spiniform seta and one slender seta on apex of each lobe. Other two specimens of this stage apparently differ from each other and from the specimen described in their fifth legs. In one of them, the fifth pair of legs are asymmetrical and fairly distorted (Fig. 24–7). In the rest specimen, middle part is never concaved, but straight (Fig. 24–8).

The fourth copepodid stage.

Female. Body (Fig. 21-4) about 0.80 mm in length, composed of eight somites. Ratio of urosome to metasome considerably increased. First and second abdominal somites each with an oblique spinular row on each lateral surface. Ventroposterior edge of second abdominal somite fringed with a number of spinules. Last abdominal somite ornamented almost as in previous stage. *Antennule* (Fig. 25–1) five-segmented; second segment differentiated from proximal part of second segment in previous stage; third segment furnished with one aesthetasc; apical segment demarcated into two parts by a fine groove or suture which is clearly recognized in ventral view.

Leg 1 (Fig. 25–2). Coxa considerably protruded inwards. Basis scarcely differing from that in adult. Ornamentation and shape of both rami nearly identical with those in previous stage. The terminal setula of distal endopodite segment is not detected as in the previous. *Leg 2* (Fig. 25–3). Coxa and basis almost as in previous stage. Exopodite; first segment with several spinules on distal edge of outer half; interspace between proximal two outer spines of distal

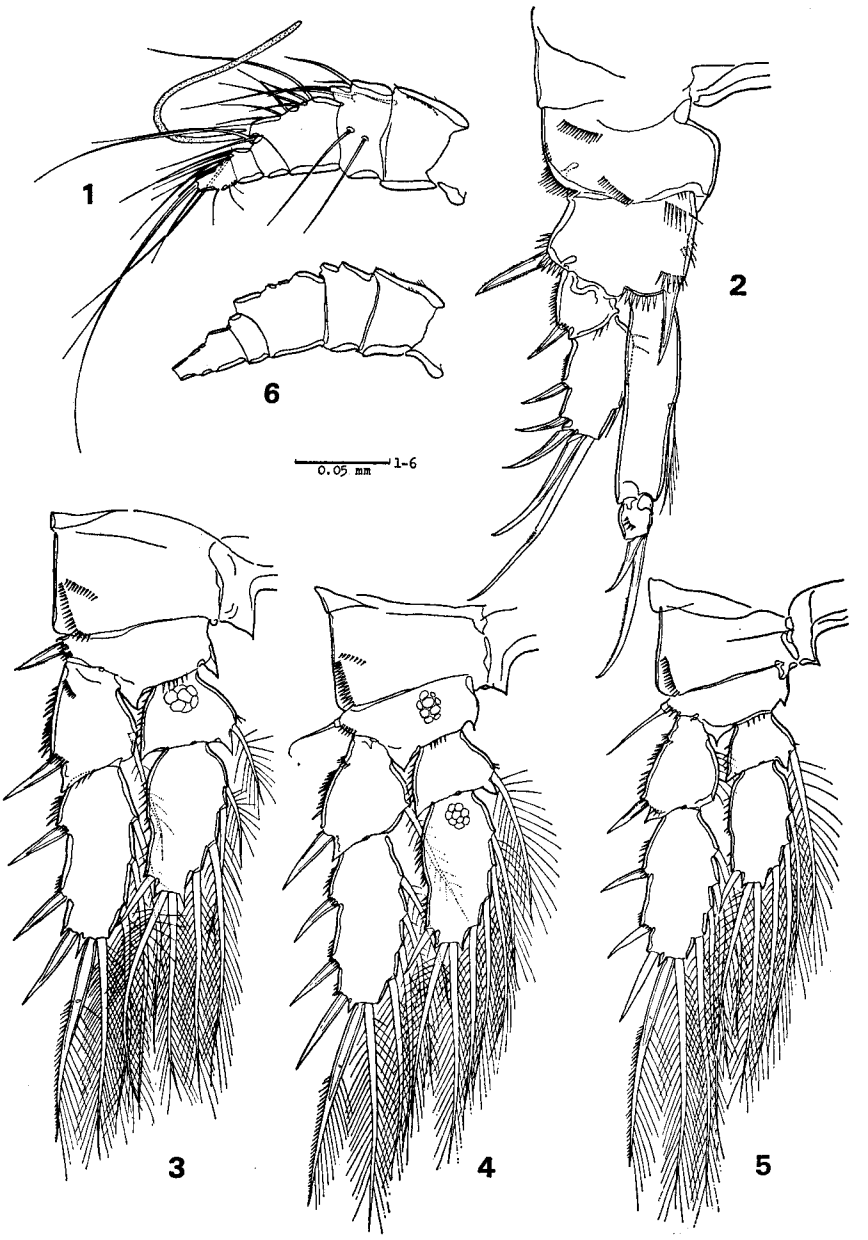

Fig. 25. *Eudactylopus andrewi*. Fourth copepodid stage. Female. 1. antennule; 2. leg 1; 3. leg 2; 4. leg 3; 5. leg 4. Male. 6. antennule, all setae omitted.

segment relatively widened. Second endopodite segment with four inner marginal setae. *Leg 3* (Fig. 25–4). Coxa and basis same as in previous stage. Exopodite; one inner seta added to first segment; one outer spine at about one-third the length and one inner seta added to distal segment. Second endopodite segment with four inner marginal setae instead of three in previous stage. *Leg 4* (Fig. 25–5). Coxa with one nearly longitudinal, spinular row on anterior surface near outer margin. Basis same as in previous stage. Both rami two-segmented. Exopodite much longer than endopodite; first segment ornamented nearly as in leg 3 in previous stage; distal segment about twice as long as first, furnished with three outer spines, two terminal and four inner marginal setae. Endopodite; first segment with one well developed inner seta; second with one outer spine near distal corner, two terminal and three inner marginal setae; both outer margins spinulose. *Leg 5* (Fig. 26–1). A pair of legs represented by a wide, four-lobate, common plate. Inner two and outer two lobes are apparently homologous with the inner expansion of baseoendopodite and the exopodite in adult, respectively. Middle rim between both inner expansions well sclerotized. Inner expansion with one thickset, inner seta about midst, four distal setae, each arising from a small protuberance, of which the outermost is slender, the next is the longest, and the rest two are thickset as in the inner seta above mentioned. Exopodite with four

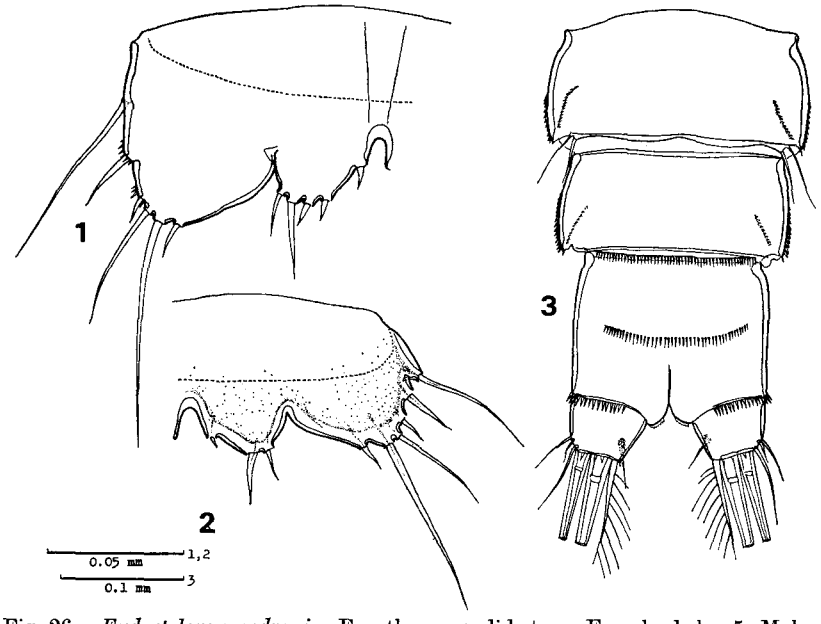

Fig. 26. *Eudactylopus andrewi*. Fourth copepodid stage. Female. 1. leg 5. Male. 2. leg 5; 3. leg 6 and abdomen, ventral.

setae in all, of which outer two are accompanied with several spinules basally, inner three each arises from a small protuberance. One elongate outer seta on a small process at each outer edge, which represents the outer seta of baseoendopodite in adult. *Leg 6* (Fig. 26–3). A pair of legs represented by a very narrow plate along posterior extremity of ventral surface of first abdominal somite. A pair of setae arising from each outer end.

Male. Body length nearly same as in female. *Antennule* (Fig. 25–6). No demarcation on apical segment was detected both dorsally and ventrally. All legs ornamented as in female except for the fifth pair. *Leg 5* (Fig. 26–2) represented by a four-lobate plate as in female, but different in shape and in armature of inner expansion. This plate is rather narrower than in female, particularly in the outer lobes. Inner expansion with one dwarfed setula on middle inner edge, and two relatively longer setulae on distal end. It is clearly recognized that one seta appearing in the next stage is forming inside inner part of outer lobe. In the shape and ornamentation of the sixth pair of legs, no difference was recognized between sexes.

The fifth copepodid stage.

Female. Body (Fig. 21–5) about 1.05 mm in length, composed of nine somites, fairly alike to adult in appearance. First abdominal somite not fused with second. Ventro-posterior edge of each second and third abdominal somite fringed with a number of spinules. Two oblique spinular rows on each lateral surface of second abdominal somite, while one such row in third abdominal somite. Anal somite a little longer than preceding somite, with a long transverse spinular row on ventral surface and several short spinular rows on both lateral surfaces. Rostrum (Fig. 27–2) with conspicuous, keel-shaped formation at distal part of ventral surface. *Antennule* (Fig. 27–1) seven-segmented as in adult; third and fourth segments apparently differentiated from third segment in previous stage, and apical two derived from fifth segment slightly demarcated.

Leg 1 (Fig. 27–3) nearly same as in adult, except for thickset appearance, and both rami of course three-segmented. The terminal setula of the last endopodite segment is clearly recognized. *Leg 2*, *leg 3* and *leg 4* not so differ from those in adult. *Leg 5* (Fig. 27–4) fairly expanded in appearance. Both legs completely separated together, but closely met together along inner margin of baseoendopodite. Setal number in both rami exactly identical with in adult. Outer margin of inner expansion of baseoendopodite fringed with many delicate hairs or spinules. Exopodite not separated from baseoendopodite, partially covered with outer part of inner-expansion; inner part conspicuously protruded inwards, forming into a clear corner. Inner seta of baseoendopodite apparently separate far from distal one. Outer process of baseoendopodite well developed. *Leg 6* (Fig. 27–5). Each leg represented by a small protuberance with three dwarfed setulae.

Male. Body length little shorter than in female. Abdominal segmentation

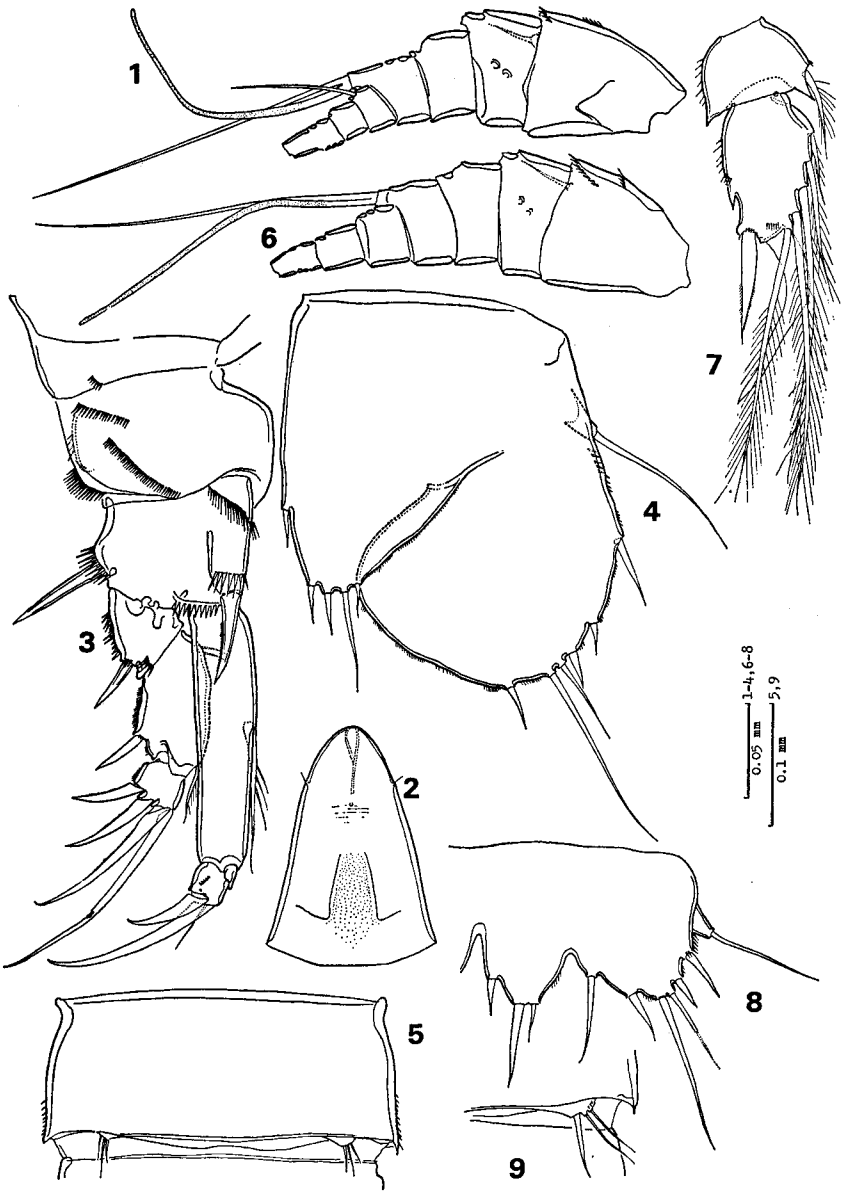

Fig. 27. *Eudactylopus andrewi*. Fifth copepodid stage. Female. 1. antennule; 2. rostrum; 3. leg 1; 4. leg 5; 5. leg 6 *in situ*. Male. 6. antennule; 7. endopodite of leg 2; 8. leg 5; 9. leg 6 *in situ*.

and ornamentation same as in female, except for sixth pair of legs. *Antennule* (Fig. 27–6) seven-segmented as in female; fifth and sixth segments slightly elongate.

First four legs ornamented as in female, except for endopodite of second pair of legs. *Leg 2* (Fig. 27–7). Endopodite two-segmented; proximal segment same as in female; distal one almost twice as long as first, forming into a spur-shaped protuberance at two-thirds the length of outer margin, with one thickset, finely ciliate spine on outer distal corner, one strikingly strong, arched claw on rather inclined distal end and one longer, hairy seta at inner base of former claw, and with four inner marginal hairy setae, of which proximal two are apparently shorter than others; several spinules along outer margin, base of outer spine, and on anterior surface near base of distal claw. *Leg 5* (Fig. 27–8) very alike to that in adult, but innermost seta of exopodite not so developed. *Leg 6* (Fig. 27–9) remarkably bigger than that in female.

Discussion. It is very curious that the apical segment of antennal exopodite is furnished with four bare setae on its distal end in the first copeopdid stage, and those four setae, probably together with the short distalmost part of the segment, are transformed into only one bare seta in the second stage as in the adult. At the first glance, an anxiety that these specimens of exactly the first copepodid stage were not of *E. andrewi* but of other species or even of other genus came to my mind. But, after closer examination, some conspicuous *traubenförmig* formations which had been reported exclusively in *E. andrewi* by Vervoort (1964) were apparently recognized in their bodies. Further, other instances that the apical ornamentation of antennal exopodite is transformed, though they are rather slight than in the present, were already known in different genera, *Tigriopus* and *Harpacticus* (Itô, 1970; 1971). The present first copepodids, therefore, were regarded as of *E. andrewi*.

Whole antennular formation process from the three-segmented antennule in the first copepodid stage to seven-segmented in the last stage was clarified in the present study. That the antennule of the fifth copepodid in *E. andrewi* has seven segments as in the adult is precisely recognizable also in the Sewell's paper. Contrary to this, the fifth copepodid female of *E. striatus* Sewell (Swell, 1940) has nine-segmented antennules of which segmentation is the same as in the adult, while the antennules of the fifth copepodid male of *E. fasciatus* Sewell are seven-segmented (Sewell, 1940; Vervoort, 1964). More younger stages of both *E. striatus* and *E. fasciatus* are unknown up to the present. In probability, in those two species and also other species of the genus, *E. andrewi* excluded, the antennular segmentation in the fifth copepodid male seems to be identical with that of the fourth copepodid stage. If this supposition is quite right, such pattern in antennular formation in the male accords with that reported in *Tigriopus*, in which the antennule of the fifth copepodid male persists almost the same segmentation as in the fourth stage while of the fifth copepodid female is fully differentiated same as in the adult (Itô, 1970).

The transformed second leg in the male is very alike to that reported in *E. fasciatus* (Sewell, 1940). The leg of the same species reported by Vervoort, however, differs from the above mentioned specimen reported by Sewell.

In the present species described the shape of the exopodite of the fifth pair of legs in the fifth copepodid female completely agrees with that reported by Sewell. Both specimens show that the conspicuously cornered inner margin appears already in this stage. The significance of the peculiar shape of the exopodite in the adult female of *E. andrewi* is apparently supported also from this fact in the fifth copepodid stage.

***Protolatiremus* n. gen.**

The present new genus apparently belongs to the family Thalestridae, though in several respects it has clear relation to the genus *Latiremus* reported by Bozic (1969) who proposed the family Latiremidae for the species. The generic character for this new genus is represented by a sole new species as the type-species described below.

The generic name reflects the primitive situation on the lineage from certain genus or genera in the family Thalestridae to the family Latiremidae with the much modified species, *Latiremus eximius*, highly advanced into interstitial habitat.

***Protolatiremus sakaguchii* n. gen. et n. sp.**

(Figs. 28~32)

Female. Body (Fig. 28–1) about 0.72 mm in length, rostrum and furcal setae excluded, and about 3.5 times as long as greatest width. Constriction between metasome and urosome obscure. Metasome fairly longer and wider than urosome which is gradually tapering behind and slightly depressed dorso-ventrally. Rostrum (Fig. 29–1) scarcely detected in dorsal aspect *in situ*, small, triangular, and with a pair of sensilae. Cephalothorax about as long as posterior width, less hairy. First two free thoracic somites each posteriorly furnished with a very thin hyaline frill (Fig. 28–2) which is conspicuously serrate along free edge and with several hairs each arising from a tubular formation near base of hyaline frill. Genital double-somite with no demarcation of two somites; genital area as shown in figure (Fig. 28–4) and one hairy and two bare setae arising from a sclerotized part on each lateral extremity of genital area; two parallel rows of delicate spinules on lateral surface near anterior edge; one transverse spinular row and two setulae on lateral surface near base of hyaline membrane along posterior end (Fig. 28–3). Antepenultimate somite (Figs. 28–3, 5, 6) furnished with an arched row of some spinules on each lateral surface of anterior part, a transverse row of a number of delicate spinules on anterior ventral surface, many rather taller spinules arranged in several succeeding rows together with several hairs along base of hyaline membrane both laterally and ventrally. Penultimate somite ornamented almost as

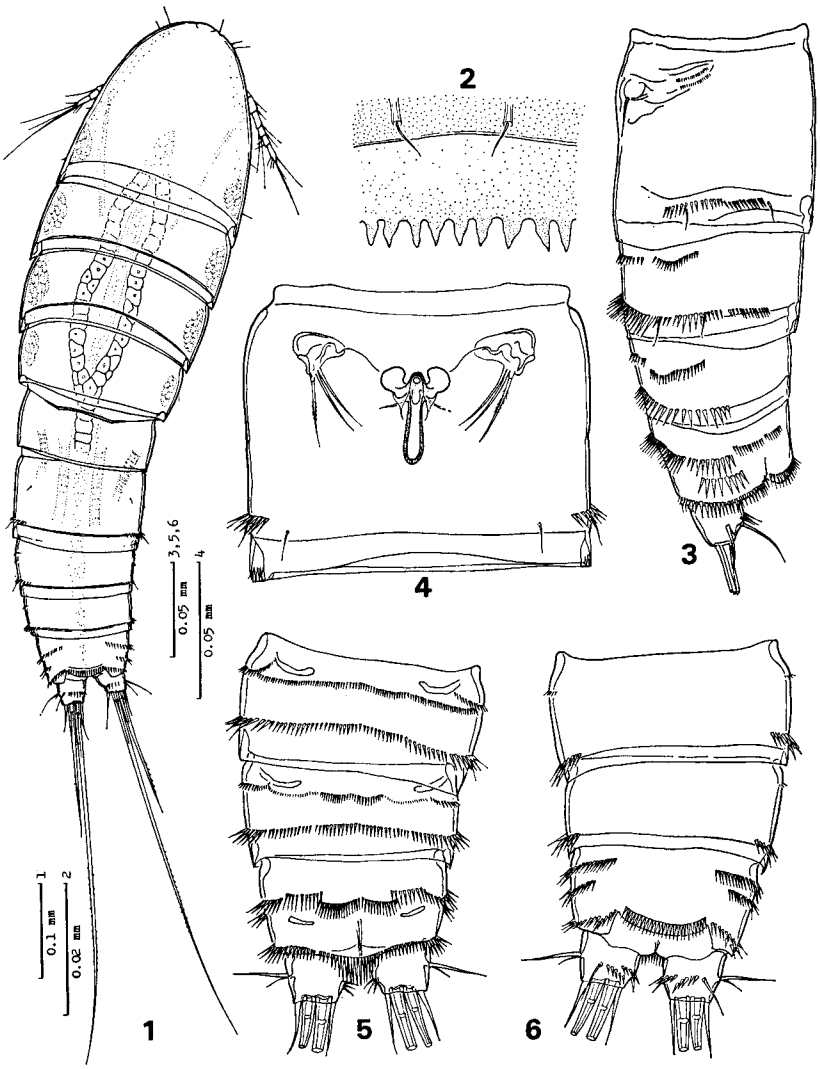

Fig. 28. *Protolatiremus sakaguchii* n. g. et n. sp. Female. 1. dorsal view; 2. posterior part of epimeron of first free thoracic somite; 3. abdomen, lateral; 4. genital double-somite, ventral; 5. abdomen, ventral; 6. abdomen, dorsal.

in previous somite, but without hairs. Anal somite of quite spinulose appearance; each lateral surface with a pair of parallel rows consisting of some thick spinules; about middle ventral surface with several spinular rows arranged roughly into a transverse row; posterior end fringed with a number of spinules laterally and

ventrally, in which some spinules on mid ventral end are fairly elongate; anal operculum slightly rounded, with many spinules in parallel with free end. Furcal ramus (Figs. 28–5, 6) apparently shorter than basal width, with well developed principal terminal setae; a pair of setae, one of which is much dwarfed, on middle outer edge; several spinules arising from base of one dorsal seta, which is geniculate basally, to inner edge; one seta on each side of principal terminal setae.

Antennule (Fig. 29–1) nine-segmented; first segment with many spinules on anterior edge and one spinulose seta on anterior distal corner; second one about as long as first, with many bare setae and several hairy setae; fourth one furnished with one aesthetasc on anterior distal end; distal five segments more slender than others; sixth one much longer than fifth; seventh and eighth ones small, of almost equal length; last one about as long as preceding two segments combined, furnished with one small aesthetasc. *Antenna* (Fig. 29–2). Coxa very short, with no particular ornamentation. Basis about as long as wide, with two groups of several spinules on anterior edge and one spinulose seta on anterior distal end. Exopodite distinctly two-segmented; first segment fairly thickened distally, with two spinulose setae on and near distal end; second segment a little shorter than first, with two spinulose setae of equal length marginally, and one bare, slender seta and one thickset, finely ciliate seta on distal end, and a spinule-like protuberance near distal end. Endopodite composed of two segments; proximal segment about twice as long as basis, with one spinulose seta, which is quite alike to the spinulose seta on basis in the appearance, at one-third the length of anterior edge; distal segment about as long as preceding one, slightly thickened distally, with two lateral claws, distal one of which is accompanied with a pair of parallel bare setulae near base, five geniculate elongate spines and two bare setae, one of which is probably a basal branch of the former geniculate spine, and many spinules along anterior margin. *Mandible* (Fig. 29–3). Praecoxa with some spinules near base of coxa-basis, and furnished with tridentate pars incisiva (Fig. 29–4), indistinctly tridentate lacinia, at least three, apically more or less serrate spines and one spinulose spine accompanied with several spinules basally along cutting edge; pars molaris well developed. Coxa-basis much widened distally, clearly inclined inwards, with an arched row of several taller spinules near middle outer edge, three spinulose setae on inner distal end, one of which is strikingly developed; several spinules arranged in a row traversing with distal part and extending to dorsal rim. Exopodite four-segmented; first segment longest, about as long as distal three combined, with one hairy seta on inner distal end; second one without seta; third with one hairy seta; last one with two setae apically. Endopodite a little longer than four exopodite segments combined, with two setae at one-third the length of inner edge, three pairs of two close setae on distal end and one small seta on inner distal corner, and several spinules on distal half of inner margin. *Maxillula* (Fig. 29–5). Praecoxa with some rigid spinules on outer rim, arthrite furnished with six, more or less spinulose claws and two spinulose setae on inner end, two parallel setae on surface, and an arched spinular row on outer dorsal part of

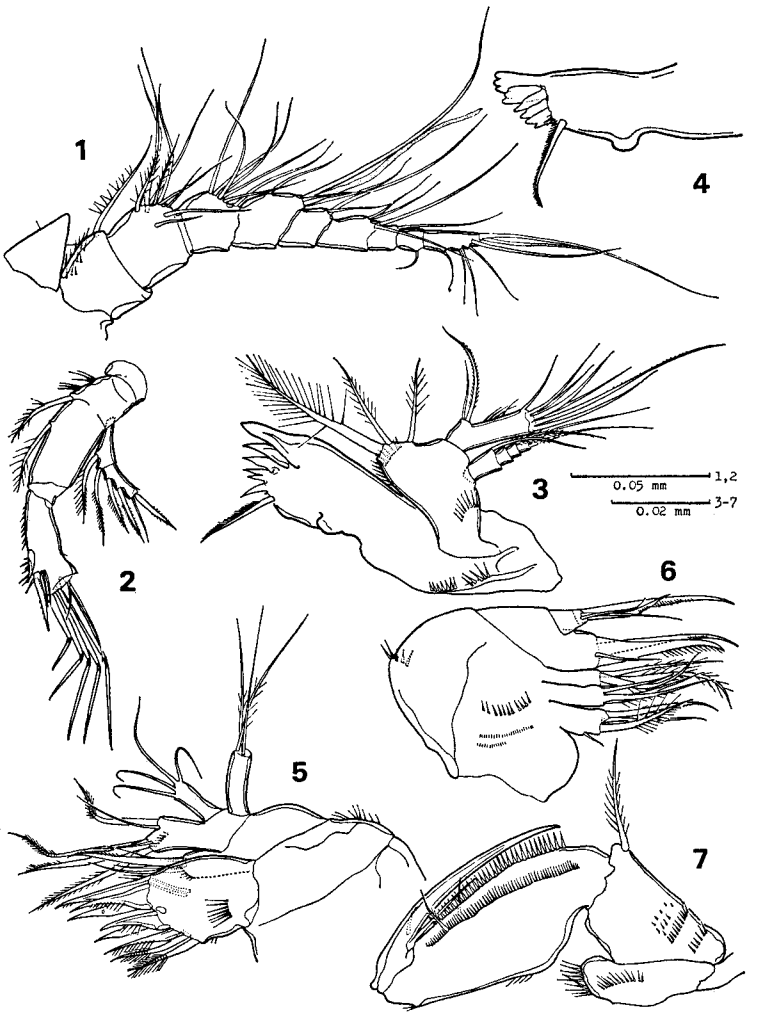

Fig. 29. *Protolatiremus sakaguchii* n. g. et n. sp. Female. 1. rostrum and antennule; 2. antenna; 3. mandible; 4. mandibular praecoxa; 5. maxillula; 6. maxilla; 7. maxillipede.

surface, and several spinules on dorsal edge near inner end. Distal end of inner process of coxa slightly exceeding middle edge of arthrite of praecoxa, furnished with one spinulose thick seta and three bare, slender setae; several spinules on dorsal edge near inner end. Distal end of basis nearly reaching to inner end of arthrite of praecoxa, with one spinulose, thick seta and one bare, slender seta on ventral edge, one bare and three spinulose setae on inner extremity; an oblique spinular

row near inner end. Exopodite represented by a cylindrical segment, ornamented with three, less hairy setae apically. Endopodite a little shorter than exopodite, inclined inwards, with four bare setae. *Maxilla* (Fig. 29–6). Syncoxa with three transverse spinular rows, of which the ventralmost one is composed of much longer spinules than the rest, several spinules near outer rim, and furnished with three endites; proximal endite slightly thicker than others, with three more or less spinulose setae on apex and a setula on middle ventral edge; ventral two endites, each with three spinulose or hairy setae. Basis forming into a strong, pectinate claw accompanied with one bare seta and one elongate spine. Endopodite represented by a small segment with two elongate spines and two bare, slender setae. *Maxillipede* (Fig. 29–7). Coxa very short, protruded outwards, with one transverse spinular row; outer edge spinulose. Basis with two spinular rows and several scattering spinules; one spinulose seta arising from inner edge near distal end. First endopodite segment much longer than basal two combined, with two setae at about two-thirds the length of spinulose inner margin, one long spinular row nearly parallel with inner margin, several spinules on mid outer edge and on distal outer edge. Second endopodite segment forming into a strong, elongate claw accompanied with one straight, elongate seta on inner base and one setula.

Leg 1 (Fig. 30–1). Coxa fairly widened outwards; anterior surface with two slightly arched spinular rows, each situating near proximal end and near middle distal edge, two transverse rows of some delicate spinules, each on inner part near base and along inner distal edge, one row composed of taller spinules arising from middle outer edge inwards; several spinules on and near outer distal corner, and on posterior surface near middle outer edge. Basis much smaller than coxa; inner margin clearly inclined and outer margin conspicuously incurved; one short oblique spinular row on anterior surface near middle basal edge; outer spine strong, accompanied with several rigid spinules basally; a spinular row arising from outer edge near inner base of exopodite to anterior distal edge near inner base of endopodite; inner distal corner with one spine accompanied with an oblique spinular row near base; several hairs on about middle inner margin; some spinules on inner basal corner. Exopodite three-segmented; first segment slightly thickened distally, with one bare outer spine, some rigid spinules along outer margin and on anterior surface near distal edge; second one 1.3 times as long as first, with several spinules along outer margin, one remarkably spinulose outer spine on distal corner, and one hairy, elongate seta near inner distal corner; third one much shorter than previous two, with one bare setula (slender spine?) on proximal outer edge, three spines, middle one of which is non-geniculate and other two clearly geniculate, on outer distal edge, and one strikingly elongate spine which is much longer than three exopodite segments combined and arises from inner distal end. Endopodite rather slender in appearance, arising from middle distal end of basis; first segment longest, about as long as three exopodite segments combined, furnished with one hairy, elongate seta at middle inner edge, and several spinules on both margins of proximal half; second segment very small and bare; third one as long as second,

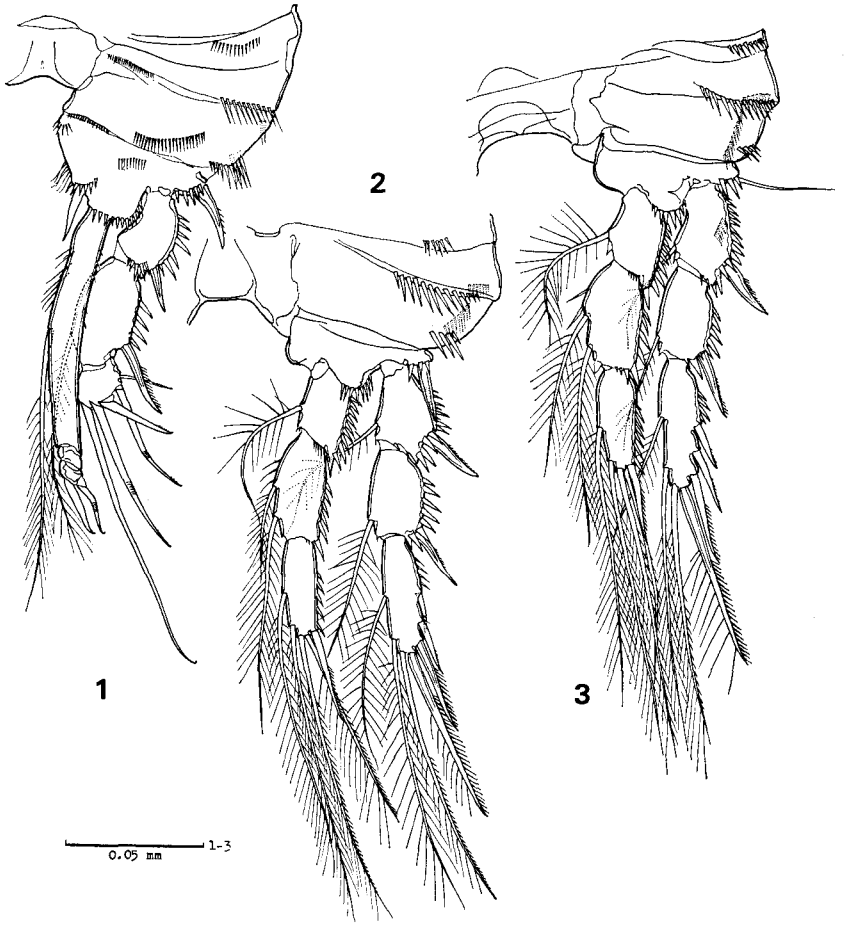

Fig. 30. *Protolatiremus sakaguchii* n. g. et n. sp. Female. 1. leg 1; 2. leg 2; 3. leg 3.

with two terminal spines of almost equal length, outer one of which is geniculate and the other non-geniculate. *Leg 2* (Fig. 30–2). Coxa much wider than long; anterior surface with three transverse spinular rows, proximal one of which is composed of several spinules and short, middle one is the longest, composed of many taller spinules, and distal one is composed of several thick spinules, attaching to outer distal corner; posterior surface with two rather short rows of some slender spinules, each running transversely and rather longitudinally. Basis much smaller than coxa, remarkably lowered at outer one-third the width; inner distal rim fairly cornered; middle distal part near outer base of endopodite slightly protruded and spinulose; outer spine strong, accompanied with several thick, rigid spinules.

Both rami three-segmented, more or less spinulose along each outer margin. Exopodite; first segment slightly widened distally, with one strong outer spine, which is finely ciliate along dorsal rim, on three-fourths the length and one hairy inner seta on nearly same level of outer spine; second segment as long as first, with one outer spine arising on distal corner and one hairy inner seta; third one a little longer and slender than preceding segment, with three outer spines, of which the distalmost one is the longest and clearly spinulose, of rather pectinate appearance, one elongate spine which is spinulose outwards and hairy inwards, and one seta, which is fringed with many delicate spinules outwards and hairy inwards, on distal end, and with two inner setae, proximal one arising from about middle edge and other one fairly approaching distal end. Endopodite a little shorter than exopodite; first segment forming into a spur-shaped protuberance at outer distal corner, with one hairy seta at about two-thirds the length of inner margin, and several slender spinules along outer half of anterior distal edge; second one longer than first, slightly swelling inwards, with two hairy inner setae on distal half, and several slender spinules on inner margin; third one a little smaller than preceding segment, with one spine on outer distal corner, two terminal setae, both finely spinulose outwards and hairy inwards, and two hairy inner setae. *Leg 3* (Fig. 30–3). Setal and spinal ornamentation of all segments nearly alike to that described in leg 2, except for basis which is furnished with one bare outer seta instead of spine. First exopodite segment with an oblique spinular row on middle posterior surface near outer edge. *Leg 4* (Fig. 31–1). Basal two segments apparently smaller than in previous leg. Posterior surface of coxa with a slightly arched, spinular row on outer part rather distally. Exopodite segment much longer than endopodite. First two exopodite segments ornamented as in leg 3. Third exopodite segment fairly elongate, with three outer spines as in preceding leg, while the proximal one out of two inner setae is much dwarfed, and apparently approached the distal one and is furnished with some hooky spinules along inner rim of distal half, and the terminal two as well as the inner distal one are strikingly elongate. Endopodite ornamented as in previous leg except for middle segment which is furnished with only one inner seta instead of two. *Leg 5* (Fig. 31–2). Baseoendopodite wider than long, less spinulose on rather straight inner margin, with one slender, elongate seta on a short cylindrical process on outer extremity accompanied with several spinules near base of process; distal end of inner expansion reaching to half level of exopodite segment; four parallel, spiniform setae which are remarkably spinulose on both sides, two of which arise from distal end, and other three arise from inner edge; interspace between distalmost inner seta and inner one out of two distal setae fairly widened, and with some slender spinules; five rigid spinules on anterior surface near distal two setae, apparently forming into a transverse row; outer margin of inner expansion less spinulose. Exopodite almost oval in shape, with one spinulose seta at about three-fourths the length of inner margin, one bare elongate seta on distal end, and four setae on distal half of outer margin, middle two of which are finely spinulose and the rest bare; proximal

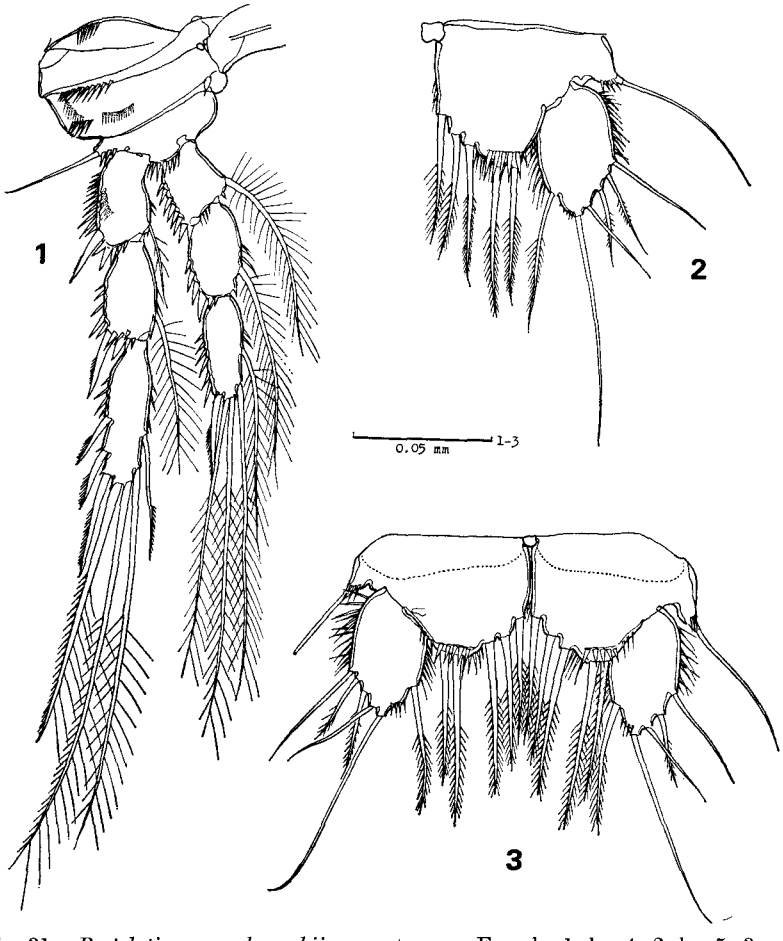

Fig. 31. *Protolatiremus sakaguchii* n. g. et n. sp. Female. 1. leg 4; 2. leg 5; 3. a pair of leg 5.

half of inner margin fringed with some slender spinules, and several minor spinules on inner distal part; many roughly arranged spinules along proximal half of outer margin.

Male. Body (Fig. 32–1) about 0.55 mm in length. Cephalothorax about as long as two succeeding free thoracic somites combined. Metasome much longer and wider than urosome. Abdomen (Fig. 32–6) gradually tapering behind; first somite nearly bare, but several minor spinules on lateral surface near posterior end; second one posteriorly furnished with a circumscribing spinular row, in which several spinules of ventro-lateral part are much taller and thicker than others;

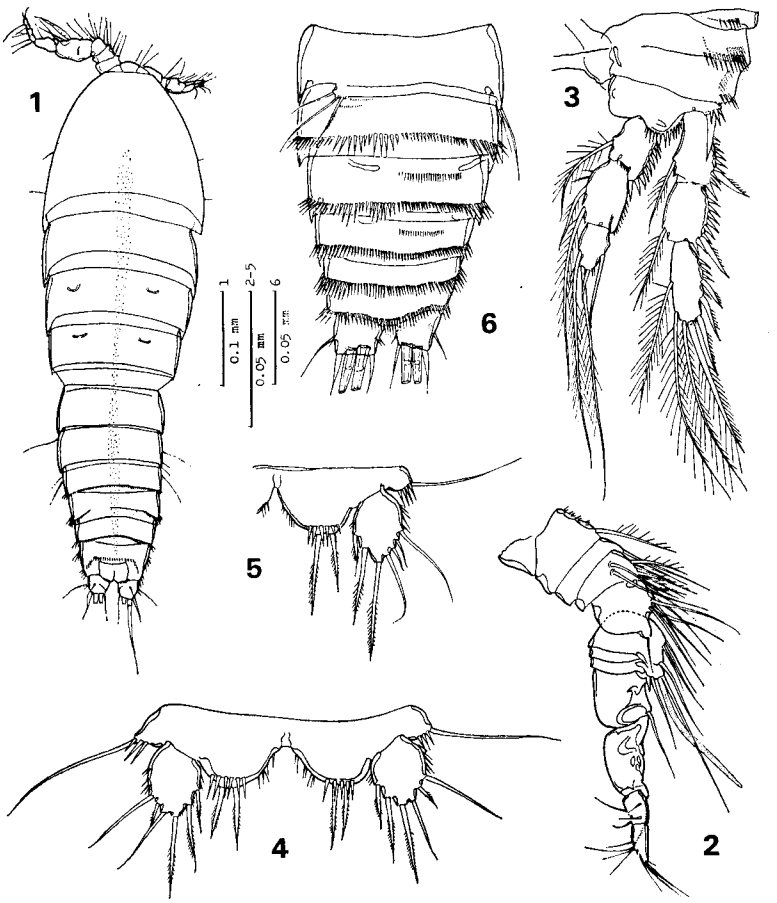

Fig. 32. *Protolatiremus sakaguchii* n. g. et n. sp. Male. 1. dorsal view; 2. antennule; 3. leg 2; 4. a pair of leg 5; 5. leg 5; 6. leg 6 and abdomen, ventral.

such spinular row of each third and fourth somite interrupted dorsally, and other short spinular row attached each ventral surface rather anteriorly; anal somite furnished with one transverse spinular row ventrally and laterally, and other spinular row arising near posterior end of ventral surface extending dorsally from both sides, to just anterior part of anal operculum. Furcal ramus ornamented as in female. *Antennule* (Fig. 32–2) haplocer, of fairly complicate articulation as shown in figures; first segment spinulose along whole anterior edge, and with one spinulose seta; second one very short, and with only one bare seta on a small protuberance at anterior distal edge; third one with some spinulose and bare

setae; first segment largest, apparently articulated into four parts, with one thick aesthetasc on a short cylindrical process at mid anterior edge. *Antenna, oral appendages, leg 1, leg 3* and *leg 4* same as in female except for relative size.

Leg 2 (Fig. 32–3). Basal two segments and exopodite ornamented as in female, but fairly weak in appearance. Endopodite segment much shortened, due to remarkable atrophy in distal segments; outer distal part of second segment forming into a slightly rounded corner, and some minor spinules along outer margin; third one small, a little protruded at one-third the length of outer margin, one slender spine on just distal edge of protruding part, one short spine and one long hairy seta on distal end, and one hairy inner seta on about same level of outer spine, and several spinules on outer distal corner. *Leg 5* (Fig. 32–4). Both baseoendopodite segments confluent together at inner part, but slightly discernible by an obscure groove; inner expansion not so developed, but forming a fairly sclerotized rim, with a pair of spinulose spiniform setae on distal end, several slender spinules on inner edge, six and five rigid spinules on anterior surface near distal end, in right leg and left leg respectively. Exopodite rather oval in shape, but not so elongated, with two spinulose inner setae, one spinulose terminal seta, and three outer setae, of which middle one is the shortest and spinulose or hairy while others are bare. *Leg 6* (Fig. 32–6). A pair of legs represented by a narrow plate with one hairy and two bare setae on each outer extremity.

Variability. In five females and two males examined, the spinular row on anterior surface near distal end of baseoendopodite in the fifth pair of legs consisted of five or six rigid spinules. One female showed an abnormal ornamentation in the left exopodite of the fifth pair of legs. The segment is lacking one spinulose seta (Fig. 31–3). On the other hand, in one male out of two, the left exopodite of leg 5 (Fig. 32–5) was furnished with two bare setulae between two longer outer setae, while of the right leg was the same as in the specimen described.

Remarks. The present new form belongs to the family Thalestridae without doubt, judging from the segmentation as well as principal ornamentation of the first pair of legs and some other characters. The shape and ornamentation of slightly deformed, three-segmented endopodite in the male, however, is quite unique in the family. This new form shows certain resembrance in several respects to the species within the genus *Rhynchothalestris* Sars, particularly in the nine-segmented antennule in the female, the antenna with basis, the last exopodite segment in leg 2, leg 3 and leg 4 with three outer spines, the setal number of inner expansion of baseoendopodite of leg 5 in the female, etc.

On the other hand, noteworthy resembrance in several characteristics is recognized between the present new species and *Latiremus eximius* Bozic 1969 of the family Latiremidae Bozic. At first, I would like to stress that both species are of the same ecological habit as marine interstitial dwellers. Although *Latiremus eximius* has a strikingly impressive characteristic as clear deformation in the fourth pair of legs in the male, the species by Bozic is much alike to the present new species in the antenna with basis, the ornamentation and shape of the maxillipede,

the first pair of legs except for the endopodite, and the three-segmented rami of leg 2, leg 3 and leg 4 in both sexes. There is no difference in the ornamentation of antennal basis and first endopodite segment between these two species, and further, the one-segmented antennal exopodite in *Latiremus eximius* is quite alike to that in the present species, if it lacks the bare apical seta and demarcation between two segments in the latter species. The shape of apical spiniform seta of antennal exopodite completely agrees each other, even in the nature of narrow base. The antennule of *L. eximius* is eight-segmented while it is nine-segmented in the present. Nevertheless the former species has an apparently hairy seta on the first segment rather common with the present species which has the spinulose seta. The presence of such spinulose or hairy seta on antennular segment is fairly unique in this family.

The spiniform setae or elongate spines on the apical segment in the first pair of legs in *L. eximius* primarily made me imagine a close analogy with those of other several genera, *Itunella*, *Orthopsyllus*, *Delamarella*, etc. Such remarkable elongation of the apical spines or setae is a rather common phenomenon among interstitial forms, such as the species within the family Cylindropsyllidae, as well as several other crawling forms. This tendancy for certain adaptive character against interstitial habitat is apparently recognizable also in the present new species.

Besides the present species, the most related form to the genus *Latiremus* is represented by several species of the genus *Delamarella* Chappuis (*D. arenarida* Chappuis 1953, *D. karamani* Petkovski 1957, *D. galateae* Cottarelli 1971), which were all reported exclusively from interstitial habitats. The species within the genus *Delamarella* have highly degenerated characteristics, though the exopodite of the fourth pair of legs in the male is certainly deformed into the same manner as in *Latiremus eximius*. Conspicuous tendancy for reduction in the setal or spinal number and also in the articulation of certain legs has been already known among so many species dwelling in interstitial habitat, for example, all the species of the genus *Psammastacus* Nicholls seem to be the most extreme case in the family Cylindropsyllidae. Therefore a rough evolutional line arising from *Protolatiremus* to *Latiremus* and further to *Delamarella* is supposable with special reference to the degeneration, probably adaptive for the habitat, in their ornamentation and articulation of appendages, nevertheless it is slightly dubious whether they are in a completely linear phylogenetical relation.

Syntypes. Seven females and two males collected from a sandy beath of Daikokujima Islet, Akkeshi (3–XII–'71, Sakaguchi leg.).

Diosaccus ezoensis n. sp.

(Figs. 33～36)

Female. Body (Figs. 33–1, 2) about 1.44 mm in length, rostrum and furcal setae excluded, tinctured with bright yellow on whole surface. Nauplius eye

conspicuous. Metasome much longer than urosome. Greatest width as well as greatest height localized at middle part of cephalothorax, and thorax and abdomen gradually tapering behind. Rostrum (Fig. 34–1) with round apex, not bent down in its attachment but immediately projecting ahead, forming smooth outline with cephalothorax in lateral view, furnished with a pair of sensilae marginally, and three pairs of delicate hairs, each arising from a minor pit on dorsal surface. Cephalothorax fairly longer than three succeeding free thoracic somites combined, with very smooth surface; small bright, pearl-white gland-like formations recognized in both lateral part of anterior half. First three thoracic somites robustly built in appearance; each epimeron scarcely protruded behind at postero-lateral corner; fourth thoracic somite depressed dorso-ventrally. Abdomen (Figs. 33–3, 4) nearly flat ventrally, therefore giving rather semicircular appearance in cross section. Genital double-somite subdivided into two parts by a clear transverse suture arising from dorsal part, ending at both lateral edges, with less number of hairs dorsally or laterally; a pair of slender bare setae on a small protuberance attached onto ventral surface at both antero-lateral extremities of genital area. Antepenultimate somite furnished with a pair of minor tubular formations, each on middle

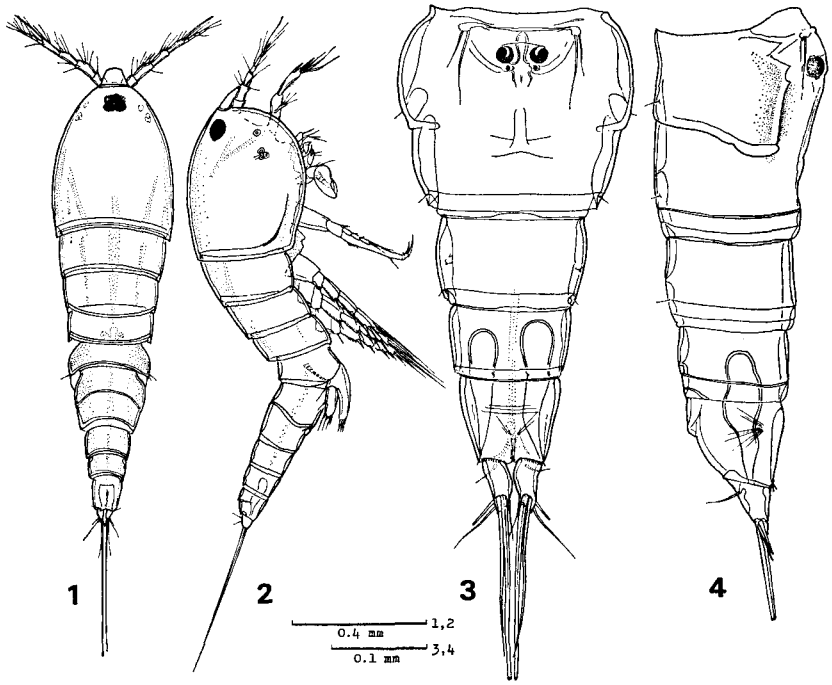

Fig. 33. *Diosaccus ezoensis* n. sp. Female. 1. dorsal view; 2. lateral view; 3. abdomen, ventral; 4. abdomen, lateral.

ventral surface near lateral edge, and several hairs near posterior edge laterally or dorsally. Penultimate somite a little shorter than preceding somite, with no particular ornamentation. A pair of elongate pouchs were detected through the last two somites. They seemingly consist of very thin tissue, and open at each outer lateral end of anal somite near outer base of furcal ramus. Anal somite a little longer than preceding somite, slender, greatest width not attaining even half width of genital double-somite, furnished with some minor spinules on ventro-posterior edge; anal operculum slightly rounded. Furcal rami closely meeting together, rather small, much longer than wide; principal terminal setae deeply inserted; a pair of bare setae arising from lateral edge near distal end; one very slender seta on inner distal corner; one short seta on dorsal edge near anterior extremity.

Antennule (Fig. 34–1) eight-segmented, fairly slender in appearance, and with rather shorter bare setae; first segment short, with one anterior seta; second one about twice as long as first, with many setae both dorsally and anteriorly; third one about as long as second, but slender; fourth one fairly produced at antero-distal part with one aesthetasc; last four segments remarkably slender and short; fifth segment shortest, with only one seta on antero-distal end; sixth one longer than preceding, with two setae anteriorly; seventh slightly shorter than sixth, with one dorsal and two posterior setae; last one longer than preceding, with a small aesthetasc apically. *Antenna* (Fig. 34–2). Coxa short and bare. Basis about twice as long as diameter. Exopodite one-segmented, rather cylindrical, about as long as basis, with two hairy setae on distal half, one seta and one bare setula on distal end. First endopodite segment slightly swelling anteriorly, with no particular ornamentation. Second endopodite segment nearly as long as three basal segments combined, rather slender, with a row of many hook-shaped spinules along nearly whole posterior edge, one spine accompanied with a pair of parallel setae, arising from lateral edge at about two-thirds the length, one claw on anterior edge; two longer claws, three geniculate elongate spines and one bare seta on distal end; several, rather flexible spinules on anterior edge of proximal part. *Mandible* (Fig. 34–3). Praecoxa well sclerotized, weakly bipartite at cutting edge; neither pars incisiva nor lacinia differentiated. Coxa-basis arising from outer ventral corner of praecoxa, fairly inclined inwards, furnished with one thick spinulose seta accompanied with several slender spinules basally and one hairy seta, a little longer than former, both on inner distal end. Exopodite small, rather cylindrical, with one hairy thickset seta midst, and two shorter setae apically. Endopodite well developed; proximal half much expanded inwards and with one spinulose short seta and much thick and long, hairy seta; six setae of different lengths on distal end; distal inner margin fringed with some slender spinules. *Maxillula* (Fig. 34–4). Arthrite of praecoxa furnished with two thickset, hairy parallel seta on middle surface, and several more or less spinulose claws and spines along inner edge, of which exact number was not defined. Coxa furnished with only one thickset, plumose seta on inner extremity. Basis well developed, remark-

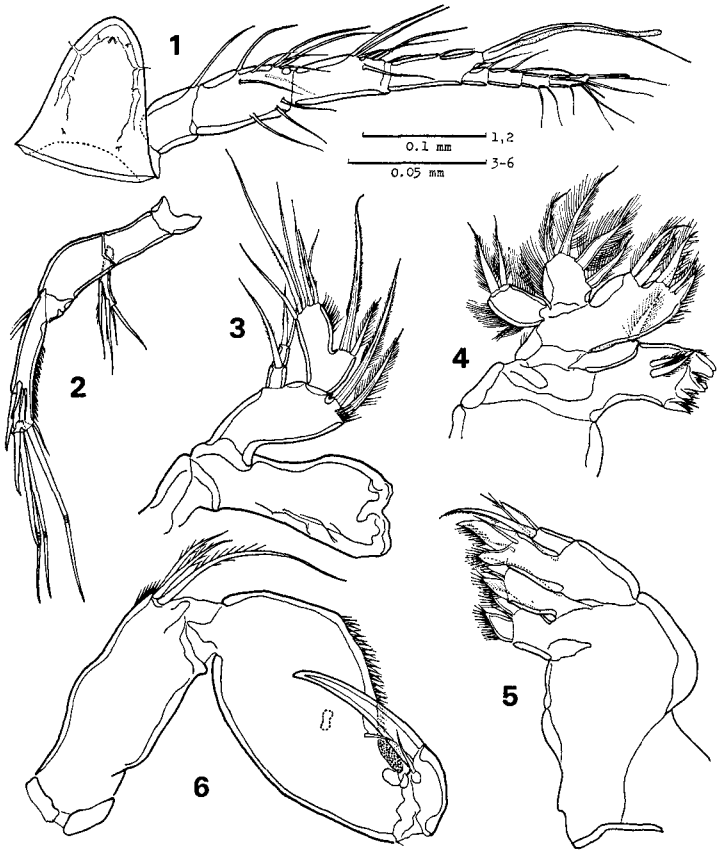

Fig. 34. *Diosaccus ezoensis* n. sp. Female. 1. rostrum and antennule; 2. antenna; 3. mandible; 4. maxillula; 5. maxilla; 6. maxillipede.

ably thickened inwards, with one broad, spinulose seta and one short hairy seta on inner dorsal extremity, one thick plumose seta together with one hairy slender seta arising from inner end, a pair of thickset plumose setae on ventral side, and several spinules on outer rim. Exopodite longer than wide, fringed with many fine hairs along both margins, and with a pair of plumose setae apically. Endopodite with many hairs along outer rim, and four thick plumose setae distally and inwards. *Maxilla* (Fig. 34–5). Syncoxa fairly elongate, remarkably sclerotized at outer distal rim, furnished with two close endites on inner edge of distal part; each endite ornamented with a pair of short, much broadened, spinulose setae on inner end, and one bare setula arising from edge between both setae. Basis forming into a cylindrical process inwards, and furnished with one thickset claw which bears some spinules on and near dorsal edge, two bare setae, each arising

from inner end near base of claw, and one broad, spinulose seta which is nearly alike to those on endite, on dorsal inner corner. Endopodite represented by a short cylindrical process directing inwards, with one thick spinulose seta and two smaller setae apically. *Maxillipede* (Fig. 34–6) well robustly developed. Coxa quite short, with no particular ornamentation. Basis about twice as long as greatest diameter, with three spinulose or hairy setae on inner distal corner, and several spinules near setae. First endopodite segment a little longer than basal two segments combined, about twice as long as greatest width, forming into a screlotized thickening on inner edge near distal end; middle part of inner edge with many spinules roughly arranged; one bare setula at about two-thirds the length, near sclerotized thickening. Second endopodite segment short, but much sclerotized, with one strong, slightly arched claw which is clearly defined basally, and one bare setula arising from a small protuberance near base of claw.

Leg 1 (Fig. 35–1). Coxa almost as long as wide, slightly tapering distally, scattering many delicate hairs on anterior surface near inner distal corner. Basis much smaller than coxa, with one slender hairy seta and several spinules on outer edge, and one thick, ciliate, spiniform seta, accompanied with several spinules basally, on anterior surface near inner distal corner. Exopodite composed of three, rather small segments; all spines very finely ciliate along inner side; first segment with one outer spine near distal end, and some taller spinules along outer margin; second one about as long as first, with one outer spine and one hairy inner seta, fringed with some minute spinules along outer margin, and with some hairs or rather flexible elongate spinules along inner margin; third one smaller than preceding, with two close outer spines on distal corner, one elongate spine and one hairy slender seta on distal end, and with very delicate spinules along outer margin. Endopodite much elongate in appearance; first segment nearly twice as long as three exopodite segments combined, scarcely tapering distally, with some long, rather flexible spinules along inner margin of basal half, and one spiniform inner seta at one-eighth the length; apical two segments small; second one with several spinules on outer edge and one bare setula arising from posterior distal edge near inner corner; last one with two strong claws, both finely ciliate at outside, longer one more than twice as long as other, and one bare setula on distal end, several spinules on outer edge. *Leg 2* (Fig. 35–2). Coxa a little swelling outwards, furnished with a short longitudinal row of several slender spinules on anterior surface near outer edge. Basis forming into an acutely sharpened protuberance on distal edge between both rami, and with one bare outer seta arising from proximal corner. All outer spines of both rami apparently spinulose on both sides. Exopodite; first segment longest, thickened distally, with one outer spine arising from base of a spiniform protuberance of distal corner, many slender long spinules along outer margin and some rather flexible spinules or hairs along inner margin; second one with many minute spinules along outer margin, one outer spine, and one hairy inner seta on middle edge, and several hairs on proximal inner edge; third one a little longer and more slender than preceding segment, with two outer spines, one

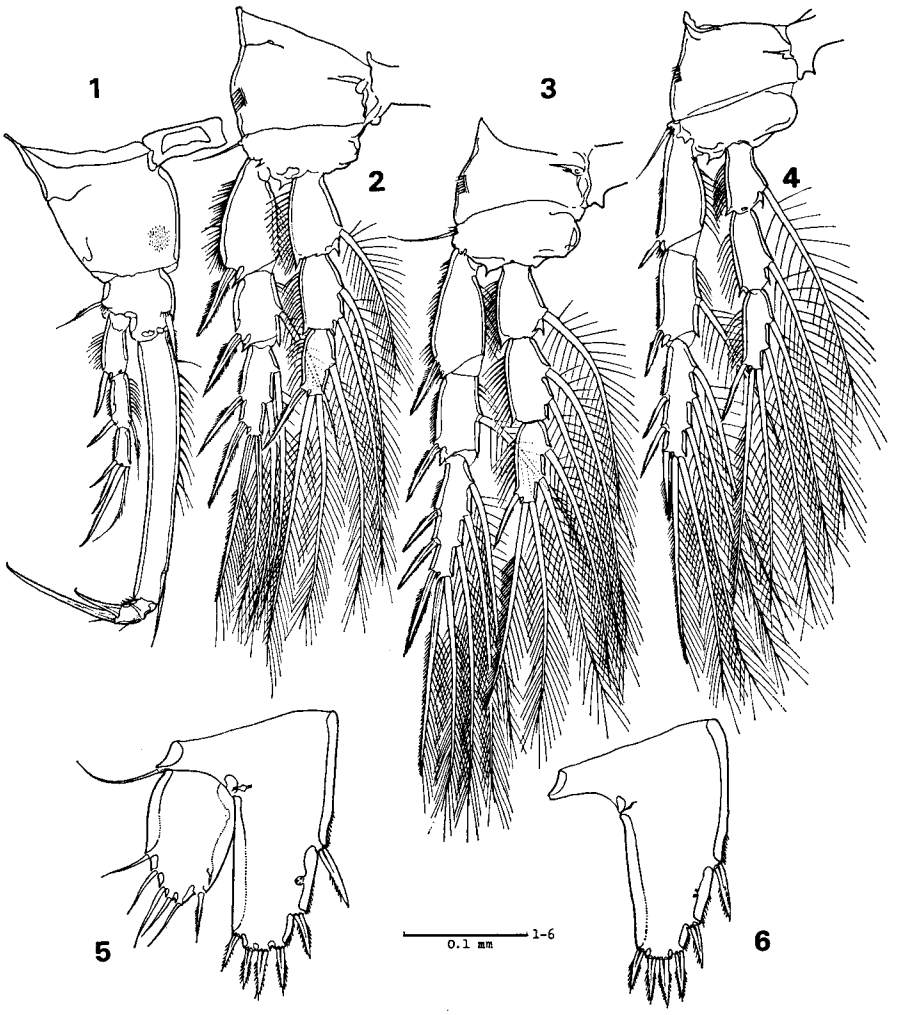

Fig. 35. *Diosaccus ezoensis* n. sp. Female. 1. leg 1; 2. leg 2; 3. leg 3; 4. leg 4. 5. leg 5; 6. leg 5 in another specimen.

elongate spine, which is spinulose outwards and hairy inwards, and one hairy seta on distal end, and two inner setae. Distal end of last endopodite segment reaching to middle of last exopodite segment; first two segments forming into a spur-shaped protuberance on each distal corner; all outer margins of three segments fringed with many long hairs; first segment biggest, with one plumose inner seta; second one with two inner setae on distal half; third one with one spine on outer distal

corner, a pair of terminal setae and one inner seta midst. *Leg 3* (Fig. 35–3). Coxa and basis ornamented nearly as in leg 2, but outer seta of basis apparently accompanied with several spinules basally. Exopodite a little elongate rather than in preceding leg; third segment three spinulose outer spines and three inner setae. Third endopodite segment with two inner setae. *Leg 4* (Fig. 35–4). Coxa and basis nearly as in leg 3. Both rami fairly slender in appearance. Outer spines of exopodite rather dwarfed. Setal and spinal number of exopodite same as in leg 3. Second endopodite segment with only one inner seta near distal corner. Distal end of third endopodite segment scarcely reaching to level of proximal inner seta of last exopodite segment. *Leg 5* (Fig. 35–5). Baseoendopodite fringed with well sclerotized rim, slightly protruded outwards, ending in one bare seta, and with a short but deep groove near inner base of exopodite segment; inner expansion strikingly developed, far exceeding beyond distal end of exopodite segment, rather rectangularly expanded; outer margin quite straight; almost distal half of inner margin spinulose; six more or less serrate spines, of which the proximalmost one arises from middle inner edge and is the longest, the next from inner edge at about five-sixths the length, and other four from on and near distal end. Exopodite rather oval in shape, highly sclerotized, with six setae in total, of which the innermost one is apparently spinulose and arises from fairly distal rim, and all others entirely bare and of almost same length.

Male. Body (Fig. 36–1) about 0.9 mm in length, apparently tapering behind, yellow. Nauplius eye conspicuous. Second and third abdominal somites, each fringed with many spinules along ventral posterior edge. *Antennule* (Fig. 36–2) haplocer. Because of so complicate articulation, exact number of segments was not defined. First segment with several spinules on middle anterior edge; second one about 1.5 times as long as first; one slender aesthetasc arising from third segment; swollen segment with a strong cylindrical process which is ornamented with one thick aesthetasc apically. *Antenna* and *oral appendages* same as in female.

Leg 1. Basis (Fig. 36–3) furnished with one thick truncate process at inner edge near distal end. *Leg 2. Endopodite* (Fig. 36–4) remarkably modified, composed of two segments. First segment with one usual hairy seta on inner distal corner, and with many slender spinules or hairs along outer margin. Second segment represented by a small disk, of which middle outer edge is slightly concaved, furnished with three hairy, shorter setae on inner edge; two close, elongate spines arising from inner distal corner, directing rather outwards; each apical part of both elongate spines apparently hooky; one well developed, plumose seta arising from distal end. *Leg 3* and *leg 4* same as in female. *Leg 5* (Fig. 36–5). Both baseoendopodites completely confluent, each inner expansion rather triangularly protruded, and furnished with two parallel strong spines, each serrate at both sides, on distal end; outer seta slender and bare. Exopodite nearly confluent with basal segment, but an obscure demarcation is recognized at inner half; distal end reaching to level of distal end of inner expansion, and with one consider-

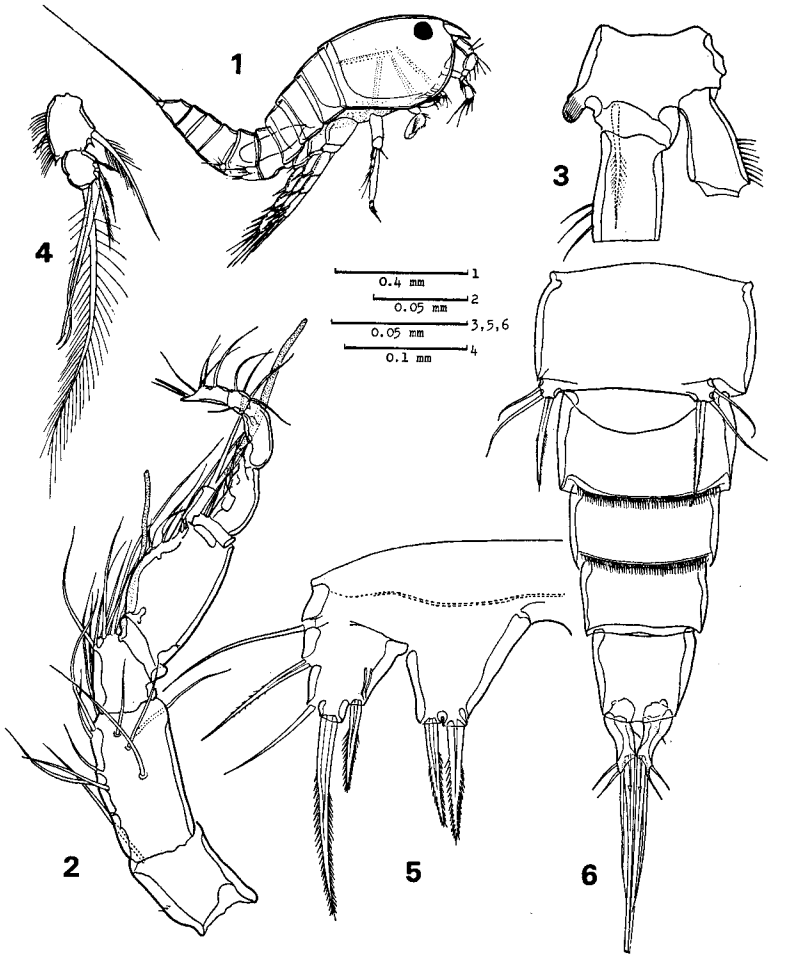

Fig. 36. *Diosaccus ezoensis* n. sp. Male. 1. lateral view; 2. antennule; 3. coxa of leg 1; 4. endopodite of leg 2; 5. leg 5; 6. leg 6 and abdomen, ventral.

ably strong, spinulose spine; one moderate, spinulose spine arising from inner edge of fairly distal part, and a longitudinal groove running to its base; outer edge with two setae, proximal one hairy and other bare and slender. *Leg 6* (Fig. 36–6) represented by a small protuberance attaching to posterior end of ventral side of first abdominal somite, with one spinulose spine and two bare and slender setae.

Variability. Among four females and two males as syntypes from Oshoro, and other two females and two males from Akkeshi, the fifth pair of legs in a female from Oshoro shows slight difference. The inner expansion (Fig. 35–6) tapers

distally, more acutely than in the specimen described. No other difference was detected.

Remarks. The present new species is completely characterized by the baseoendopodite of leg 5 in female, which bears six serrate spines on inner expansion. The structural resemblance in the fifth pair of legs in female is found in *Diosaccus spinatus* Campbell from Vancouver Island (Campbell, 1929) and from California (Monk, 1941) and also in *D. truncatus* Gurney (1927) from Port Said. The last mentioned species has five spines on the inner expansion which is fairly alike to that reported in the present new species in the size and shape, though the species is quite easily discernible from all other known species within the genus as well as the present by a unique characteristic in the furcal rami. *D. spinatus*, which was fully redescribed by Lang (1965) based upon the specimens from California, is probably most allied to the present new species, though the baseoendopodite of the fifth pair of legs in the female has five spines. The endopodite segment of the second pair of legs of male in *D. spinatus* fairly resembles that of the present in the general appearance, while the shape of each elongate spine is different. The shape of maxillipede in both species is quite alike together. In this connection, the elongate appearance of maxillipede in *D. truncatus* is rather allied to those in *D. dentatus* (Thompson et A. Scott 1903), *D. valens* (Gurney 1927), etc. *D. tenuicornis* (Claus 1863) and *D. borborocoetus* Jakobi 1954 are apparently alike to the present as well as *D. spinatus* in this appendage. Probably such two types of the maxillipede are present within the genus.

Syntypes. Four females and two males collected from Oshoro by algal rinsings (21–VI–'71. Itô leg.). Other material from Akkeshi was also examined (2 ♀♀ and 2 ♂♂, 11–VII–'71. Itô leg.).

Paralteutha simile Monk

(Figs. 37~41)

Paralteutha simile Monk 1941, p. 88, pl. 2, fig. 5~11; Lang 1965, p. 6.

Female. Body (Figs. 37–1, 2) about 1.2 mm in length in rather rounded condition, and slightly elongate in stretched condition, remarkably depressed dorso-ventrally, much alike to typical isopod in appearance, composed of highly sclerotized somites; cephalothorax and urosome tinctured with light yellow, first three thoracic somites tinctured with brown. Nauplius eye present, but small and not so conspicuous in dorsal view because it is inserted in ventral side; dorsal surface of each somite more or less granulate. Cephalothorax about 0.67 mm in greatest width, and a little longer than succeeding three thoracic somites combined, with a transverse band of narrow thickening dorsally; several delicate hairs along both lateral rims; ventral side of both lateral parts conspicuously thickened except for short length of posterior edge which is rather lamellar-like; rostral projection, which is not defined at base, fairly remarkable in stretched condition; posterior rim tinctured with brownish purple; a circular skeletal frame-

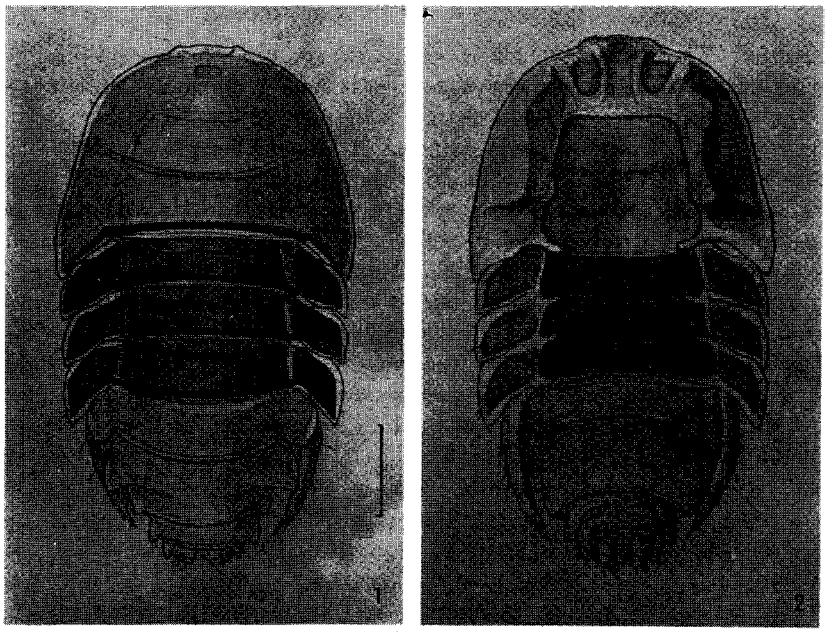

Fig. 37. *Paralteutha simile.* Female. 1. dorsal view; 2. ventral view. All appendages of metasome, together with whole internal structures, were removed. Bar represents 0.2 mm.

work that surrounds each antennular foramen (see Fig. 37–2). First three thoracic somites of almost equal length, with well developed epimera, tinctured with brownish purple along posterior rim and just inside of lateral margins. Fourth free thoracic somite slightly narrower than preceding somite, giving attachment to the fifth pair of legs at both antero-lateral corners of ventral part. Abdomen (Figs. 40–1, 2) a little wider than long, of acutely tapered appearance. Genital double-somite obscurely subdivided by a narrow smooth zone transversely running on dorsal side, fairly expanded laterally; a pair of setulae arising from dorsal surface at a little inside of each lateral edge of anterior subdivision; other two setulae arising from each lateral end of dorsal narrow smooth zone described; ventral side of lateral edges more or less spinulose; genital area differentiated at fairly anterior part. Antepenultimate somite well extending posteriorly at both lateral hind parts, fringed with some delicate spinules, and with three small, tubular protuberances on middle dorsal surface; weak serration occurring along posterior edge. Penultimate somite scarcely granulate dorsally, nearly smooth; dorsal postero-mesal part slightly extending behind and forming into a thin posterior rim which is slightly bipartite apically, and nearly covering anal somite dorsally; lateral edges less spinulose. Anal somite very small, almost invisible from dorsal side,

but from ventral side its shape clearly defined; length much shorter than width, acutely tapering behind, with a longitudinal groove ventrally. Furcal ramus (Figs. 40–1, 2) attaching to rather anterior part of ventral side of anal somite, therefore, nearly anterior half of ramus invisible from dorsal side *in situ*; rather truncate in appearance, about 1.5 times as long as greatest width; distal end slightly inclined; one thickset, hairy seta and one bare setula on outer distal corner, one bare short seta on middle distal edge, two hairy small setae and one rather longer, bare seta on inner distal edge; distal part of both sides more or less spinulose; one small, basally geniculate seta arising from dorsal surface near inner distal corner.

Antennule (Fig. 38–1) nine-segmented, all segments considerably sclerotized; first segment attached to basal process arising from antennular foramen, fairly thickened distally, with one hairy seta on antero-distal corner, some elongate hairs along anterior edge, and a bush of many hairs on ventral side near postero-distal corner; second one a little longer than first, finely hairy along anterior edge, with some anterior and dorsal bare setae, and a bush of hairs as in preceding segment; third one much shorter and slightly slender than third, furnished with one rather slender aesthetasc at anterior distal end which is never protruded distally; fifth one much slender than fourth, apparently forming into a cylindrical process at anterior distal part, and furnished with one aesthetasc apically; apical five segments much smaller than others; fifth one with only one bare seta on antero-distal end; sixth one a little longer than preceding; seventh and eighth segments of equal length, smallest, and one slender, basally geniculate seta arising from posterior distal end of each segment; last one a little longer than preceding two segments combined, with one slender aesthetasc apically. *Antenna* (Fig. 38–2). Coxa short, with no particular ornamentation. Basis scarcely longer than diameter, with one sparsely spinulose seta at antero-distal edge. Exopodite two-segmented, small; first segment about twice as long as second, with one plumose seta on distal corner; second one with two terminal setae which are of equal length and finely ciliate at both sides, and with one plumose seta as in previous segment, on fairly distal edge. First endopodite segment about as long as basal two segments combined, slightly swelling anteriorly, and with one slender, somewhat hairy seta on middle anterior edge. Second endopodite segment much slender than preceding, gradually thickened distally, almost as long as basis and first endopodite segment combined, and furnished with one claw and two bare setae on and near anterior edge at about two-thirds the length; four midst geniculate, elongate spines, one of which divaricates basally into a seta, on distal end; one claw on distal extremity and one bare, short seta on middle posterior edge of distal end; several spinules on posterior edge of fairly distal part and along anterior margin of proximal half. *Mandible* (Fig. 38–3). Praecoxa considerably elongated inwards, remarkably sclerotized; pars incisiva probably bidentate, thick at basal half; lacinia mobilis deeply inserted; one claw and three sharp spines on dorsal side of lacinia, and two hairy, small setae on dorsal edge; pars molaris represented by a low protuberance of

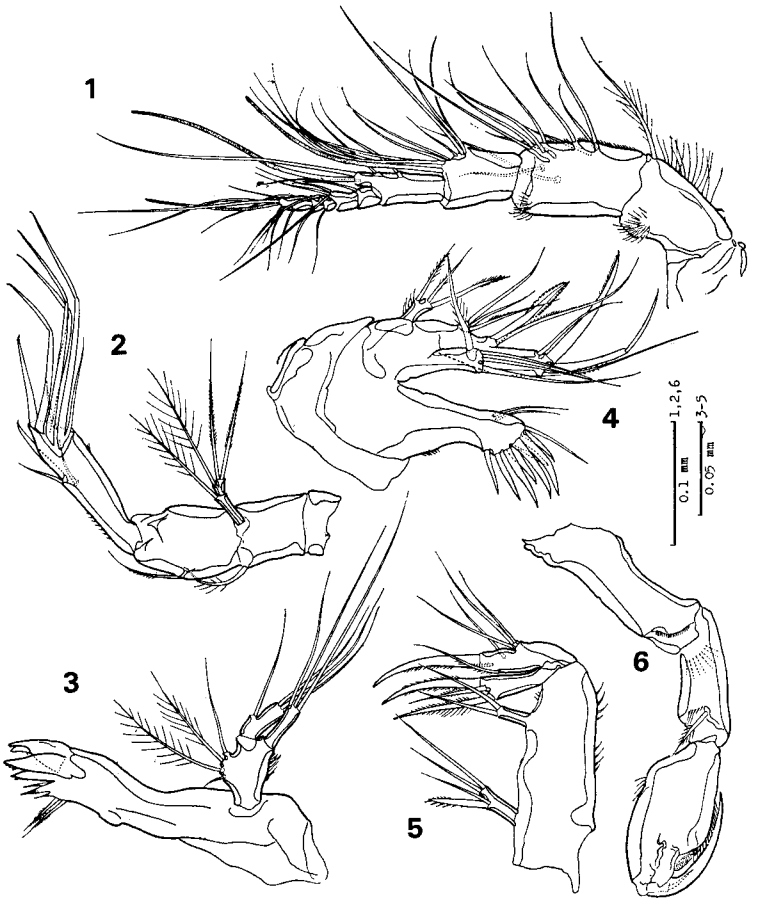

Fig. 38. *Paralteutha simile*. Female. 1. antennule; 2. antenna; 3. mandible; 4. maxillula; 5. maxilla; 6. maxillipede.

dorsal rim. Coxa-basis arising vertically from outer part of praecoxa, apparently longer than wide, slightly protruded at middle part inwards, and with four setae, of which the proximal one is remarkably dwarfed and bare, the middle two are elongate and plumose, and the rest is entirely bare and arises from a small protuberance; outer rim fairly thickened, and with some hairs. Exopodite cylindrical, with two considerably elongate bare setae on distal end and one a little shorter seta on inner distal corner. Endopodite about as long as exopodite, thickened at basal half, furnished with one inner seta on middle edge and three terminal setae; all setae entirely bare. *Maxillula* (Fig. 38–4) strikingly complicated in appearance. Arthrite of praecoxa fairly produced without basal demar-

cation, tapering apically, fringed with thick, well slcerotized rim both dorsally and ventrally; eight claws or spines along inner end, one seta on inner ventral conrer, and a pair of parallel setae arising from inner part near ventral edge; several delicate spinules on dorsal rim of proximal part. Cylindrical process of coxa a little exceeding to middle arthrite of praecoxa, with one seta on dorso-apical corner, and two rather slender setae on apical end, and one thickset, sparsely hairy seta on ventral edge near apical end; several spinules along dorsal rim. Basis scarcely demarcated from coxa at basal part, nearly confluent; apical extremity of inner process reaching to inner end of arthrite of praecoxa, furnished with one strong, elongate claw, which is pectinate along ventral edge of apical half, and one bare seta close to ventral side of base of former claw; one elongate spine which is articulate midst and arises from dorsal corner of apical part, and accompanied with one elongate, slender and hairy seta; one thickset spine, which is remarkably serrate at both sides, and one much elongate, spinulose seta on a small protuberance of middle ventral edge; some slender spinules or hairs on and near dorsal edge of inner process. Exopodite represented by a small, but elongate segment, clearly defined at base, and furnished with one thicker hairy seta and one slender seta on distal end, and other one slender seta arising from outer edge near distal corner; outer edge hairy. Endopodite represented by a very small protuberance on basis, and with one hairy and two bare setae. *Maxilla* (Fig. 38–5). Syncoxa remarkably elongate, more than 2.5 times as long as greatest width, fringed with well sclerotized rim, with three endites; outer rim fringed with several spinules; proximal endite arising from one-fourth the length, clearly defined at base, with one spinulose spine and one bare seta on dorsal edge at one-third the length, and a pair of bare setae on apical end; middle endite arising from three-fourths the length, cylindrical, a little shorter than proximal endite, and with two bare setae apically; distal endite arising from distal extremity of inner edge, well developed, slightly thickened apically, furnished with one strong, moderately arched spine which attaches to apical extremity and is finely spinulose at both sides, one slender hairy seta and one spinulose thickset seta on rather inclined distal corner. Basis extending inwards, reaching to apical end of distal endite of syncoxa, and apically furnished with one strong claw which is moderately arched and is finely spinulose along dorsal side; one slender hairy seta arising from dorsal edge; one hairy setula near base of claw; one bare seta on same side of former setula between apical end and endopodite; outer half of ventral rim considerably sclerotized. Endopodite represented by a very small segment on middle ventral edge of basis, well defined at base, and with two slender bare setae terminally and one slender seta laterally. *Maxillipede* (Fig. 38–6). Coxa well developed, more than three times as long as diameter in rough estimation, with an arched row of some delicate spinules near distal end. Basis fairly shorter than coxa, with one short spinulose seta just inside distal end, a transverse spinular row near base of seta, and a slightly arched row of less number of slender spinules rather proximally. First endopodite segment almost as long as coxa, fairly cornered at one-third the length

of much sclerotized outer rim; inner distal part furnished with a finely granulate formation; distal half of inner margin spinulose; some hairs on outer rim at one-third the length. Second endopodite segment forming a strong claw accompanied with one short seta near its base.

Leg 1 (Fig. 39–1). Coxa strikingly elongated, more than twice as long as greatest width; inner margin almost straight, with many hairs; an oblique row of some hairs on anterior surface near outer distal corner; inner rim furnished with many delicate hairs along inner extremity as well as on anterior side; both outer and inner rims giving fairly different appearances in anterior view and posterior view. Basis remarkably extending outwards, with one spinulose seta at two-thirds the length of dorsal edge, and one hairy spiniform seta on anterior surface near inner distal corner; middle dorsal edge spinulose, inner rim with delicate hairs; middle ventral rim between both rami well sclerotized. Exopodite three-segmented, arising from outer extremity of basis, longer than two endopodite segments combined; first segment slightly swelling at inner side and thickened distally, with one bare, short seta at three-fourths the length of outer margin, distal end apparently inclined, outer margin, except for distal part, finely spinulose, inner margin entirely bare; second one a little longer than first, with one bare setula at about three-fourths the length of outer margin and one hairy seta on opposite edge, and spinulose along outer margin; third one very small, with four spinulose spines, three of which arise from outer edge and the rest from distal end, and one midst geniculate, bare spine terminally. Endopodite two-segmented, arising from inner distal edge of basis, with a row of many longer hairs along each outer margin and many scattering delicate hairs on anterior side of each inner rim; first segment a little swelling midst, about twice as long as greatest width, and furnished with one plumose seta on middle inner margin; second one about 1.5 times as long as first, with five hairy, not so elongate setae, one of which arises from outer edge near distal end, and two of which are on distal end, and other two on distal part of inner margin. *Leg 2* (Fig. 39–2). Coxa about as long as wide, with some spinules on basal ridge, middle outer edge and outer half of distal edge; sclerotized outer rim clearly extending inwards along posterior sides as a triangular thickening. Basis extending outwards, much longer than coxa, with one plumose seta on outer extremity of spinulose dorsal margin. Both rami three-segmented. Exopodite arising from outer extremity of basis, nearly as long as endopodite, with many delicate spinules on and near each outer margin; first segment with one spinulose spine on outer distal corner and some longer hairs along inner margin; second one a little shorter than first, with one outer spine distally and one hairy seta on about middle inner edge; third one scarcely longer than first, fairly slender in appearance, with three spinulose outer spines, one elongate spiniform seta, which is finely spinulose outwards and hairy inwards, and one hairy seta on distal end, and with two inner setae on proximal half. Endopodite fairly thicker than exopodite, fringed with many elongate hairs along each outer margin (Fig. 39–3); first segment apparently thickened distally and swelling at inner side, furnished with

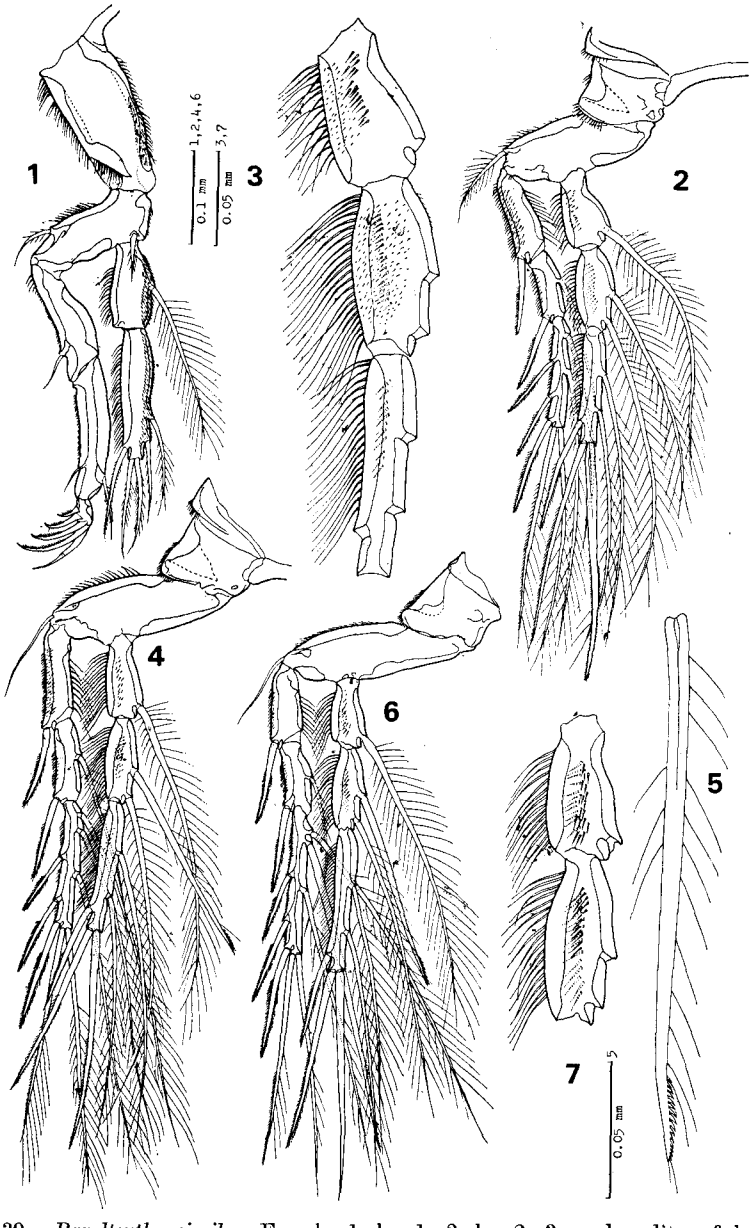

Fig. 39. *Paralteutha simile.* Female. 1. leg 1; 2. leg 2; 3. endopodite of leg 2, all setae and spines omitted; 4. leg 3; 5. elongate spine of middle endopodite segment of leg 3; 6. leg 4; 7. first two endopodite segments of leg 4, all setae and spine omitted.

one much elongate, plumose seta on inner distal edge, some spinules directed outwards and some delicate hairs on anterior surface; second one about as long as first, with two inner setae on distal half, some spinules arranged longitudinally on posterior surface and many delicate hairs on anterior surface; third one about 1.5 times as long as second, with one spinulose outer spine at four-fifths the length, one spiniform seta on outer side of distal end, and one strong, elongate spine which is delicately ciliate at both sides of apical half and arises from inner side of distal end, and with two inner setae, a longitudinal row of some spinules on posterior surface. *Leg 3* (Fig. 39–4). Coxa nearly as in leg 2. Basis more expanding outwards, with one remarkably thin, bare seta on outer extremity. Both rami slightly longer and slender than in leg 2. Third exopodite segment furnished with three inner setae, two of which are remarkably close together and arise from fairly proximal part. Second endopodite segment furnished with one elongate spine, which arises from about two-thirds the length of inner margin and is sparsely hairy along both sides and apically serrate (Fig. 39–5), instead of normal seta in leg 2, and one plumose seta at inner distal corner, and with many scattering spinules on anterior surface, a longitudinal row of several spinules directing outwards. *Leg 4* (Fig. 39–6). Coxa and basis nearly as in leg 3, but fairly narrower. Exopodite; first two segments shorter than in leg 3; third segment much elongate, about as long as first two segments combined, with one remarkably elongate spine instead of distal one of two close setae in leg 3. First two endopodite segments with many spinules on both anterior and posterior surfaces (Fig. 39–7). *Leg 5* (Figs. 40–3, 4) composed of two cylindrical segments, almost vertically arising from antero-lateral corner of somite and immediately directing posteriorly, extending to posterior end of genital double-somite. Baseoendopodite scarcely depressed dorso-ventrally, with one bare seta at middle inner edge; inner distal part forming into a small cylindrical process which is dwarfed inner expansion, and furnished with one shorter bare spine and one elongate, ciliate spine on distal end, and two bare setae on and near base of cylindrical process inwards; outer part hairy and dorso-outer edge spinulose. Exopodite scarcely longer than baseoendopodite segment, with four apical or subapical claws, all finely ciliate at both sides, and one spinulose spine on dorso-outer edge at two-thirds the length; one bare seta arising from about middle ventro-outer edge; ventral surface of proximal half hairy; dorso-outer edge densely spinulose.

Male. Body (Fig. 41) about 1.1 mm in length, rather slender in appearance; coloration as in female. First two abdominal somites completely articulated.

Antennule (Fig. 40–5) probably eight-segmented, haplocer; first segment with one plumose seta on anterior edge near distal end, many elongate hairs on middle anterior edge and some shorter hairs or spinules on posterior edge; third one furnished with one aesthetasc; fourth one fairly swollen, forming into a cylindrical process at anterior distal part and with one aesthetasc apically; last segment of horned shape, with a very small aesthetasc on posterior edge, ac-

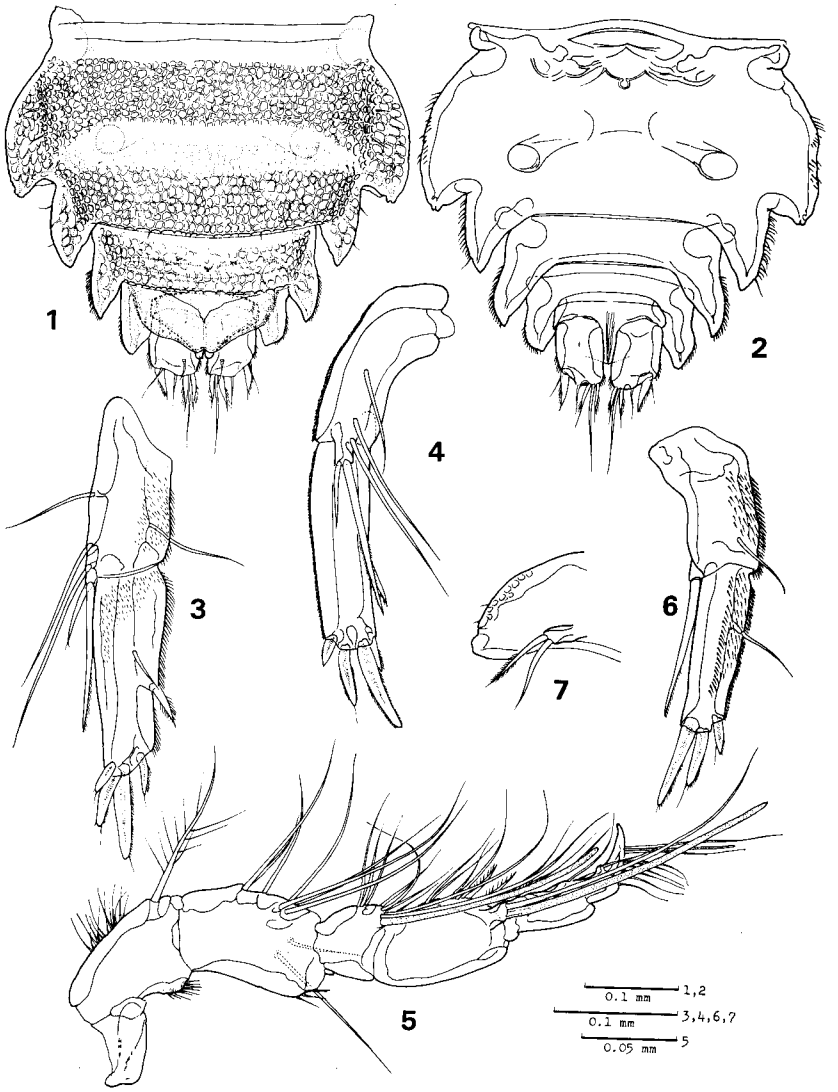

Fig. 40. *Paralteutha simile.* Female. 1. abdomen, dorsal; 2. abdomen, ventral; 3. leg 5, ventral; 4. leg 5, internal. Male. 5. antennule; 6. leg 5, ventral. 7. leg 6 *in situ.*

companied with two slender setae. *Leg 5* (Fig. 40–6). Baseoendopodite about twice as long as wide, with one bare seta at ventro-outer surface of fairly distal part, one strong spine on inner cylindrical process, and with many spinules on and near outer rim. Exopodite a little longer than baseoendopodite segment, furnished with three thickset claws apically, one bare seta on outer edge at about two-fifths

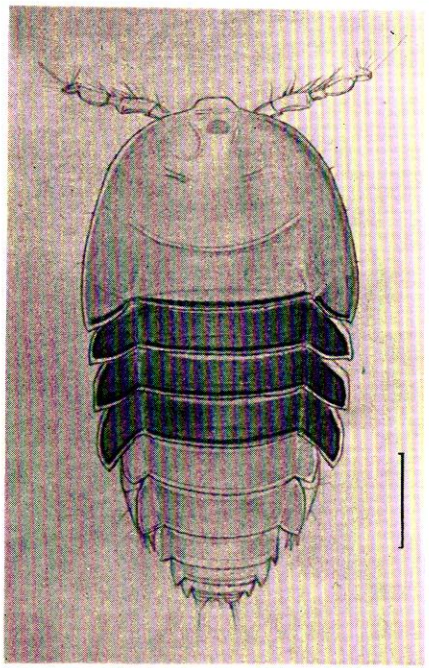

Fig. 41. *Paralteutha simile*. Male. Dorsal view. Bar represents 0.2 mm.

the length, and many spinules along outer edge and on outer half of ventral side. *Leg 6* (Fig. 40–7) represented by a cylindrical process with two apical setae.

Variability. Four females and three males were examined. No particular difference was recognized among them

Remarks. The present specimens of female fairly accord with the descriptions and figures by Monk (1941) based upon two females from California, particularly in the nine-segmented antennule, the shape and ornamentation of thoracic legs except for the last pair of legs. Such cylindrical legs as the fifth pair of legs in this species give quite different appearances according with its position. Sometimes rear structure is unable to detect. As far as judging from the Monk's figure of fifth leg, the baseoendopodite is furnished with one terminal spine and two setae on cylindrical process in all, and on the exopodite segment one bare seta is absent. This apparent descrepancy between Monk's and the present materials probably occurred due to such situation mentioned above. Unfortunately only very poor information was given for the male by Monk, therefore, I am unable to compare them.

Specimens examined. Four females and three males collected from plankton hauls in Akkeshi Bay (1 ♀ and 1 ♂, 5-VII-'68; 3 ♀♀ and 2 ♂♂, 9-VII-'70. Itô leg.).

Heterolaophonte discophora (Willey)

(Figs. 42～47)

Laophonte discophora Willey 1929, p. 531, figs. 2, 3, 6; Willey 1930, p. 607, pl. XVIII, fig. 16～18; Willey 1931, p. 5. *Heterolaophonte discophora*: Lang 1948, p. 1375, fig. 557-1; Lang 1965, p. 480, fig. 262～265. *Heterolaophonte rotundipes* Chappuis 1958, p. 420, fig. 23～34.

Female. Body (Figs. 42–1, 2) about 0.95 mm in length, rostrum and furcal setae excluded; nearly cylindrical in appearance; metasome and urosome of almost same length, and no remarkable constriction between two major body parts; all somites clearly defined from each other. Rostrum (Fig. 42–4) small, almost

triangular in shape, furnished with a pair of sensilae near apex; distal part of both edges rather hyaline. Cephalothorax scarcely longer than greatest width, slightly produced downwards at middle ventral edge of each lateral part of integument; whole surface with many rows of some delicate spinules and some scattering hairs, and fringed with many longer hairs along ventral edge, delicate

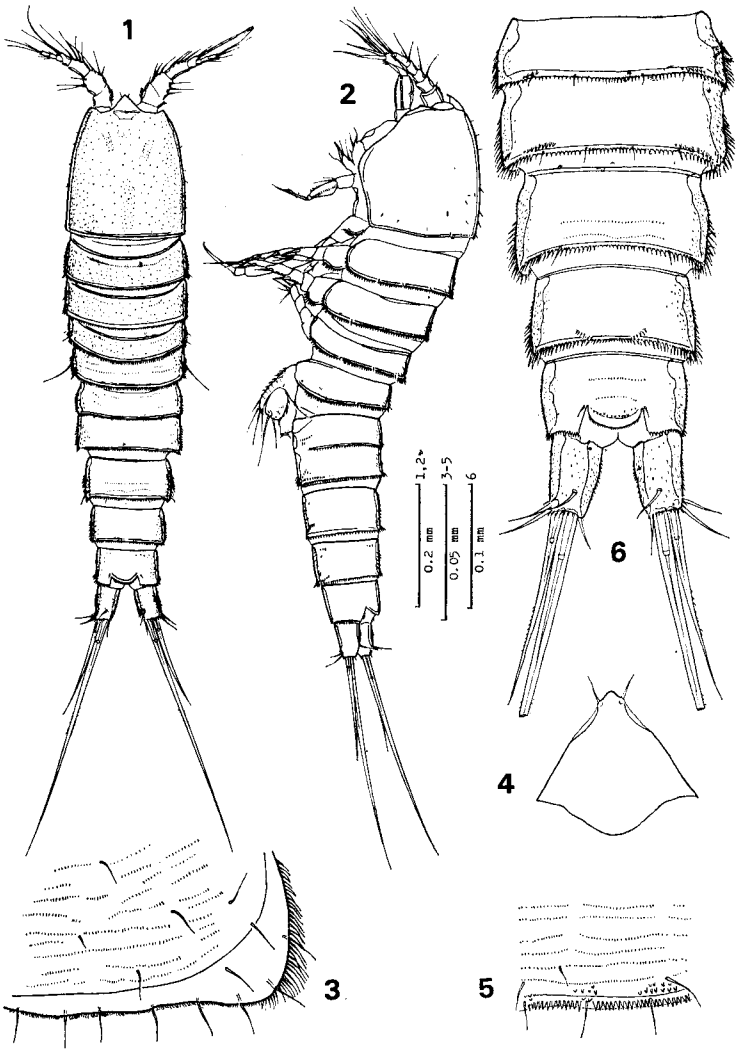

Fig. 42. *Heterolaophonte discophora*. Female. 1. dorsal view; 2. lateral view; 3. postero-lateral part of cephalothorax; 4. rostrum; 5. epimeron of first free thoracic somite; 6. abdomen, dorsal.

hairs and some sensilae along posterior edge (Fig. 42–3). Thoracic somites with some transverse rows of numerous delicate spinules, some groups of granular protuberances, several scattering hairs, and fringed with a spinular row along posterior edge (see Fig. 42–5). Abdomen (Fig. 42–6, Fig. 43–1) slightly tapering behind. Genital double-somite subdivided dorsally and laterally by a clear suture with many spinules and several hairs; leg 6 represented by one delicate setula and one longer bare seta on both sides of genital area; ventro-lateral edges fairly spinulose; ventral surface of posterior subdivision ornamented with many quite delicate spinules arranged into several roughly transverse, and more or less arched rows, and a distinct spinular row along posterior edge. Ornamentation in antepenultimate somite nearly same as in posterior subdivision of genital double-somite. Penultimate somite without hairs on posterior edge. Anal somite with a row of many minor spinules along posterior edge ventrally and laterally; anal operculum moderately rounded, fringed with some hairs and with some granular protuberances on dorsal surface near free edge, and further, accompanied with a setula on both lateral extremities. Furcal ramus truncate, 1.4 times as long as basal diameter, with one basally geniculate seta on dorsal surface at two-thirds the length, two close setae on outer edge near distal end accompanied with several spinules, one shorter seta on inner distal corner; principal terminal setae normal.

Antennule (Fig. 43–2) seven-segmented; first segment with many delicate spinules on and near posterior edge, and several rigid spinules on anterior distal edge, and with one smaller seta; second one with at least three dorsal setae and other setae on antero-distal part; fourth one forming into a well developed cylindrical process at anterior distal part and furnished with one slender aesthetasc apically; apical three segments small, and of about same length; fifth segment with only one seta at anterior distal end; last one with several basally geniculate setae, and one slender, but fairly elongate aesthetasc terminally. *Antenna* (Fig. 43–3). Coxa small, without particular ornamentation. Allobasis slightly swelling midst, with fairly sclerotized anterior rim; one small spinulose seta arising from about two-thirds the length of anterior edge. Exopodite one-segmented, quite dwarfed, attaching to about one-third the length of allobasis, with three setulae on and near distal end. Endopodite thickened distally, about as long as allobasis, furnished with four claws, three elongate, midst geniculate spines; several spinules on proximal part of anterior edge, fairly distal part of posterior edge, and around base of antero-distal claw which is accompanied with one bare setula near base; outermost elongate spine bifurcate basally. *Mandible* (Figs. 43–4, 5). Praecoxa remarkably sclerotized, with indistinctly bidentate pars incisiva, probably tridentate lacinia mobilis, two fairly serrate spines, one slender spine and one spinulose seta; pars molaris well developed. Coxa-basis together with both rami represented by an almost cylindrical palpus which is much inclined inwards, and is furnished with one sparsely hairy seta at inner distal end, and four bare setae ventrally; several spinules on ventral edge near base of outermost seta. *Maxillula* (Fig. 43–6). Praecoxa rather low, with some spinules on ventral edge along base of

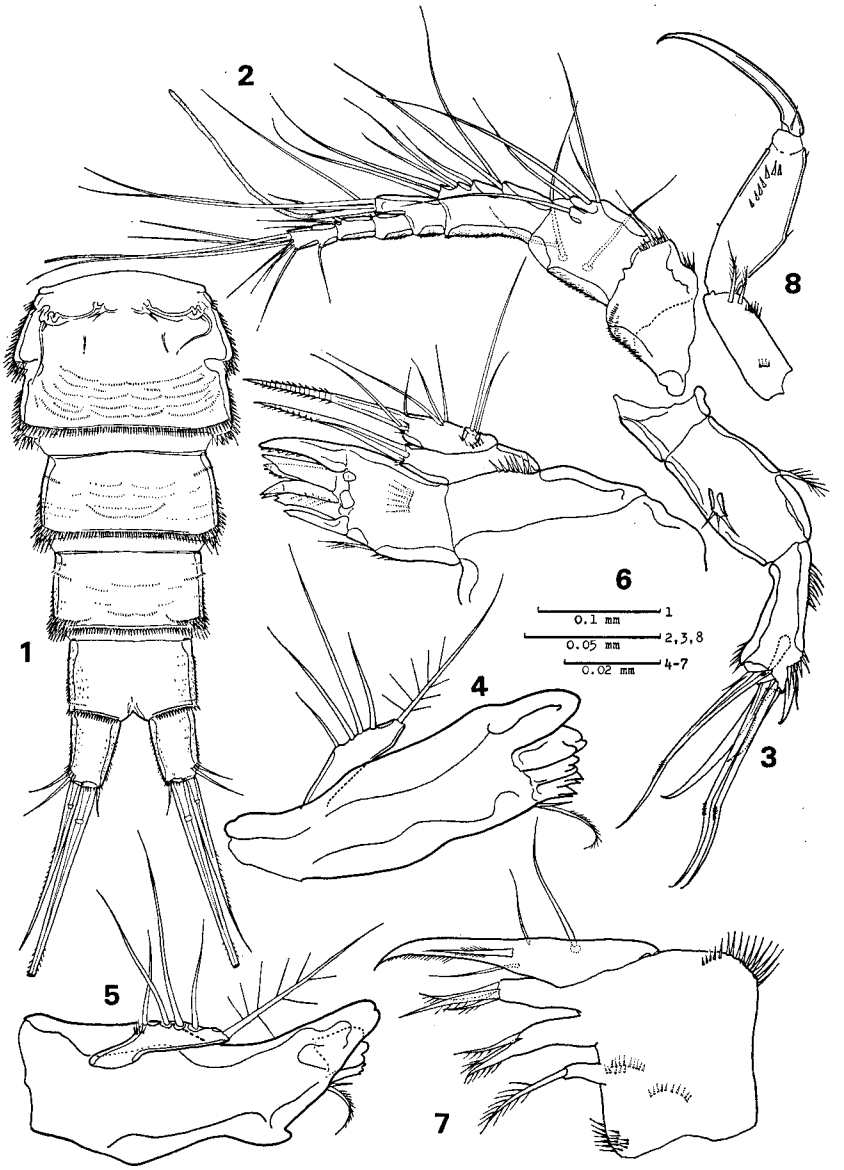

Fig. 43. *Heterolaophonte discophora.* Female. 1. abdomen, ventral; 2. antennule; 3. antenna; 4, 5. mandible; 6. maxillula; 7. maxilla; 8. maxillipede.

coxa; arthrite furnished with six strong claws on inner end and one hairy seta on dorsal edge; several slender, elongate spinules on middle surface, and less number of minor spinules on dorsal edge. Coxa furnished with one spinulose spine accompanied with one bare seta and several spinules basally. Basis not so extending inwards; inner end with one strong spine which is spinulose at distal half, two bare setae and several spinules. Exopodite very small, one-segmented, accompanied with some spinules along base, and with two bare setae terminally. Endopodite represented by three close, bare setae arising from about middle ventral edge of basis. *Maxilla* (Fig. 43–7). Syncoxa of about rechtangular appearance, with some spinules roughly arranged into a row on outer ventral part, two arched spinular rows, and several spinules on inner proximal part and furnished with three cylindrical endites; proximal endite smallest, bearing one spinulose seta on apex; middle one forming into a thick, dorsally spinulose seta distally without distinct demarcation, and bearing two spinulose setae; distal one furnished with three thick, more or less spinulose, apical setae. Basis inwards forming into a remarkably strong claw which is slightly arched dorsally in apical part, and is pectinate along dorsal edge; this claw without basal demarcation, but one thick and two bare slender setae representing its base in appearance. Endopodite represented by a quite small segment with one longer bare seta apically. *Maxillipede* (Fig. 43–8). Coxa was not detected. Basis about three times as long as diameter, with two spinulose, shorter setae distally, several spinules on outer edge near distal end and on proximal part. First endopodite segment about 1.5 times as long as basis, fairly swelling outwards, with a longitudinal row of several rigid spinules on distal half near inner margin, a delicate spinule on about middle and near distal end of outer edge. Second endopodite segment represented by a strong, slightly arched claw, about as long as first endopodite segment, and accompanied with a setula near base.

Leg 1 (Fig. 44–1). Coxa fairly expanded outwards at proximal part, tapering distally; some robust spinules on proximal half of outer edge, and several minute spinules on middle inner edge. Basis smaller than coxa, slightly thickened distally, with one spinulose seta on middle outer edge; one small, spinulose or hairy seta on anterior surface near inner distal corner; middle part of inner margin spinulose; a longitudinal row of some spinules directed outwards on anterior surface near inner margin; several spinules on and near outer edge. Exopodite small, three-segmented; all outer margins more or less spinulose; outer spine of first segment distinctly spinulose at outer side; second segment longest, about 1.5 times as long as first, with one bare outer spine; third one about as long as first, with one outer spine at two-thirds the length, one spine on outer distal corner, and two much elongate, midst geniculate spines terminally. Endopodite much robust in appearance; first segment about twice as long as three exopodite segments combined, and five times as long as wide, with several rather flexible spinules on inner edge and some rigid spinules on anterior surface near outer margin; second one about one-fifth the length of first segment, furnished with one remarkably de-

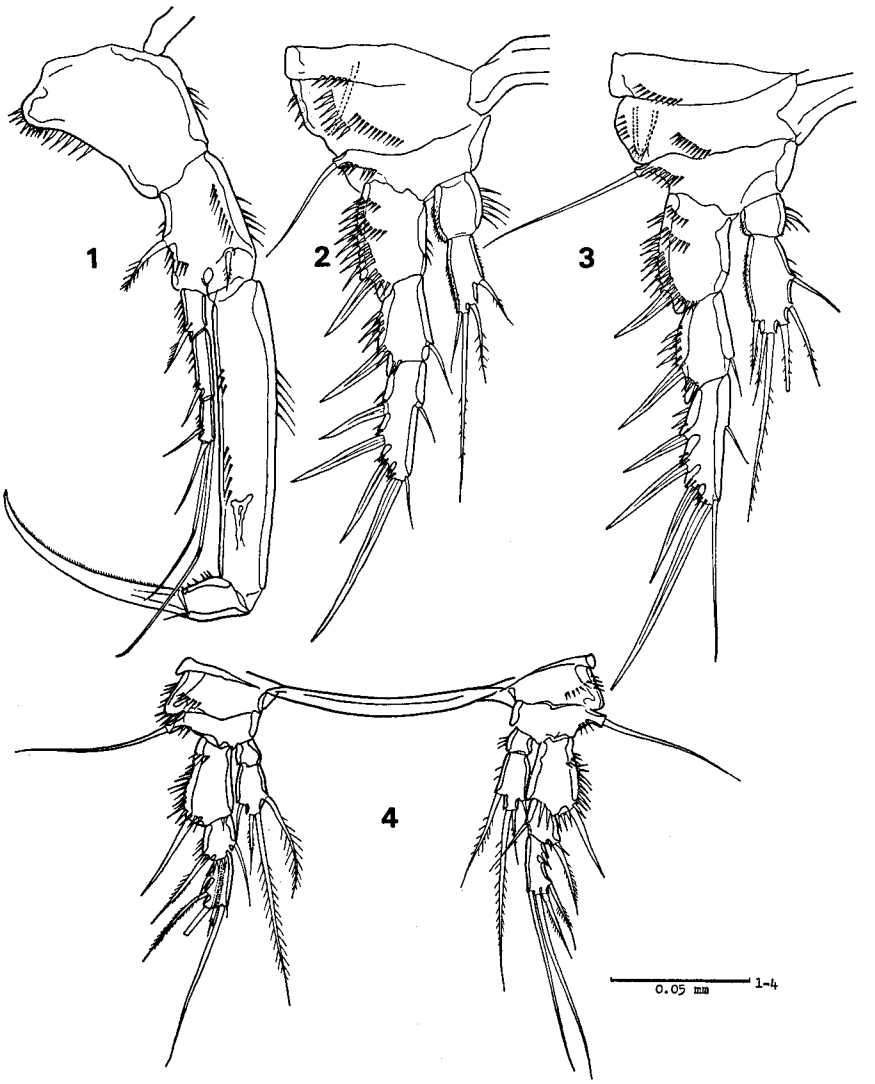

Fig. 44. *Heterolaophonte discophora*. Female. 1. leg 1; 2. leg 2; 3. leg 3; 4. a pair of leg 4.

veloped terminal claw which is finely ciliate along whole outer edge and is much longer than three exopodite segments combined, and a bare setula at inner distal corner; several spinules on outer edge. *Leg 2* (Fig. 44–2). Coxa much widened, with one transverse and two oblique rows of some spinules on anterior surface, and

several spinules along outer edge. Basis forming into a short cylindrical process outwards, and with one bare seta apically; several spinules arising from base of cylindrical process inwards. Exopodite apparently tapering distally, more or less spinulose along outer edges; first segment with at least three oblique spinular rows on anterior surface of outer half, one strong outer claw, and several rather flexible spinules on inner edge; second segment with one outer claw, one bare inner seta at fairly distal edge, and several spinules on anterior surface near outer margin; third one much longer than second, with three outer claws, one elongate claw and a setula on distal end, and one bare setula at two-fifths the length of inner margin. Endopodite small; first segment without seta, spinulose along inner margin, and ciliate on and near outer edge; second one a little longer than first, slender in appearance, with two hairy inner setae on distal half, one bare setula and one somewhat hairy seta on distal end. *Leg 3* (Fig. 44–3). Coxa, basis and exopodite almost same as in leg 2. Endopodite; first segment apparently dwarfed; second one more than twice as long as first, swelling midst, with one shorter seta on fairly distal part of outer edge, three inner setae, and two terminal setae. *Leg 4* (Fig. 44–4). As already described by Lang (1965), this leg in females seems to be very variable in shape as well as its ornamentation particularly in the last exopodite segment. The segments in two females dissected showed quite deformed appearance as described later. Coxa, basis and endopodite were scarcely variable in the shape and ornamentation. Basal two segments much smaller than in previous leg. Coxa with several spinules on outer edge and anterior surface. Basis with one bare longer seta on cylindrical process at outer end, and several spinules. Exopodite much longer than endopodite; first segment longest, apparently thickened distally, with one bare outer spine near distal corner, many spinules along outer margin and anterior side of outer half of distal edge, and a short spinular row on anterior surface of proximal part; second one small, with one spinulose, spiniform outer seta and one bare, slender inner seta; third one slender, much longer than second, slightly thickened distally, with five setae in all. In the right leg, the last exopodite segment is furnished with two outer setae, of which the proximal one is bare and small, while the distal one is well developed and hairy, and three distal setae, middle one of which is deeply withdrawn. Contrary to this, in the left leg, the proximal outer seta is apparently withdrawn, and the middle one of distal setae is normally developed. Endopodite; first segment small, with several spinules on inner edge; second one more than twice as long as first, with one inner, one outer, and two terminal setae. In another female (Fig. 45–1), the outer spine of first exopodite segment is a little hairy. Apical two exopodite segments in the right leg were absent (it is not due to failure in dissection). The third exopodite segment in the left leg is much dwarfed and bears only three thickset setae. *Leg 5* (Fig. 45–2). Baseoendopodite forming into a strong, basally thickened process outwards, with one bare elongate seta on its apex; inner margin fairly rounded, fringed with some rather flexible spinules; inner expansion well developed, reaching to near distal end of exopodite segment, furnished with

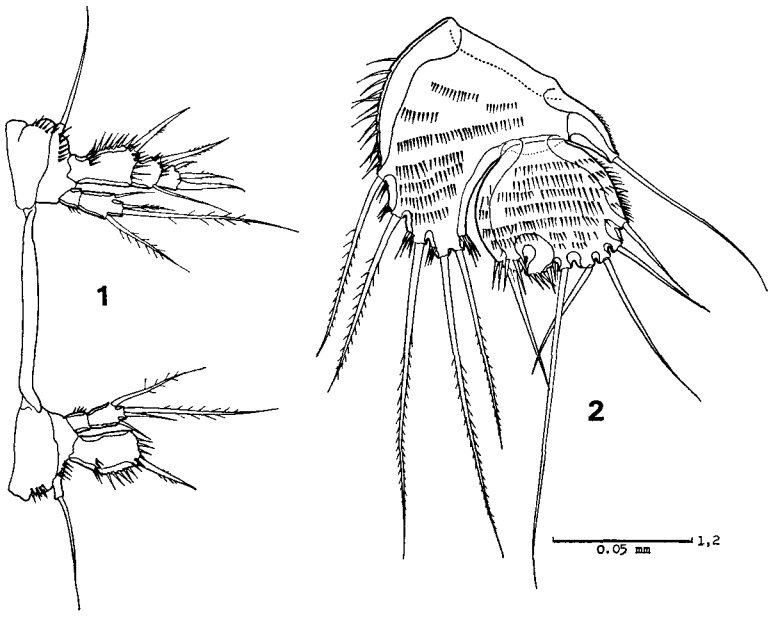

Fig. 45. *Heterolaophonte discophora.* Female. 1. a pair of leg 4; 2. leg 5.

five, rather longer setae which bear some shorter hairs along both sides and arise from a lobular protuberance in each; some transverse spinular rows on anterior surface. Exopodite of almost round shape, with one straight spiniform seta which is apparently thickened at basal part and arises from inner distal corner, and is accompanied with several taller spinules near base; four distal setae arising from a lobule in each, of which the innermost one is the longest; one seta on outer edge near distal end; outer edge densely spinulose; some transverse spinular rows on anterior surface; sclerotized rim between spiniform seta and innermost distal seta described apparently bipartite.

Male. Body (Figs. 46–1, 2) 0.96 mm in length, slightly slender in appearance rather than female. Urosome (Fig. 46–3) scarcely tapering behind. Fourth thoracic and first abdominal somites with many spinules on both lateral surfaces. Second to fourth abdominal somites furnished with some transverse or arched rows of many well developed spinules on each ventral surface and fringed with a number of rigid spinules posteriorly. Furcal ramus more slender than in female. *Antennule* (Fig. 47–1) chirocer, probably seven-segmented; third segment small, triangular in shape; fourth one much swollen with at least two serrate spines on anterior edge, one thick aesthetasc.

Leg 1 as in female. *Leg 2* (Fig. 47–2) strikingly bigger than in female. Coxa considerably expanded outwards, with one transverse and several oblique spinular

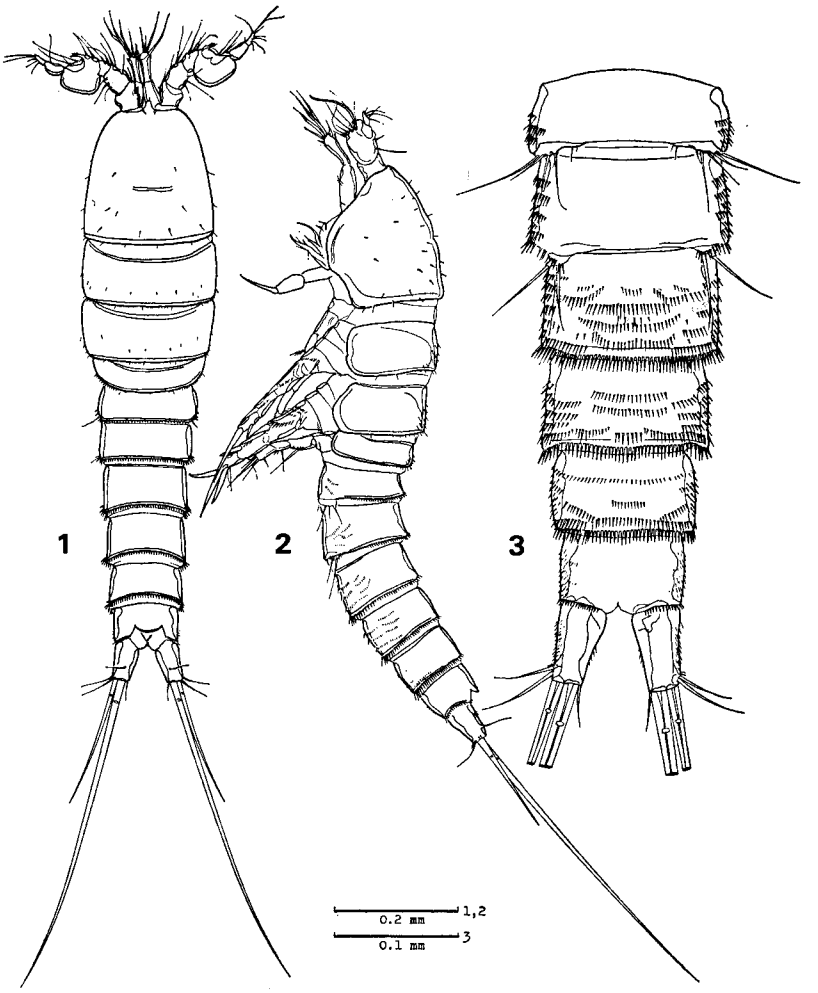

Fig. 46. *Heterolaophonte discophora*. Male. 1. dorsal view; 2. lateral view; 3. leg 5, leg 6 and abdomen, ventral.

rows on anterior surface. Outer seta of basis distinctly spinulose. Exopodite well sclerotized at each rim; first segment about twice as long as wide, with an oblique spinular row on anterior surface near proximal outer corner; second one a little slender and shorter than first; third one forming into three conspicuous lobules, two at outer edge and one at inner distal corner, and with four remarkably thick claws, one bare hair-like setula near base of terminal claw, one shorter seta arising from posterior surface near inner edge at about one-fourth the length.

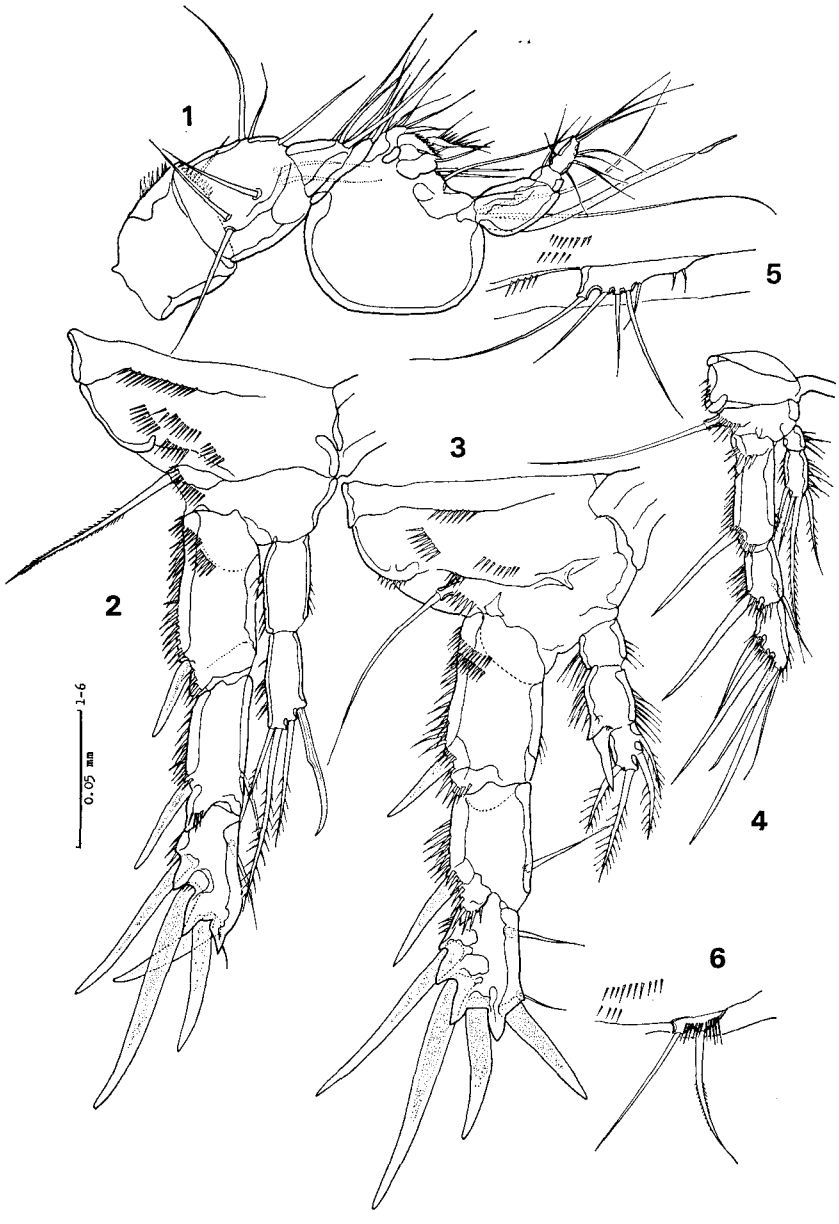

Fig. 47. *Heterolaophonte discophora*. Male. 1. antennule; 2. leg 2; 3. leg 3; 4. leg 4; 5. leg 5; 6. leg 6.

Endopodite composed of two segments of equal length; second segment with two spinulose terminal setae, one spinulose seta and one longer spine on distal part of inner edge. *Leg 3* (Fig. 47–3) developed as in leg 2. Outer seta of basis bare. First exopodite segment with two parallel oblique spinular rows on anterior surface; second segment apparently shorter than first; third one forming into three lobules, with four thick claws, inner terminal one arising from inside of terminal lobule and accompanied with a setula; one shorter seta on posterior surface near proximal inner edge. Endopodite three-segmented; first segment spinulose at both edges; demarcation between apical two segments rather obscure; second one a little longer than first, forming into a triangular and a strong, spur-shaped protuberances at outer distal corner, and spinulose marginally; third one small, furnished with four spinulose, shorter setae in all. *Leg 4* (Fig. 47–4). Outer seta of basis bare. First exopodite segment scarcely thickened distally, with one elongate outer spine; second one about half as long as first, with one outer spine of nearly equal length as in previous segment and one inner seta; third one about as long as second, not thickened distally, with two outer and two longer terminal spines, and one bare, slender seta apically. *Leg 5* (Fig. 47–5) represented by a narrow plate with one longer seta on a small protuberance at outer extremity, four bare setae on outer half, and two setulae on inner corner. *Leg 6* (Fig. 47–6) represented by a small plate with one bare seta at outer end, and one thick, hairy seta on middle edge; a transverse row of some taller spinules on anterior surface.

Remarks. An apparent characteristic for this species is present in the third exopodite segment of leg 4 in female, though it is occasionally transformed in various degrees. The 'typical' shape of this segment is represented by the much elongate and distally thickened appearance (cf. Willey 1929, fig. 2; Lang 1965, figs. 264-a, a. 1; Fig. 44–4 in the present paper) which is quite unique in the genus. Setal structure of baseoendopodite of leg 5 in female was never explained by Willey. In this connection, the inner expansion of this segment is furnished with four setae in all in the specimens reported by Lang (1965) from California, while five setae are present in my material and also in the specimens (quelques exemplaires mâles et femalles) insufficiently reported by Chappuis (1938) for *H. rotundipes* that was regarded as a synonym of this species by Lang (1965). On the other hand, the fifth leg in male bears two setulae on inner part in the present and Chappuis's specimens, but these two are absent in the specimens by Lang and also by Willey (1930). The presence of such setulae on this leg seems to be not unusual in the genus (see Lang 1965, fig. 258-d, for *H. variabilis*).

Specimens examined. One female (9–VII–'68, Itô leg.), one female and one male (11–VII–'71, Itô leg.) collected from coarse sands and pebbles of low tidal zone at Aikappu, Akkeshi.

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