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THE SCHIZOPODA OF THE SAN DIEGO REGION

BY

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(Contribution from the Scripps Institution for Biological Research)

This paper gives brief accounts of the Schizopoda contained in the plankton collections of the Scripps Institution for Biological Research made during the last five years with both surface and closing nets.

The body of a schizopod is readily separable into a larger anterior part, the cephalothorax (or the thorax) and a more slender posterior portion, the abdomen. The thorax is covered by the carapace which may be produced over the eyes into a rostrum; this structure varies considerably in shape and size within the group. Below the eyes are found the antennules (also called the first or upper antennae) which have two flagella attached to a 3-jointed peduncle. The peduncle is of considerable taxonomic value. The antennae (second or lower antennae) lie somewhat outside of and below the antennules and have but one flagellar organ; the basal part of the antenna is provided with the scale or squama which is of use in taxonomy.

The mouth parts are behind and below the antennae, and consist of the mandibles and maxillae; following these there are eight pairs of appendages which have received various names. Zimmer (1909, p. 2) applies the term "cormopod" to the eight pairs of appendages of the thorax that have both exopodite and endopodite. According to Sars (1885) the first of these is the maxilliped, the others being the legs. Ortmann (1893, p. 5) used the term cormopod as Zimmer does, the fourth to the eighth cormopods corresponding to the walking legs of the Decapoda, the others being the counterparts of the "Maxillarfüsse." On the other hand, Holt and Tattersall (1905, p. 101) discard the term maxilliped and speak of the first thoracic appendage as "the first thoracic limb" and of its endopodite as "the first leg," and so on. These authors refer to eight legs (endopodites) while Zimmer uses the term cormopod in the sense in which they use thoracic limb. Sars speaks of the maxilliped and the legs, separately.

Hansen (1909, p. 6) in his discussion of the Mysidacea applies the term gnathopod to the appendage which, according to Zimmer, is the second cormopod, according to Holt and Tattersall the second thoracic leg, and in Sars's terminology the first leg. It is probable that Hansen intends his designation to hold for the Mysidacea only, though he does not say so.

It is plain that among the Euphausiacea there are eight pairs of legs so far as the use of the organs is concerned and disregarding the possible relationships of the appendages in comparison with other Crustacea. For that reason, it seems to me that the usage of Holt and Tattersall is distinctly advantageous. The cormopods are not used as feeding organs but as walking legs ("Gangfüsse," Zimmer, 1909, p. 3), and though the last two pairs are apt to be more or less reduced, the use of the term leg is advisable for general purposes. The suggestion of Holt and Tattersall as to numbering the limbs is followed in this paper.

The appendages of the abdomen with the exception of those on the sixth segment may properly be called pleopods in most cases, and no confusion can arise from the use of that term. The last segment of the abdomen is the telson, and the two broad plates on each side of it are the uropods which are always biramous. The telson and the two pairs of uropods make up the tail fin or caudal fan.

Sars (1885, p. 5) gives a detailed account of the general morphology of the Schizopoda, and useful discussions will be found in Ortmann (1893, p. 3) and Zimmer (1909, p. 1).

Most authors consider that the Schizopoda are separable into two orders, the Euphausiacea and the Mysidacea. Sars (1885, p. 10) divided the Schizopods into four families, but it appears that subsequent writers have not followed this arrangement. It is now generally agreed that the order Euphausiacea includes one family, Euphausiidae, to which the more highly organized Schizopoda belong. A brief diagnosis of the family is as follows. There are two rather easily determined points: first, the legs have gills attached to them and the gills are not covered over by the sides of the carapace; second, the telson carries on each side a subapical spine or "lancet" located a short distance anterior to the tip (pl. 2, fig. 27). The side margin of the carapace at the lower edge may be smooth or carry one (pl. 1, fig. 14) or two (not more) small forward-pointing teeth. The seventh and eighth pairs of legs are nearly always more or less reduced, the eighth pair especially showing a tendency toward retrogression. The second to eighth pairs of legs carry gills, and these are retained on the last two pairs irrespective of the amount of reduction undergone by the appendages. The gills on the anterior legs have but one main branch while the posterior ones have several. The pleopods are well developed in both sexes and serve as swimming feet; the inner rami of the first and second pairs function in the males as copulatory organs. These structures are of great systematic importance and detailed accounts of them will be found in the papers by Hansen (1910, pp. 79, 80; 1911). He states (1910, p. 79) that the endopod of the first abdominal appendage (using the genus *Thysanopoda* as the type) is divided into three large lobes, the "inner," "median" and "setiferous;" an "auxiliary" lobe may be present between the setiferous and median lobes or attached to the base of the inner margin of the former. The setiferous lobe and the stalk by which the endopod is attached to the basipodite are regarded as the inner ramus proper, while the other lobes are outgrowths of the inner portion of the endopodite in this sense. In *Thysanopoda* (which does not occur in our collections) the inner lobe carries three processes, the more median one designated as the "spine-shaped," the "terminal" process on the end of the lobe between the bases of the spine-shaped process and the "proximal" process; the latter is the outer one of the three of the inner lobe. The median lobe is longer than the inner and carries the "lateral" process, which is strongly hooked in *Thysanopoda* and *Euphausia*.

From this typical condition there are marked differences in the number and shape of the processes, and these are of much value in the separation of genera and species. As Hansen states (1910, p. 79) the inner plate with its lobes is rolled up from the inner side. Its dissection and proper arrangement is often rather difficult.

Phosphorescent organs are characteristic of the Euphausiidae; the organs are lens-shaped and one is normally found on each eye stalk, a pair on the base of the second and seventh legs and one under each of the first four segments of the abdomen.

The Mysidacea, in contrast to the Euphausiacea, may not have gills on the legs, or, if present, they are covered by the carapace; the telson (pl. 2, fig. 21) lacks the subapical appendage. Ortmann

(1893, pp. 5 and 6) has given a contrasting tabular summary of the characters of the Euphausiacea and Mysidacea.

Within the Euphausiidae there are three subfamilies according to Holt and Tattersall (1905). In the collections from this region two of these are represented, the Euphausinae and the Nematoscelinae, the former by the genera *Euphausia* Dana and *Nyctiphanes* Sars, and the latter by *Thysanoessa* Brandt, *Nematoscelis* Sars and *Stylocheiron* Sars. The descriptions of genera and species given here are necessarily repetitions of those already published elsewhere because no forms have been found that are certainly new. It has seemed desirable, accordingly, to limit the text to accounts of the most easily recognized and most characteristic particulars, and to show in the figures those structural points that in connection with the text will render it possible to verify identifications. No attempt has been made to consider or refer to the literature previous to the Challenger Report on the Schizopoda (Sars, 1885), nor is the list of papers since then nearly complete.

The discussion of the distribution and movements of the more abundant Schizopoda as shown by the data obtained by the Institution is reserved for another paper, in which a full list of the hauls containing Schizopods will be given with the number of each species in each haul.

ORDER EUPHAUSIACEA

The keys given here are largely adapted from Zimmer (1909) and from Hansen (1911). I have included the genera *Siriella* and *Neomysis* in the key for the Mysidacea, since they occur on the coast, Holmes (1900), Hansen (1913), although I did not find representatives of them in the collections I examined. Account has also been taken of *Thysanoessa raschii* M. Sars in the key for the Euphausiacea, following the statements of Hansen (1911, p. 8). This species has been recorded from the Pacific Coast by Hansen (1913, p. 174), and does not have the elongated inner ramus in the second thoracic limb. If the inclusion of *T. raschii* stands, it will necessitate modifying the descriptions of the sub-families Euphausinae (Holt and Tattersall) and Nematoscelinae (Holt and Tattersall).

KEY TO THE GENERA OF THE EUPHAUSIACEA

1. None of the first six thoracic limbs with the inner ramus noticeably elongated; cornea of eyes not biblobate (pl. 1, figs. 6, 8, 9, 13) 2
1. Second or third thoracic limb with noticeably elongated inner ramus; cornea of eyes more or less bilobate (pl. 1, figs. 1, 3, 4) 4
2. The inner ramus of the seventh thoracic limb consists of two long joints; there is an upstanding leaflet that points backward on the basal joint of the peduncle of the first antenna (pl. 1, figs. 6, 8, 13) ....*Nyctiphanes*
2. The inner ramus of both the seventh and eighth thoracic limb is rudimentary; no leaflet on the basal joint of the peduncle of the first antenna 3
3. The outer ramus of the seventh thoracic limb is developed as in the first six; the inner ramus is lacking from the seventh limb in males ....*Thysanoessa* (part)
3. Both rami of the seventh and eighth limbs very rudimentary in both sexes, being reduced to inconspicuous bristles ....*Euphausia*
4. The inner ramus of the second thoracic limb is elongate 5
4. The inner ramus of the third thoracic limb is elongate ....*Stylocheiron*
5. The inner ramus of the second thoracic limb is very long and slender; there are no bristles along the margins of the penultimate joint (pl. 2, fig. 35) ....*Nematoscelis*
5. The inner ramus of the second thoracic limb is elongated, but rather stout; there are bristles along both margins of the penultimate joint (pl. 2, fig. 31) ....*Thysanoessa* (part)

FAMILY EUPHAUSIIDAE

SUBFAMILY EUPHAUSINAE HOLT AND TATTERSALL

"Eyes not or only slightly bilobate. None of the legs much longer than their immediate fellows, nor terminating in brushes or claws. Palps of maxillae simple" (Holt and Tattersall, 1905, p. 101).

Genus **Euphausia** Dana

Euphausia, Sars (1885), p. 63.
Euphausia, Zimmer (1909), p. 12.
Euphausia, Hansen (1910), p. 89.
Euphausia, Hansen (1911), p. 21.

Euphausia is most readily separated from the other members of the family by the condition of the last two pairs of legs (Sars, 1885, p. 64; Zimmer, 1909, p. 12). Both are very much reduced, being merely bristle-like processes hidden among the bushy gills. Hansen (1911, p. 21) has given an account of the various species of *Euphausia*, which may be grouped according to the number of lateral denticles on the carapace and the presence or absence of dorsal processes on certain of the abdominal segments.

Key to the Species of the Genus Euphausia

1. Two denticles on the lateral margin of the carapace .... *recurva*
1. One denticle on the lateral margin of the carapace 2
2. No dorsal keel or process on abdominal segments three to five .... *pacifica*
2. A well-defined process on the dorsal posterior margin of the third abdominal segment .... *gibba*

Our collections contained but one animal, a female, which shows the two denticles, and it is provisionally referred to the following species.

Euphausia recurva Hansen

Pl. 2, fig. 30

Euphausia recurva Hansen (1905b), p. 13.

The specimen agrees closely with the description given by Hansen, practically the only difference being that the leaflet on the first joint of the antennule curves forward; the structure of the second joint is as described by Hansen. In *E. mutica* (Hansen, 1905b, p. 14; 1909, p. 93, pl. 14, fig. 1a) the leaflet curves forward, but the second joint of the antennule is without a slender spine-like process. It is difficult to estimate the value of such characters, but the structure of the second antennular joint is of specific importance according to Hansen (1909, p. 94).

The length of the specimen is 12 mm.

The second group which Hansen has formed among the species of *Euphausia* is composed of those with a single lateral denticle and without a dorsal process on the third to the fifth abdominal segments (Hansen, 1911, p. 24). One species of those in the San Diego Region is found in this group.

Euphausia pacifica Hansen

Pl. 1, figs. 9, 14; pl. 2, figs. 18, 19, 23, 27, 29

Euphausia pacifica Hansen (1911), p. 28, fig. 10; (1913), p. 174.

The anterior part of the carapace is not produced into a rostrum, though, seen from above, the margin is somewhat obtuse (pl. 1, figs. 9, 14). The eyes are spherical and unusually large. The first joint of the antennule has in each sex a strong pointed process, at the anterior end on the dorsal side, which is directed forward (pl. 2, fig. 29);

the third joint is provided on the dorsal surface with a delicate lamella which runs lengthwise of the joint (pl. 2, fig. 19). The first joint is about as long as the second and the third together, and the third is three-fourths the length of the second.

The males are identified by the structure of the inner part of the first pleopod. The appearance of this as generally seen under the microscope is shown in plate 2, figure 23, while figure 18 shows the appearance of the organ as seen somewhat from the side. The hood-like structure in figure 23 is the median lobe and it carries the hooked lateral process and the short spine-like additional process; the terminal process is shown at the left of the figure and the proximal process lies between it and the median lobe. Hansen's description of the organ is as follows: "Terminal process of the copulatory organs moderately short, a little thicker than in two other species, a little expanded toward the end, with the outer ramus only a short tooth and the inner very much longer but bent much forwards. The proximal process somewhat longer than the terminal, without any secondary branch beyond the middle, while the distal part is somewhat expanded, forming a plate which is much longer than broad, with the terminal margin rounded and only feebly emarginate somewhat from the broadly rounded end. Lateral process without tooth on the distal part." Hansen's figure does not show the small spine on the median lobe which evidently corresponds to the additional process; he states (1910, p. 79) that in all species of *Euphausia* known to him the median lobe lacks an additional process. *E. pacifica* was described in 1911 and the fact that the additional process is present should be added to his account. This author neither mentions nor figures the lamella with the finely serrate distal margin shown on the proximal process in figure 23 (plate 2); in some cases a considerable part of the edge of the plate of the process is finely serrated. Such differences as have been mentioned between our specimens and those described by Hansen are doubtless unessential and I do not hesitate to identify the San Diego forms as *E. pacifica* Hansen.

The larger individuals of both sexes are from 20 to 25 mm. long.

Hansen states (1911, p. 29) that *pacifica* is very common in Japanese waters; it is abundant here.

Hansen's third group of the species of *Euphausia* consists of those having one pair of lateral denticles on the carapace and a dorsal keel on the third segment of the abdomen. This is the so-called "*gibba* group" and our only species is the following.

Euphausia gibba Sars

Pl. 1, fig. 2; pl. 2, figs. 26, 33, 36

Euphausia gibba Sars (1885), p. 91, pl. 16, figs. 1–8.

Hansen once stated (1905b, p. 17) that this form is identical with *E. pseudogibba* Ortmann (Ortmann, 1893, p. 12, pl. 1, fig. 6), but later restored *pseudogibba* to good standing (Hansen, 1909, p. 97, pl. 14, figs. 4a-e). I am unable to say whether the two species are truly distinct, but our specimens closely resemble *gibba*. According to Hansen (1905b, p. 17) Sars's figures are in part inaccurate, but judging from them and from the notes given by Hansen concerning such forms as *hemigibba* and *paragibba* (Hansen, 1909, p. 100) the only difference that I can detect between the San Diego specimens and those described as *gibba* lies in the little rounded extension of the forward margin of the second joint of the antennule at the outer angle (pl. 2, figs. 33, 36). So far as I know this is not mentioned elsewhere, but it occurs constantly in our specimens. The leaflet at the distal end and on the inner side of the first joint of the antennule is shown in figure 26 (pl. 2). The extension of the third abdominal segment is as shown by Sars (1885, pl. 16, fig. 1). There would be no justification at present for making a new species to receive the forms from this region, especially as we do not know the structure of the copulatory organs of the males.

The largest female is 23 mm. long, the smallest 10 mm.

Genus **Nyctiphanes** Sars

Nyctiphanes Sars (1885), p. 14

Nyctiphanes, Holt and Tattersall (1905), p. 103.

Nyctiphanes, Zimmer (1909), p. 9.

Nyctiphanes, Hansen (1911), p. 17.

According to Sars the main characteristic of this genus is the "reflexed leaflet" on the base of the peduncle of the antennules in front of the eyes (pl. 1, see figs. 6 and 13). This affords a means of easy recognition of the genus, at least among the Schizopoda of this region. The outer ramus is lacking in the seventh and eighth pairs of feet in the female (Zimmer, 1909, p. 9) and the endopodite of the seventh pair consists of two long joints, while that of the last pair is very rudimentary, not jointed and without setae. The females carry the eggs in two sacs. The copulatory organs of the males are characterized by the platelike or leaflike character of the inner lobe, in which the outer margin is finely serrated, while the proximal and terminal processes are wanting; there is a well-developed lateral process, but the median lobe, if present, is very short as compared with that of other genera (see pl. 2, figs. 25, 32, and Hansen, 1911, p. 16).

According to Hansen (1911, p. 17) the only reliable specific characters for *Nyctiphanes* are found in the peduncles of the antennules, and in the sexual appendages of the males. The second and third joints of the peduncles of the antennules are heavier in males than in females (pl. 1, see figs. 8 and 10). The author mentioned, after wide experience in the study of Schizopoda, forms two groups of species in *Nyctiphanes*, using as a basis the leaflet on the antennule (Hansen, 1911, pp. 19, 20). The numerous specimens obtained here all belong to the second group, in which "the lobe . . . is conspicuously longer than broad, not triangular, with the short acute tip turned mainly or totally outwards" (Hansen, 1911, p. 20). The only species in this group is the following.

Nyctiphanes simplex Hansen

Pl. 1, figs. 6, 8, 10, 13; pl. 2, figs. 20, 25, 28, 32

Nyctiphanes simplex Hansen (1911), p. 20.

It is difficult to ascertain from the brief description of *simplex* and in the absence of figures whether the San Diego specimens belong to that species or not. As may be seen from figures 8 and 10 (plate 1), the character of the antennular lobe agrees with the account given by Hansen, and, in addition, there is (fig. 8) a spine on the second joint of the antennule which is probably "the oblique spine or an obliquely triangular acute tooth" on the upper surface, at the distal end and on the inner side as described by Hansen (1911, p. 20). In the males the copulatory appendage has no median lobe (Hansen states, p. 20, that it is abbreviated "with no part along the outer margin of the lateral process"), and there are the bristles described by Hansen on the inner margin of the third of the antennule (pl. 1, fig. 10). There is a sexual difference in the form of the leaflet on the basal joint of the antennule (cf. pl. 2, figs. 20 and 28); in the female it is rounded at the tip and does not have the strong beak-like process that is present in the male.

For the present there seems to be no reason why our specimens should not be identified as *Nyctiphanes simplex* Hansen.

The length of the egg-bearing females is 14-15 mm., that of adult males is 11-12 mm. Hansen gives the length as 11-16 mm., and the distribution as the tropical and north temperate East Pacific.

SUBFAMILY NEMATOSCELINAE HOLT AND TATTERSALL

"Eyes more or less bilobate. Second or third legs elongate, with distal extremity forming a brush or claw" (Holt and Tattersall, 1905, p. 107). Calman (1905, p. 154) gives a key for the genera of this family.

Genus **Thysanoessa** Brandt

Thysanoessa, Sars (1885), p. 119.
Thysanoessa, Holmes (1900), p. 229.
Thysanoessa, Zimmer (1909), p. 18.
Thysanoessa, Hansen (1911), p. 36.

Hansen (1911, p. 36) considers that the usual diagnosis of this genus is insufficient and he gives a new definition of it, including with the forms previously known as *Thysanoessa* those called *Rhoda* Sim. The rostrum is always of good size, and the eyes, while generally constricted into a narrow upper and a broad lower portion, may be almost circular. The two distal joints of the antennules are more slender in the females, and the flagella are short in both sexes. The first six pairs of legs are always normally developed and the second pair may be much lengthened and thickened; if so, the last two joints have strong spine-like bristles along both edges (pl. 2, see fig. 31, and Zimmer, 1909, p. 21, fig. 32). The last two pairs of legs are reduced and modified and show sexual differences. Hansen states that in the seventh (sixth, according to his usage) pair the outer ramus is normally developed and the inner ramus wanting in males, while in females the exopod is always present, but may be either unjointed or 2-jointed. The last pair is without the inner ramus.

Thysanoessa is allied to *Nematoscelis,* but readily separable from it because of the structure of the second pair of legs, for in the latter genus the two terminal joints of the elongate legs do not carry bristles along the edges.

KEY TO THE SPECIES OF THE GENUS THYSANOESSA

1. Third or fourth segment of the abdomen with a dorsal process extending from the posterior margin .... *spinifera*
1. Third and fourth segments of abdomen without a dorsal process 2
2. Eyes bilobate; denticle on margin of carapace placed anterior to the middle line .... *raschii*
2. Eyes nearly circular (not constricted), denticle on margin of carapace located well behind the middle line .... *gregaria*

Thysanoessa gregaria Sars

Pl. 1, figs. 5, 16; pl. 2, figs. 24, 31

Thysanoessa gregaria Sars (1885), p. 120, pl. 21, figs. 8–17; pl. 22.
Thysanoessa gregaria, Holmes (1900), p. 230.
Thysanoessa gregaria, Holt and Tattersall (1905), p. 108.
Thysanoessa gregaria, Zimmer (1909), p. 20, figs. 32, 33, 34.
Thysanoessa gregaria, Hansen (1911), p. 43; (1913), p. 174.

The descriptions given by Sars, Holmes, Zimmer and Hansen are very complete. In plate 1, figures 5 and 16, is shown the shape of the front part of the head, and in plate 2, figure 24 is a part of the first pleopod of the male, showing, from left to right, the spine-shaped, terminal, proximal and lateral processes. The structure of the copulatory organs in our specimens agrees with the drawing given by Hansen (1911, p. 44) and with that of Sars (1885, pl. 22, fig. 29). Hansen states that these organs form the best specific characters, especially in the structure of the proximal process. There is much variation in the length and shape of the rostrum and in the length and relative depth of the sixth abdominal segment. *T. gregaria* is one of the species having the elongated second legs.

The length is from 12 to 15 mm.

Thysanoessa spinifera Holmes

Thysanoessa spinifera Holmes (1900), p. 229, pl. 4, fig. 81.
Thysanoessa spinifera, Hansen (1911), p. 41.

This species may be readily identified by the strong keel on the upper surface of the fourth and fifth abdominal segments, each keel ending in a long spine directed backwards. The corneal portion of the eyes is not constricted as in *gregaria*.

Our collections contained two females, each 15 mm. long. Holmes gives the length as 30 mm.

Genus **Nematoscelis** Sars

Nematoscelis Sars (1885), p. 126.
Nematoscelis, Zimmer (1909), p. 16.
Nematoscelis, Hansen (1910), p. 106.
Nematoscelis, Hansen (1911), p. 47.

The most characteristic mark of the genus is the greatly lengthened and extremely slender second pair of legs (see pl. 2, fig. 35, and Zimmer, 1909, figs. 24, 25). In some species the last joint only bears bristles, in others the last joint and distal end of the preceding one (pl. 2, fig. 34). The eyes are large and the corneal part is constricted into two portions. The second and third joints of the antennules are longer and slenderer in females than in males. The seventh legs have well-developed exopods; in the female the endopod is 2-jointed, but is lacking in males. The copulatory organs of the males "possess the three processes on the inner lobe, but the spine-shaped process is nearly straight and nearly parallel with the two others . . . : the lateral process is never hook-shaped and an additional process is wanting" (Hansen, 1911, p. 46).

Hansen (1911, p. 48) considers six species in the genus and divides them into two groups; among other distinctive characters, he makes use of the presence or absence of bristles on the distal end of the penultimate joint of the second legs.

Nematoscelis difficilis Hansen

Pl. 1, figs. 1, 3, 4, 12, 15; pl. 2, figs. 22, 34, 35

Nematoscelis difficilis Hansen (1911), p. 48, fig. 18.

This form is closely allied to *N. megalops* Sars, according to Hansen, and *N. difficilis* was established only on the basis of the male copulatory organs (pl. 2, fig. 22). Our specimens agree, in that respect, with Hansen's description (1911, p. 48, fig. 18). The proximal process is shorter than the terminal but reaches well beyond the middle of the serrated part of the latter. This is the most readily determined difference between *N. megalops* Sars and *N. difficilis* Hansen. As mentioned by Hansen (1911, p. 50) the males of *difficilis* show differences among themselves in the form of the rostrum. As shown in figures 1 and 3 (pl. 1) the form of the rostrum may be similar in males and females, or it may be very short in the male as shown in figures 12 and 15. I have seen one specimen in which the rostrum is of intermediate length.

Egg-bearing females average 22 mm. in length, males are not over 20 mm.

Genus **Stylocheiron** Sars

Stylocheiron Sars (1885), p. 136.
Stylocheiron, Zimmer (1909), p. 22.
Stylocheiron, Hansen (1910), p. 113.
Stylocheiron, Hansen (1911), p. 52.

This genus should be readily identified if the third pair of legs is intact. These organs are greatly elongated (see fig. 35, p. 23, in Zimmer, 1909) and the penultimate joint is broadened and in several species the joint carries a strong spine at the distal end so disposed that, with the end joint, a kind of grasping organ or chela is formed. The eyes are large and more sharply constricted into two portions than in *Nematoscelis,* for example; the difference in size between the upper and lower segments is more marked also. In *Nematoscelis* the lower part is either directed forward or the two parts lie in the same dorso-ventral line but in *Stylocheiron* the lower part lies well posterior. In the female (Hansen, 1911, p. 52) the endopodite of the fifth (sixth) legs is 3-jointed, that of the sixth (seventh) pair 2-jointed. The males always lack the inner ramus in the sixth (seventh) pair, while in the fifth (sixth) pair it may be present, as in the female, or lacking.

Our material of *Stylocheiron* consists of two specimens. One is an egg-bearing female in which both of the elongate legs are broken; the other is an immature individual that belongs in all probability to *S. maximum* Hansen. The chelae closely resemble those shown by Hansen (1910, pl. 16, fig. 6b) and the structure of the eyes and the abdominal segments show that the immature specimen does not belong to *S. abbreviatum* (Hansen, 1910, p. 122).

The larger specimen is 25 mm. long, the smaller about 12 mm. Since the former lacks the very characteristic "chelipeds" and the other is not mature it is unnecessary to deal farther with them.

ORDER MYSIDACEA

The principal characters of this order have already been mentioned. A very full discussion is given by Hansen (1910, pp. 4-11) and beginning on p. 11 he presents a synopsis of the subfamilies and tribes of the largest family, the Mysidae. The account of the order and the synoptic keys for families given by Zimmer (1909, p. 28) should be very useful; he considers the Mysidae on p. 43 and on succeeding pages he gives keys for subfamilies and genera.

Key to the Genera of the Mysidacea

1. Eyes of the usual form (pl. 1, figs. 11, 17) 2
1. Eyes reduced to plates, fused in the middle line, without pigments or facets (pl. 1, fig. 7) ....*Pseudomma*
2. The outer ramus of the uropod consists of two joints ....*Siriella*
2. The outer ramus of the uropod consists of one joint 3

3. The propodite of the thoracic limbs is 1-jointed ....*Holmesiella*
3. The propodite of the thoracic limbs consists of several joints, forming a "tarsus" 4
4. The propodites (tarsi) of the thoracic limbs consist of seven or eight joints ....*Mysis*
4. The propodites (tarsi) of the thoracic limbs consist of six joints ....*Neomysis*

FAMILY MYSIDAE

SUBFAMILY LEPTOMYSINAE ORTMANN (1908)

MYSINAE Hansen (1910)

Genus **Holmesiella** Ortmann

Holmesiella Ortmann (1908), p. 4.

Holmesiella is characterized most readily by the fact that the inner ramus of the fourth pair of pleopods in the male is more than twice as long as the outer. Ortmann (1908, p. 4) considers that the genus belongs to the subfamily Leptomysinae, but Hansen (1910, p. 10) is of the opinion that it should be placed in the tribe Erythropini of the family Mysinae.

Holmesiella anomala Ortmann

Pl. 1, figs. 11, 17

Holmesiella anomala Ortmann (1908), p. 6, pl. 1, figs. 1–10.

While the forms I refer to this species do not exactly conform to the description given by Ortmann, they are so closely similar that there can be no justification for making another species. The margins of the telson in these animals have not more than fourteen spines while Ortmann's have from 16 to 18. The armature at the end of the telson is just as described and figured by Ortmann.

In figures 11 and 17 (pl. 1) is shown the shape of the head of a large male in lateral and dorsal views; Ortmann has not given such figures.

The larger males and females are from 20 to 21 mm. long; Ortmann states that his largest specimens are 40 mm. in length. Ours are possibly not adult.

Genus **Pseudomma** Sars

Pseudomma Sars (1885), p. 188.
Pseudomma, Zimmer (1909), p. 99.

This genus is characterized by degenerate eyes. Each eye has been reduced to a plate and the two are fused together in the middle line; they show no facets or pigment (pl. 1, fig. 7).

Our material consists of one female taken in haul 2048. All the thoracic legs are broken off, but the animal resembles *P. parvum* Vanhöffen rather closely (see Zimmer, 1909, p. 104). The antennal scale reaches beyond the peduncle of the antennule and the tooth on the scale reaches only to the end of the scale (pl. 1, fig. 7); in *parvum* the tooth extends a little beyond the scale. The proportions of the joints of the antennular peduncle are the same as in *parvum.* Most of the terminal bristles of the telson are broken; the side margin has six small spines on the right and five on the left, and they extend along half the length of the telson instead of along the last third, as in *parvum* (pl. 2, fig. 21). This is the most noticeable difference between our specimen and *parvum.*

P. belgicae Holt and Tattersall resembles the San Diego specimen particularly in the armature of the telson and in the shape of the antennal scale, but since the margin of the eye plates is smooth in *belgicae* and serrate in our form, the two are not identical. I have been unable to find an account of the condition of the edge of the ocular plates in *parvum,* but Tattersall (1908, p. 29) states that *belgicae* is the only species except *P. australe* Sars in which the edge is smooth.

On the whole, it is desirable to possess more material before assigning a definite status to the San Diego specimen.

The length is 10 mm. and there is a small amount of rosy pigment in the antennae and antennules, a distinct spot in the mouth, and in the telson and uropods.

Subfamily Mysinae

Genus **Mysis** Latr.

Mysis costata Holmes

Mysis costata Holmes (1900), p. 221, pl. 4, figs. 70–72.
Mysis costata, Hansen (1913), p. 177, pl. 9, figs. 2a-d.

One specimen was taken in haul 3147, a female with larvae in the marsupium. The structure is in all respects as described by

Holmes, but it should be noted that the telson is not emarginate at the end. This, according to Zimmer (1909, p. 160), is a characteristic of the genus *Mysis*. Hansen (1913, p. 177) gives a discussion of the relationships and structural features of this species.

This specimen is 12 mm. long.

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EXPLANATION OF PLATES

PLATE 1

Fig. 1. *Nematoscelis difficilis* Hansen, male, anterior part of head, and right eye, from side, showing long rostrum. × 10.

Fig. 2. *Euphausia gibba* Sars, female, anterior part of head, eyes, peduncle of left antennule, from side. × 10.

Fig. 3. *Nematoscelis difficilis* Hansen, female, anterior part of head, right eye, from side. × 10.

Fig. 4. *Nematoscelis difficilis* Hansen female, anterior part of head, eyes, from above. × 10.

Fig. 5. *Thysanoessa gregaria* Sars, male, anterior part of head, left eye, from right side. × 10.

Fig. 6. *Nyctiphanes simplex* Hansen, male, anterior part of head, left eye, base of left antennule, from left side. × 20.

Fig. 7. *Pseudomma* sp., female, anterior part of head, eyes, base of antennule and of antenna with scale, from above. × 20.

Fig. 8. *Nyctiphanes simplex* Hansen, female, anterior part of head, eyes, antennular peduncles, from above. × 10.

Fig. 9. *Euphausia pacifica* Hansen, female, anterior part of head, left eye, from right side. × 20.

Fig. 10. *Nyctiphanes simplex* Hansen, male, anterior part of head, eyes, peduncles of antennules from above. × 10.

Fig. 11. *Holmesiella anomala* Ortmann, male, anterior part of head, left eye, peduncle of antennule and of antenna with scale, from side. × 10.

Fig. 12. *Nematoscelis difficilis* Hansen, male, outline of fore part of head to show short rostrum, left eye, from above. × 10.

Fig. 13. *Nyctiphanes simplex* Hansen, female, anterior part of head, left eye, base of left antennule, from left side. × 20.

Fig. 14. *Euphausia pacifica* Hansen, female, head and anterior part of thorax, eyes, from above. × 10.

Fig. 15. *Nematoscelis difficilis* Hansen, male, outline of fore part of head, and of eyes, from side. × 10. Cf. fig. 12.

Fig. 16. *Thysanoessa gregaria* Sars, male, fore part of head, left eye, from above. × 10.

Fig. 17. *Holmesiella anomala* Ortmann, male, fore part of head, eyes, base of antennule, antennal scale, from above. × 10.

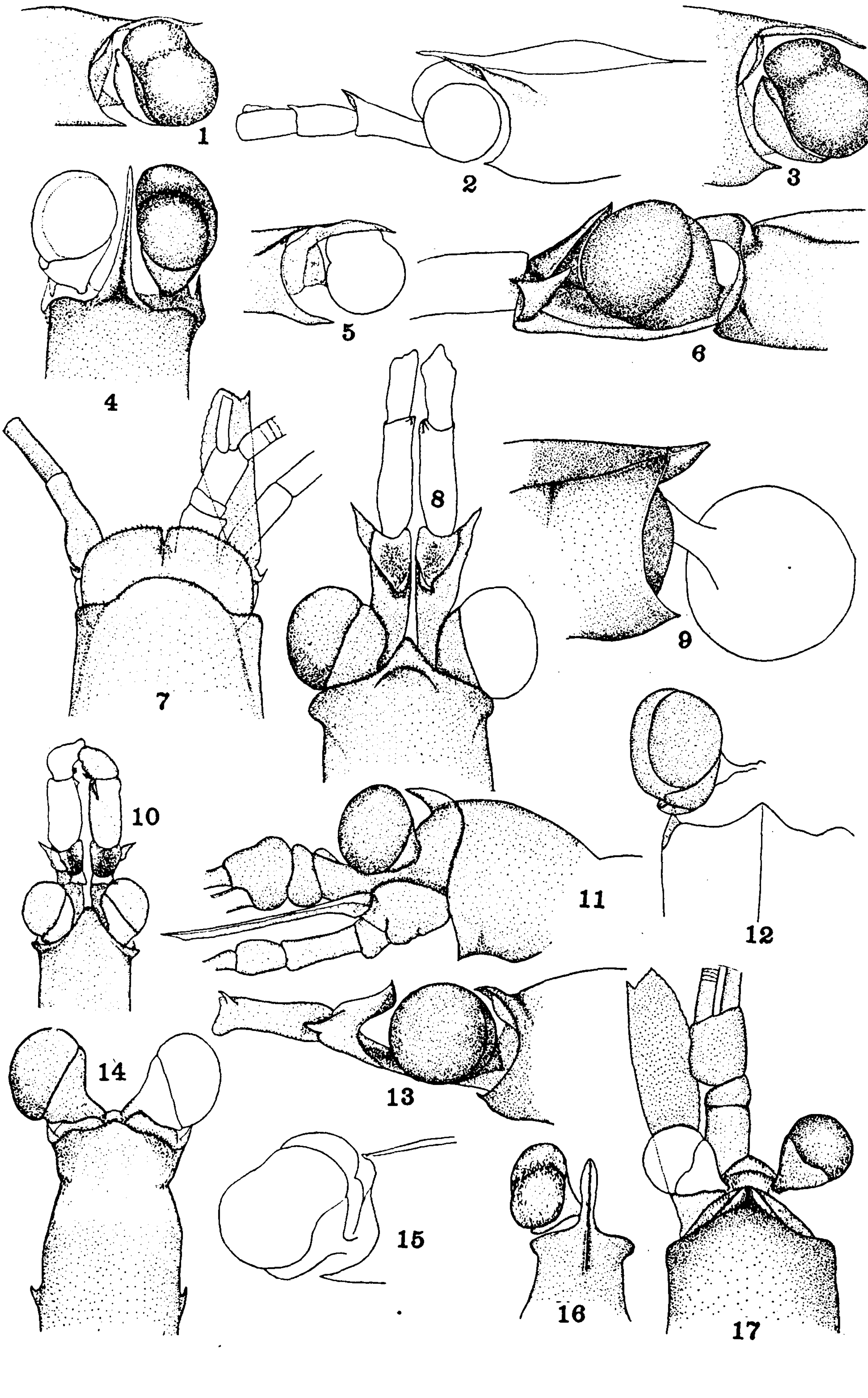
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PLATE 2

Fig. 18. *Euphausia pacifica* Hansen, male, inner and median lobes of copulatory appendage seen somewhat from side. × 70. The structures seen in the figure, from left to right, are, terminal process, proximal process, lateral process (hooked), median lobe; the short spine is the additional process.

Fig. 19. *Euphausia pacifica* Hansen, male, lateral view of third joint of antennular peduncle. × 35.

Fig. 20. *Nyctiphanes simplex* Hansen, male, first two joints of peduncle of left antennule, from above. × 35.

Fig. 21. *Pseudomma* sp., female, telson, from above. × 35.

Fig. 22. *Nematoscelis difficilis* Hansen, male, left copulatory organ. × 70. From left to right the processes shown are, spine-shaped, terminal, proximal, lateral; median lobe, auxiliary lobe.

Fig. 23. *Euphausia pacifica* Hansen, male, left copulatory organ, from in front. × 70. Similar to fig. 18.

Fig. 24. *Thysanoessa gregaria* Sars, male, inner lobe of left copulatory organ from in front. × 215. From left to right are shown the spine-shaped, terminal, proximal and lateral processes.

Fig. 25. *Nyctiphanes simplex* Hansen, male, inner part of left copulatory organ from in front. × 70. There are shown from left to right the spine-shaped process, inner lobe, lateral process, setiferous lobe; there is no median lobe in this species.

Fig. 26. *Euphausia gibba* Sars, female, scale at anterior and inner corner of first joint of antennule, from above. × 35.

Fig. 27. *Euphausia pacifica* Hansen, female, telson and left uropod from above. × 10.

Fig. 28. *Nyctiphanes simplex* Hansen, female. first joint of left antennule from above. × 35.

Fig. 29. *Euphausia pacifica* Hansen, male, first joint of antennule from the side. × 35.

Fig. 30. *Euphausia recurva* Hansen, female, first joint of peduncle of right antennule from right side to show the leaflet. × 35.

Fig. 31. *Thysanoessa gregaria* Sars, male, second leg. × 35.

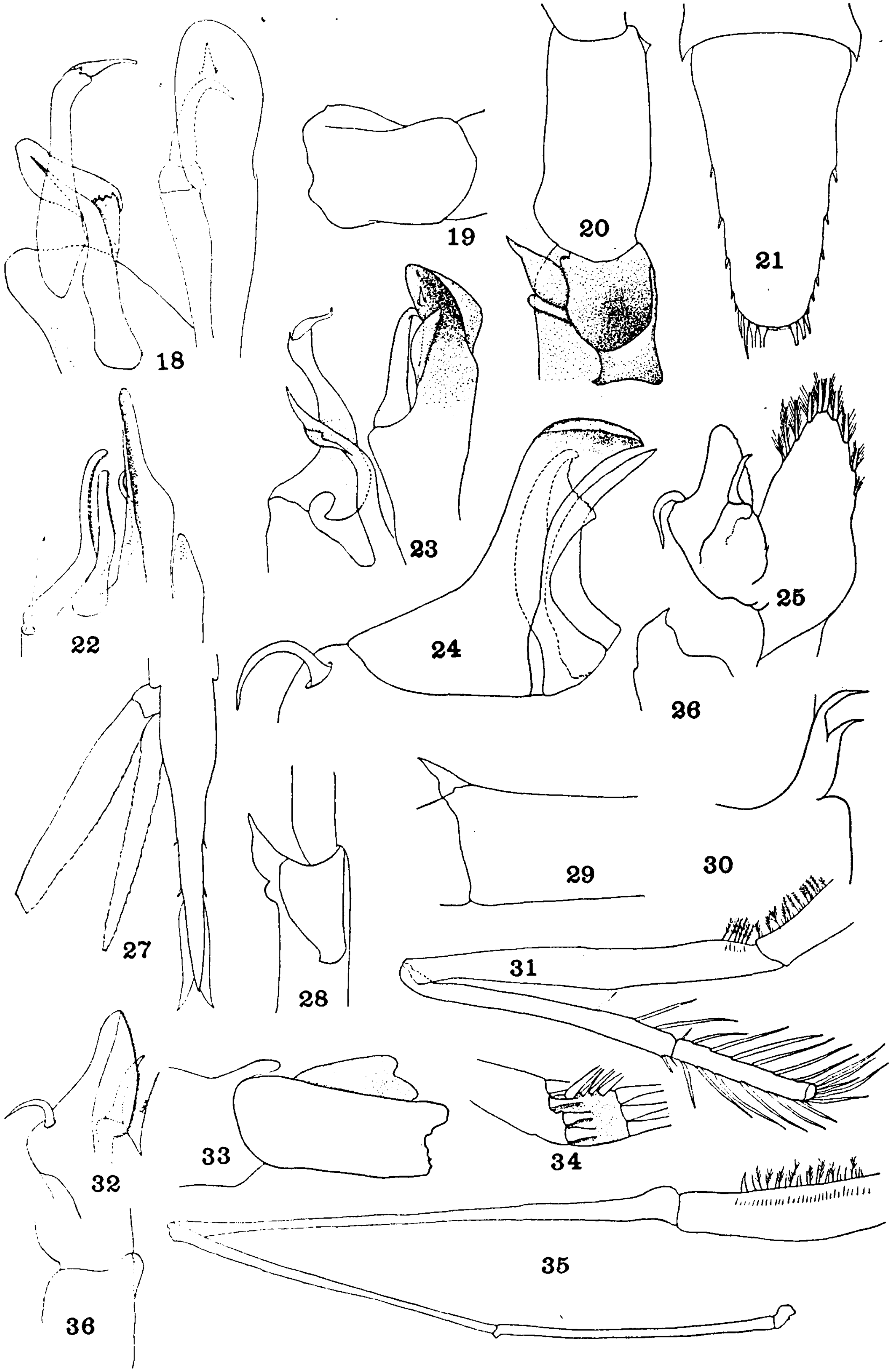
Fig. 32. *Nyctiphanes simplex* Hansen, male, right copulatory organ from in front. × 180. Cf. fig. 25.

Fig. 33. *Euphausia gibba* Sars, female, third joint of peduncle of right antennule and distal part of second, from right side. × 35.

Fig. 34. *Nematoscelis difficilis* Hansen, female, distal end of second leg. × 35.

Fig. 35. *Nematoscelis difficilis* Hansen, female, second leg. × 10.

Fig. 36. *Euphausia gibba* Sars, female, distal end of second joint of peduncle of right antennule and proximal part of third. × 35.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